METHOD SUPPORT FOR ENTERPRISE ARCHITECTURE MANAGEMENT CAPABILITIES

DISSERTATION
to obtain the academic degree of

Doktor-Ingenieur (Dr.Ing.)

of the Faculty of Computer Science and Electrical Engineering
at the University of Rostock

submitted by
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Rostock, 01.05.2016

urn:nbn:de:gbv:28-diss2017-0107-6

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Date of submission: 01.05.2016
Date of defense: 04.07.2016

ACKNOWLEDGEMENTS

"Some men see things as they are and say, why?
I dream of things that never were, and say, why not?"
Georg Bernad Shaw (1856-1950)

It is my pleasure to thank all people who have made this investigation possible. The corresponding thesis was written at the chair of computer science of the University of Rostock during my engagement as researcher assistant. Thus, I would like to thank Prof. Dr. Kurt Sandkuhl for supporting my research and for giving me so much guidance and help during the entire research process. He taught me the methodology to execute different kinds of studies, established contact with the relevant communities and gave me the opportunity to present my research results at conferences all over the world.

Furthermore, acknowledgments go to my reviewers for many helpful comments on different stages of my dissertation process. Thank you for taking the effort to read my thesis and traveling to Rostock for the respective defense.

Special thanks to Tino Weichert for the content-related support extending over several years - without him many practical insights and experiences could not have been implemented in this work. He was always motivated, tolerant and ready to help me when I met difficulties or had obstacles in my work. I also want to thank Marco Redlich and Roland Vogel for their professional commitment. They were always good discussion partners and gave me new inspirations from the business practice viewpoint, which I highly appreciate due to the fact that it is difficult to get in touch with practical partners.

I would also like to thank the many excellent students for their support regarding seminar, bachelor and master theses, especially Anna Sonnenberger, Daniel Christian, Florian Karnatz and Tim Piontek. Their findings were the basis for numerous publications regarding the topic of this work. Moreover, I appreciate the work of my 4EM.DEV project team, especially Andreas Kolerski who implemented the 4EM capability extension.

A special thanks to Raphael Jacobs for his strong 24/7 commitment and patience during proof-reading, discussions, formatting and cross-referencing in the final labor-intensive weeks of work.

My gratitude also goes to the industry partners who participated in the various studies, discussions and evaluations. In this context, the following companies and consortia are to name (alphabetically): ACL Ltd., AIDA Cruise, alfabet (a software AG company), Bombardier Transportation, Stadtwerke Rostock AG and The Open Group.

I highly appreciate the support from my colleagues at the University of Rostock and Reutlingen. I am particularly grateful to Ulrike Borchardt, Dierk Jugel, Hasan Koc, Dr. Birger Lantow and Felix Timm for their help in providing feedback and establishing the final version of the thesis.

The last months before finishing the thesis have been a challenge for my family. I would like to thank them for all the support and understanding. Without their continuous motivation and trust, it would have been impossible for me to stay on target and to finally finish this thesis. Now I am looking forward to spend time with my dear Anne, my quickly growing Alexander and our unknown anticipated offspring.

Matthias Wißotzki
Wittenbeck, Mai 01, 2016

ABSTRACT

Due to the global digitalization, fast shifting business models and short technology lifecycles, modern enterprises need strategies how to deal with those unpredictable changes to stay competitive. When implementing such strategies, enterprises have to be aware of its existing organizational and technical structures to estimate the impacts of change and to be able to quickly switch to other strategic alternatives. If impacts of change are not considered, the desired rapid strategic realignment can quickly result in a static business behavior and paralyzes business flexibility.

In this context, Enterprise Architecture Management (EAM) provides a powerful and prominent discipline for the systematic support of enterprise changes especially under consideration of business and IT perspectives. For instances, change processes could range from minor, continuous ongoing, intra-corporate changes to strategic, market-penetrating activities. Within all these activities, elements of the enterprise architecture and its management are affected independent of project's size or type of change. Thus, EAM is expected to support mentioned issues by capturing and managing these architecture elements, which could be manifested in a large number of processes, organizational units, machines, information systems, devices, data, networking infrastructure and its interrelations. EAM supports enterprises in the collection and management of (potential) impact on the architectural elements and its relationships caused by (targeted) changes. The resulting knowledge is a key factor for a comprehensive strategy assessment and implementation.

To ensure this key factor, enterprises need to ask the question "What should our EAM can do or is capable of?". As a basis for answering this question, the approaches of the capability management should serve as help, which experienced increasing attention in theory and practice. In this work, a capability-based method is developed, which assists in the identification, structuring and management of EAM capabilities. The Capability Management Guide (CMG) is based on an integrated capability approach that results from a number of scientific investigations. The approach is embedded in a process comprising four building blocks providing appropriated procedures, concepts and supporting tools evolved from theory and practical use cases.

The Capability Management Guide represents a flexible method for capability newcomers and experienced audiences to optimize enterprises' economic impacts of EAM supporting business- and IT alignment.

Keywords: *Capability Management, Enterprise Architecture Management, Strategy Management, IT Management, Business-IT-Alignment*

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KURZFASSUNG

Die zunehmende Digitalisierung, schnell wandelnde Geschäftsmodelle und immer kürzere Technologie-Lebenszyklen zwingen Unternehmen, Strategien zur Erhaltung ihrer Wettbewerbsfähigkeit zu entwickeln, welche Veränderungen in der Unternehmensumwelt kompensieren und Unternehmen optimal unterstützen. Diese Strategien können umso erfolgreicher umgesetzt werden, je besser ein Unternehmen dessen Auswirkungen hinsichtlich der organisatorischen und technischen Einflüsse abschätzen kann, um bei ungewollten Konsequenzen kurzfristig strategische Alternativen zu entwickeln. Ohne eine realistische Einschätzung der Auswirkungen, kann die angestrebte Neuausrichtung zu einem statisches und unflexibles Handeln führen.

Das Unternehmensarchitekturmanagement (UAM) ist mittlerweile eine leistungsstarke und etablierte Managementdisziplin für die systematische Unterstützung von Veränderungen unter spezieller Berücksichtigung der Geschäfts- und IT-Perspektive. Die Unterstützung bezieht sich beispielsweise auf die kontinuierliche Begleitung von kleineren, innerbetrieblichen Anpassungen bis hin zur Durchführung strategischer Markteintritte. Unabhängig von der Projektgröße oder der Art der Veränderung sind bei jeder Anpassung auch Bestandteile der Unternehmensarchitektur betroffen. Um die genannte Unterstützung leisten zu können, muss das UAM die betroffenen Elemente erfassen und verwalten, welche sich z.B. in einer großen Anzahl von Prozessen, Organisationseinheiten, Maschinen, IT Anwendungen, Daten, Netzwerkstrukturen und deren Abhängigkeiten als Unternehmensarchitektur zusammensetzen können. Damit unterstützt das UAM bei der Sammlung und Verwaltung von (möglichen) Auswirkungen auf dessen Architekturelemente und deren Beziehungen, hervorgerufen durch (angestrebte) Veränderungen. Das dadurch entstandene Wissen ist ein Schlüsselfaktor für eine umfassende Strategiebeurteilung und Umsetzung.

Um diesen Schlüsselfaktor zu gewährleisten, müssen sich Unternehmen folgende Frage stellen: „Was muss unser UAM leisten können?“ Als Grundlage für die Beantwortung dieser Frage sollen Konzepte aus dem Fähigkeitenmanagement genutzt werden, welche in Theorie und Praxis zunehmende Aufmerksamkeit erfahren. Im Rahmen dieser Arbeit wird eine fähigkeitenbasierte Methode entwickelt, welche Unternehmen bei der Identifikation, Strukturierung und Verwaltung von UAM Fähigkeiten unterstützt. Der Capability Management Guide (CMG) basiert auf einem integrierten Fähigkeitenverständnis, welches auf Grundlage verschiedener wissenschaftlicher Untersuchungen erarbeitet und in Kooperationen mit der Praxis getestet wurde. Der Ansatz ist in einen Prozess eingegliedert, welcher vier Hauptbestandteile beinhaltet und die für die Durchführung notwendigen Vorgehen, Konzepte und Hilfsmittel beschreibt.

Der Capability Management Guide ist eine anpassungsfähige Methode zur Verbesserung des UAM und richtet sich an Personen und Unternehmen, die bereits mit UAM arbeiten oder es in Zukunft planen. Als strukturierter Prozess unterstützt der CMG Unternehmen bei der Identifikation, Strukturierung und Verwaltung von UAM Fähigkeiten, um auf dessen Grundlage die Abstimmung zwischen Geschäfts- und IT-Perspektive zu verbessern.

Keywords: *Fähigkeiten Management, Unternehmensarchitektur Management, Strategie Management, IT Management, Business-IT-Alignment*

Um die Umwelt zu schonen, wurde dieses Dokument doppelseitig gedruckt.

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LIST OF ABBREVIATIONS

AA	Application Architecture
ARM	Actor & Resource Model
BA	Business Architecture
BITA	Business IT Alignment
BPM	Business Process Model
RM	Rule Model
BR	Behavioristic Research
BRM	Business Rule Model
CapM	Capability Model
CBP	Capability-Based Planning
CBPP	Capability-Based Planning Project
CEO	Chief Executive Officer
CIO	Chief Information Officer
CIM	Capability Identification Matrix
CM	Concept Model
CMM	Capability Maturity Models
CR	Change Request
CSO	Chief Sales Officer
CSV	Comma-separated value
DA	Data Architecture
DSR	Design Science Research
DSRM	Design Science Research Methodology
EA	Enterprise Architecture
EC	Enterprise Capability
EAM	Enterprise Architecture Management
EACN	Enterprise Architecture Capability Navigator
EACI	Enterprise Architecture Capability Improvement Project
G	Goal
G_{GP}	Global Practice Goal
GM	Goal Model

EM	Enterprise Modelling
GoM	Grundsätze ordnungsgemäßer Modellierung
GP	Global Practice
IA	Information Architecture
ICA	Integrated Capability Approach
IoT	Internet of Things
IRR	Internal Rate of Return
ISR	Information System Research
IS	Information System
ITM	IT Management
KB	Knowledge Base
KMS	Knowledge Management System
LP	Local Practice
Mgt.	Management
NDA	Non-Disclosure Agreement
NPV	Net Present Values
PESTEL	Political, Economic, Social, Technology, Ecologic and Legal
P_{Ln}	Local Practice Problem
P_G	Global Practice Problem
RC_n	Root Cause
ReC	Research Community
SISU	Institute für System Development
SLR	Systematic Literature Review
SME	Small and medium enterprise
SMS	Short Massage Service
SPSS	Statistical Package for the Social Science
TA	Technical/ Technology Architecture
TCRM	Technical Components and Requirements Model
TOGAF	The Open Group Architecture Framework
WI	Wirtschaftsinformatik

1 INTRODUCTION

"Enterprises are looking for a standardized solution, which handles specific EAM capabilities and provides an orientation for strategic decision."[45]

This chapter provides an introduction to capability-oriented thinking and describes how and where the use of enterprise architecture management capabilities can be useful and where deficiencies are apparent, which are going to be closed by this work. Therefore, this chapter starts with the motivation for this subject (Sect. 1.1). Based on the motivation, research questions and research goals are formulated (Sect. 1.2). Section 1.3 summarizes the contributions, the incurred publications (Sect. 1.4) and the structure of the work is presented in (Sect. 1.5).

However, before we start with the common motivation of the topic, the following discourse is designated to introduce the topic. In the development period of this work Usain Bolt was the fastest 100m sprinter in the world. In order to achieve continuous top performances and goals as records and championship victories, the athlete needs a combination of special coordination and cognitive skills, which he has to control and continuously improve in alignment with his goals and continuously changing competitors. The most important skill in sprinting implies that he accelerates his body with the help of muscle strength in a very short time to high speed. To build up and preserve this skill, Usain Bolt performs a number of training activities, which focus on specific muscle groups (focus area: hip and knee extensors, hip flexors, the erector spinae and the shoulder muscles) whose quality is dependent on the availability of funds for training camps and - devices (resources) as well as necessary actors such as coaches, physiotherapists and managers who are always equipped with the latest information on training methods or the competitive situation. This procedure describes only one example of how the development of an individual skills can be managed and has made Usain Bolt the fastest sprinter in the world.

Enterprises are also equipped with such kinds of skills, called enterprise capabilities, to achieve their ambitious goals such as launching a new product as fast as possible and achieving the market leader position in a specific industry. Similar to sports, competition varies continuously and thus companies must constantly work on their individual capabilities as well to gain and maintain required competitive advantages and achieve related goals. The prerequisite is that an enterprise has the respective knowledge about its capabilities and its "fitness level", because only then new requirements can be quickly assessed regarding impact and it can be derived "what should be trained". This work has developed a method, which helps enterprises to identify their capabilities and to maintain or manage these as part of their organizational development.

1.1 RESEARCH MOTIVATION

Adaptability of business models, responsiveness to market changes and the increasing digitalization are acknowledged factors for competitiveness on globalized markets [1,2,3,4]. Changes in market environments are triggered by upcoming technology trends like Internet of Things (IoT), advanced machine learning, Information of Everything (IoE), mobile business or cyber-physical systems [5,6,Appendix B2].

Enterprises, which want to compete over the long run, have to be fast and flexible in their adaptation [3,7].

When implementing new business models, enterprises have to be aware of their existing organizational and technical infrastructures which is manifested in buildings, machines, information systems, devices, data and networking infrastructure, etc. [8,9]. Thus, enterprises can be understood as complex and highly integrated systems, which are comprised of a set of elements such as goals, processes, organizational units, information and supporting technologies, with multifaceted interdependencies across their boundaries [10]. This system view is considered as enterprise architectures (EA).

Enterprises become more complex through the above mentioned trends and their effect in the context of strategic changes e.g. digitalization of products and services, establishment of highly integrated supply chains in global markets (with suppliers), mergers and acquisitions including global interoperability or increased outsourcing [1,4,11]. Accordingly, necessary adjustments become more complex as well, which may result in a static business behavior and paralyses business flexibility [12,13]. In this regard, enterprises can lose speed in reacting to rapidly changing demands [1,14] which in turn results in wasted opportunities of potential competitive advantage.

Consequently, economic success of an organization can only be achieved when an enterprise is able to handle upcoming challenges and complex changes as fast as possible, without generating new problems [9,15,16]. Leaving aside the fact that increasing complexity raises the costs of operations; strategic changes inside sophisticated structures have gone hand in hand with an increasing number of failed transformation projects for the last few years [12,17,18]. One reason for this is that decision makers do not have a holistic view of the organization due to the complex relations between its elements mentioned above [11,12]. This applies especially to decision makers in strategic management, which initiate the strategy formulation and its implementation through projects without its impact being adequately assessed [19,20].

In order to deal with this topic effectively and efficiently, enterprise architecture management (EAM) has established itself as a management discipline that supports enterprises in the maintenance of flexibility, cost-effectiveness and transparency of their infrastructure, information systems and business processes. In particular, the alignment between business and IT is strongly supported through EAM when changing the enterprise [22]. This remit of EAM describes the coordination of business- and IT activities, thereby assisting strategic decisions, accompanying its implementation in collaboration with IT and continuously informing strategy controlling [11]. Hence, EAM has to clarify how IT has to be adjusted to the needs of the business on the one side and on the other side, how the business has to adapt to the supplies of IT [11,51].

Thus, it is not surprising that this task of EAM is becoming increasingly important for enterprises with the increasing importance of IT [12,58]. [95] showed that almost 60% of the surveyed enterprises have Business-IT alignment (BITA) as a key goal compared to other goals such as cost reduction and increase transparency. Its importance becomes even more significant by an analysis of IT trend surveys (Figure 1.1).

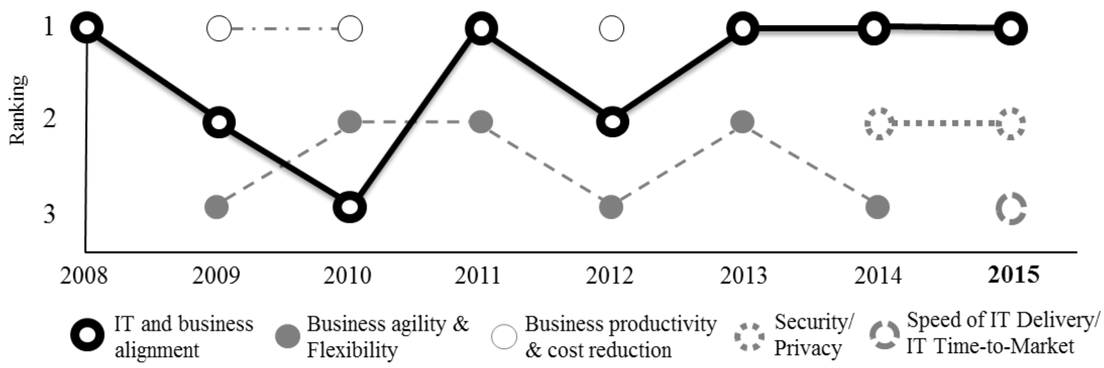

Figure 1.1 Analysis of most important organizational IT- Management concerns 2011-2015, according to [335].

Since 1980 (since 2003 annually), the Society for Information Management [335] performs surveys, in which senior IT managers of several hundred US enterprises are asked about, among others, key factors in IT management. Considering all the polls over the last 35 years the BITA has always been in the top ten of the most important IT goals. In particular the period from 2007 to 2015 showed that, besides BITA, topics such as business agility/ flexibility, productivity, cost reduction, speed and security issues have been established as recurring high-priority goals.

Consequently, what prerequisites should an enterprise fulfill to achieve these recurring high-priority goals?

In order to successfully achieve these goals, enterprises require very specific capabilities, because the knowledge about capabilities and characteristics determine the success or failure of change [192,224,225,232].

Exactly for this purpose this work provides extensive investigations regarding the important role of EAM as mediator between strategy - and IT management and the implementation of changes. Thus, our work points out the close relationship between strategy- and IT management as well as enterprise architecture management capabilities needed for successful alignment. The work describes how capability research has evolved in recent years. Therefore, we encapsulated the body of capability literature over the last 15 years and show that capability driven management concepts like capability-based planning or -investment receive more and more attention by executives and scientists, but also show that there has been no common understanding corresponding the management, structure and characteristics of EAM capabilities. Furthermore, we describe how capabilities are individually classified throughout an enterprise and its relationships to its enterprise architecture elements. Moreover, it is presented how the knowledge on the individual EAM capabilities of an enterprise can support strategic changes.

In cooperation with practice partners and considering the results of knowledge base, it has been derived that the previous approaches could not solve the detected practice problems. The lack of a consistent EAM capability understanding, the lack of a standardized course of action regarding the management, and the lack of capability based communication concepts in order to provide adequate information to affected stakeholders were mentioned, among others, as corresponding reasons. While many identified capability approaches provided good assistance regarding individual problems such as the modeling and evaluation of capabilities, there was no holistic and structured management process which continuously supports enterprises in management, adjustment and application of EAM capabilities. According to the initially described example of Usain Bolt, it means that there was no training concept for a consequent improvement of his skills, which is equivalent to a deterioration in competition.

For this reason, the Capability Management Guide (CMG) has been developed as a result of our research work, which takes into account the continuously changing enterprise environments, resulting transformation demands and, thus, the need to adapt EAM capabilities. The CMG suggests a fundamental approach to structure EAM capabilities i.e. descriptive elements and characteristics and creates a common language basis for mediation between business and IT. Thus, the method creates the basis for supporting all activities required for mediating between business and IT by providing information about the current quality of available and target quality of required EAM capabilities. This support can already be included in early planning stages of the strategy- and the IT management process. Nevertheless, the CMG is not only based on scientifically well-founded capability and method engineering approaches, but also developed in close cooperation with practice partners. The research cooperation with alfabet AG and further national and international industry partners such as ACL Ltd., AIDA Cruises, Bombardier Transportation, Software AG and Stadtwerke Rostock AG (alphabetical order) has supported the development of a practical and scientifically founded solution for EAM capability management.

Consequently, the proposed outcome of this thesis helps to systematically derive capabilities, gather and maintain with a structured process. The process includes working steps and specifically recommended procedures, concepts and tools, which are adoptable to different circumstances. The method is applicable independent of the enterprise size, branch or market. Thus, it addresses to organizational departments and employees interested in the topic itself in order to handle challenges enterprises are facing these days.

1.2 RESEARCH STATEMENT

Especially in the context of strategic decisions the question arises whether knowledge about used or unused EAM capabilities seems to be important. In this regard, it occurs that an enterprise is not aware of (all) its available EAM capabilities. However, this situation probably does not fulfill quality criteria in respect of e.g. strategic decisions, strategy planning and the following implementation [142]. Accordingly, there is the issue of how to improve prevailing quality. For this purpose, a general concept of EAM capabilities as well as a management process including identification, structuring and quality assessment is required, which motivates our main research question *(RQ)*:

RQ: In the context of strategy management, how could the management of EAM capabilities be supported methodically?

In order to answer *(RQ)*, a variety of existing approaches need to be assessed in advance. The concept of capabilities is applied and interpreted in a variety of different ways [85]. Finding an answer to (*RQ1)* should result in an EAM capability definition including necessary descriptive elements and its relationships to each other.

RQ1: *What are the components of a unified capability structure?*

Enterprises interact with different environments, which involve different types of challenges. These challenges also have impact on the composition of EAM capabilities i.e. new capabilities are needed, existing capabilities need to be adapted or are no longer needed. In order to meet these requirements, the following question arises:

RQ2: *What existing procedures in theory and practice should be taken into consideration for identifying, structuring and governing EAM capabilities?*

By answering the follow-up *(RQ2)*, enterprises create the conditions to establish a capability catalog by using structured procedures that are standardized and repeatable. In order to answer *(RQ1 – RQ2)* precisely these procedures are referred and subdivided in detachable fragments within the single research process activities. Therefore, this work is going to show that capability-based approaches are increasingly utilized in practice and that its identification, structuring and governance is still challenging.

Thus, the central research goal *(RG)* of this investigation is defined as follows.

> ***RG:*** *Development of an EAM capability management method compliant with practical requirements and scientific rigor.*

Consequently, by answering our central *(RQ) and fulfilling (RG)* a validated method should be established that supports enterprises in developing and governing its EAM capabilities. The answers to *(RQ1-RQ2)* deliver an empirical grounded integrated capability approach as well as significant method components from theory and practice and formal method engineering requirements for its validation.

1.3 CONTRIBUTIONS

Answering the research questions from the previous section this work provides a solution for an explicated practical problem of general interest. In this context, the results of this thesis provide contributions to the knowledge base as well as implications for practices, which are summarized in this section.

1.3.1 CONTRIBUTION TO KNOWLEDGE BASE

The scientific contribution of this work rests on extensive investigation within the field of capability research undertaken by conducting theoretical and empirical studies in order to develop a method for EAM capability management. As a main contribution we:

- proposed a method for EAM capability management that represents an improvement of the knowledge base in terms of providing a new solution to a problem,
- provided a differentiation scheme for the capability term on related topics, based on a literature review,
- proposed a concept for a unified set of EAM capability elements and characteristics, based on the combined outcome of seven systematic literature reviews and a research cooperation and,
- We provide insights on how capability research has evolved in the last 15 years.

1.3.2 PRACTICE CONTRIBUTIONS

Next to the knowledge contributions our research has several implications for practice:

- We developed an *Integrated Enterprise Capability Approach (IECA)*, which is supposed to be used as a unified and adaptable capability structure.
- We proposed a procedure for determining EAM capabilities, which is supported by the *Capability Identification Matrix (CIM)* concept, which can be used for capability content engineering by the help of a digital spreadsheet template.
- We extended the *For enterprise modeling (4EM)* approach by a capability model, which can be used for EAM capability modeling.
- We provided an EAM capability modeling software prototype (4EM.Desk), which is supposed to be used for collaborative EAM capability modeling and content engineering.
- We proposed a *Capability Content Layer approach*, which can be used for a flexible content engineering in terms of a desired granularity (flexible adjustment of content processing of respective capabilities).

1.4 PUBLICATIONS

Even though this thesis is written as a monolithic work, parts of the results have been published. Thus, the present thesis contains texts of already published results, which are referenced at the beginning of relevant sections. This section provides and overview about all (co-) authoring activities classified in the following publications types.

- *Published work of the thesis:* The list of publications represents research results that are directly related to the contributions of this thesis.
- *Related work:* The list of related work shows publications that are not directly applicable to the research goal of this thesis, but important for getting insights of a multidisciplinary research problem or represents smaller research investigations performing individual research process steps.

1.4.1 PUBLISHED WORK OF THE THESIS

The listed publications are peer-reviewed and comprised book chapters, conference papers and a technical report (chronologically ordered). The research results of these publications are central components of the present thesis. Argumentation and text components of these publications are used, but without direct citations. The included publications are referenced at the beginning of each chapter or section.

BOOK CHAPTERS

Wißotzki, M., Sonnenberger, A. "*A Capability Management Guide*" In : El-Sheik, E. ; Zimmermann, A. ; Jain, L. (Eds.) : Emerging Trends in the Evolution of Service-Oriented and Enterprise Architectures, Management for Professionals, Springer, accepted for publication, estimated to appear in 2016. *The content of this publication represents the second version of the CMG after the demonstration in practice in Chapter 7.*

Wißotzki, M. "*Exploring the Nature of Capability Research*" In : El-Sheik, E. ; Zimmermann, A. ; Jain, L. (Eds.) : Emerging Trends in the Evolution of Service-Oriented and Enterprise Architectures, Management for Professionals, Springer, accepted for publication, estimated to appear in 2016. *The content of this publication represents the results of our latest knowledge base analysis in Section 4.3.*

Wißotzki, M. "*The Capability Management Process - Finding Your Way into Capability Engineering*" In Simon, D.; Schmidt, C. (Eds.) (2015): Business Architecture Management - Architecting the Business for Consistency and Alignment, Management for Professionals, (Chapter 5), Springer, 2015, ISBN: 978-3319145709. *The content of this publication represents the first version of the CMG as a result of Chapter 6.*

CONFERENCES

Wißotzki, M., Koç, H., & Weichert, T. " *A Project Driven Approach for Enhanced Maturity Model Development for EAM Capability Evaluation*.", In 17th IEEE International Enterprise Distributed Object Computing Conference Workshop, TEAR 2013 (EDOCW), (pp. 296—305), Vancouver and Canada, 2013, DOI: 10.1109/EDOCW.2013.39. *The content of this publication provides foundations for the CMG process structure within Section 6.2.2.*

Wißotzki, M., Koç, H., Weichert, T. and Sandkuhl, K. "*Development of an Enterprise Architecture Management Capability Catalog.*", In Kobyliński, A. and Sobczak, A. (Eds.), Perspectives in Business Informatics Research, Lecture Notes in Business Information Processing, Vol. 158, Springer Berlin Heidelberg, pp. 112–126, 2013, DOI: 10.1007/978-3-642-40823-6_10. The content of this publication provides inputs for the problem investigation of Chapter 4 and the design and development of Chapter 6.

Wißotzki, M. "*An Exploration on Capability Research.*" In 19th IEEE International Enterprise Distributed Object Computing Conference (EDOC 2015), (pp. 179-184), Adelaide, Australia, 2015, DOI:

10.1109/EDOC.2015.33. *The content of this publication represents the results of our knowledge base analysis in Section 4.3.*

Wißotzki, M., & Sandkuhl, K. "*Elements and Characteristics of Enterprise Architecture Capabilities.*" In Perspectives in Business Informatics Research (pp. 82-96), Springer International Publishing, Tartu, Estonia, 2015, DOI: 10.1007/978-3-319-21915-8_6. *The content of this publication represents a fundamental concept for the CMG and is used within the design and development phase (Sect. 6.2.4).*

Wißotzki, M. "*A Process Approach for Capability Identification and Management*" In 17th International Conference on Enterprise Information Systems (ICEIS 2015), Institute for Systems and Technologies of Information, Control and Communication (INSTICC), Barcelona, Spain, 2015, DOI:10.5220/0005339502040212. *The content of this publication represents a development state of the first CMG version as a result of Chapter 6.*

Wißotzki, M., Koç, H. "*Evaluation Concept of the Enterprise Architecture Management Capability Navigator*" In 16th International Conference on Enterprise Information Systems (ICEIS 2014), volume 3, pages 319-327. Institute for Systems and Technologies of Information, Control and Communication (INSTICC), Lisbon, Portugal, 2014, DOI: 10.5220/0004881503190327. *The content of this publication represents a first evaluation design of CMG and an input for Chapter 8.*

TECHNICAL REPORTS

Sonnenberger, A., Wißotzki, M. "*Evaluation Concept of the Capability Management Guide 2.0 in Context of a Case Study*", Technical Report, Chair of Business Information Systems, University of Rostock, Rostock, 2016. *The contents of this publication represent inputs for the demonstration and evaluation of the CMG in Chapter 7 and Chapter 8.*

1.4.2 RELATED WORK

The listed publications are peer-reviewed and comprise books, conference papers and technical reports. The investigations in these publications have been mainly used as supplements to results of knowledge base analysis. In order to improve readability argumentations and direct citations of these publications are not set in quotation marks. The included publications are referenced at the beginning of each chapter or section.

BOOKS

Sandkuhl, K., Stirna, J., Persson, A. & Wißotzki, M. "*Enterprise Modeling: Tackling Business Challenges with the 4EM Method*" In the Enterprise Engineering Series, Springer, 2014, ISBN: 978-3662437247. *This publication provided the basics regarding the 4EM-method notation, the recommended creative techniques and the CMG Role Model of Chapter 6.*

Wißotzki, M., Christiner, F. "*Enterprise Architecture Visualization: Techniques for complexity reduction*" In AV Akademikerverlag, Saarbrücken 2012, ISBN 978-3639417852. *This publication provided possible visualization techniques for illustrating the capability catalog (Sect. 6.3), as well as statements with respect to the increasing complexity of enterprise architecture within the method perspective (Sect. 6.2.1).*

CONFERENCES

Wißotzki, M., Timm, F., Sonnenberger, A. "*A Survey on Enterprise Architecture Management in Small and Medium Enterprises*" In 17th International Conference on Enterprise Information Systems (ICEIS 2015), Institute for Systems and Technologies of Information, Control and Communication (INSTICC), Barcelona, Spain, 2015, DOI:10.5220/0005339602130220. *The results of this study provided evidence from the practice for current challenges of enterprise architecture management (Sect. 3.3.4), as well as arguments for the description of the method perspective (Sect. 6.2.1).*

Wißotzki, M., Köpp Ch., Stelzer, P. „ *Rollenkonzepte im Enterprise Architecture Management*“ In Digital Enterprise Computing (DEC 2015), Böblingen, Germany, 2015, ISBN 978-3-88579-638-1. *The results of this study provided evidence from the practice for current challenges of enterprise architecture management (Sect. 3.3.4), as well as arguments for the design of the CMG Role Model (Sect. 6.2.3).*

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Zimmermann, A., Schmidt, R., Sandkuhl, Jugel, D., Möhring, M. & Wißotzki, M. “*Enterprise Architecture Management for the Internet of Things* “ In Digital Enterprise Computing (DEC 2015), Böblingen, Germany, 2015, ISBN 978-3-88579-638-1. *The results of this study provided evidence upcomming challenges of enterprise architecture management (Sect. 3.3.4), as well as arguments for the description of the method perspective (Sect. 6.2.1).*

Zimmermann, A., Schmidt, R., Sandkuhl, K., Wißotzki, M., Jugel, D. & Möhring, M. “*Digital Enterprise Architecture - Transformation for the Internet of Things*” In 19th IEEE International Enterprise Distributed Object Computing Conference Workshop, SoEA4EE 2014 (EDOCW), (pp. 266-275), Adelaide, Australia, 2015, DOI: 10.1109/EDOCW.2015.16. *The results of this study provided evidence upcomming challenges of enterprise architecture management (Sect. 3.3.4), as well as arguments for the description of the method perspective (Sect. 6.2.1).*

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1.5 STRUCTURE

The presented work is divided into nine chapters. Following the introduction, *Chapter 2* describes the research approach of our investigation, i.e., the selection of the research strategy and methodological description in terms of research process, data collection and analysis techniques.

Chapter 3 provides explanations to topic-related subjects, approaches and the terminology used in context of this work. Enterprises and its internal, micro and macro environments are described. The concepts of enterprise modeling, enterprise architectures provide the basis for the mediator role of EAM between strategy- and IT management. The respective role is described in order to motivate the usage of capability-driven concepts that are basically introduced in this chapter.

The research process described *Chapter 2* starts with the problem investigation which is within the scope of *Chapter 4.* In this chapter, the initial undesirable state of a local problem situation is described. In order to prepare an adequate and relevant definition of a global practical problem, this work gathered similar problems from *local practices* and deduced a generalized problem description relevant for *global practice* by executing a root cause analysis. The global problem definition represents the starting point for further research activities and has to be particularly attentive to the coherence and its effects on artifact specification.

Chapter 5 classifies type and basic characteristics of the artifact to be developed. Next to the artifact type derivation this chapter transforms the explicated problem into specific requirements on the artifact resulting from previous local practices and method engineering literature.

Chapter 6 describes the design and development of the artifact under consideration of its conceptual-, methodological- and quality requirements specified in the previous chapter. This includes design and development decisions and its rationale in terms of local practice- and research community consultations as well as knowledge base investigations.

Within *Chapter 7* the artifact's first feasibility check is performed by demonstrating it to partners from local practices. The demonstration shows that even the initial version of the artifact can already solve a set of requirements. The demonstration can be considered as a weak form of an evaluation if an artifact can be used in one use case, it is also possible to do so in several uses cases as well.

Chapter 8 evaluates to what extent the CMG solves specified requirements and at least mitigates the defined practical problem.

The work ends with Chapter 9, which summarizes achieved results, reflecting the research process and outlining reference points for additional research.

The final version of the developed Capability Management Guide is presented in Appendix A.

Target group: Generally this work is addressed to all organizational departments and parties interesting in the capability topic itself, business and IT alignment issues or managing challenges of strategic transformations. Especially, enterprise architects and/or participants of the EAM team dealing with this topic.

2 RESEARCH APPROACH

This chapter provides an introduction into general research philosophies and strategies (Sect. 2.1) used for Information System Research (ISR) investigations. In order to follow a rigorous research process we are describing corresponding strategies and methods (Sect. 2.2). Considering the thematic- and scientific perspectives this work chose a research strategy, which is outlined in a process using appropriate methodologies for data collection and data analysis.

2.1 RESEARCH PHILOSOPHIES AND STRATEGIES

Research could be defined as a systematic activity that contributes to the understanding of a phenomenon. Within this work, the phenomenon can be described as the problem of enterprises in dealing with their EAM capabilities, which should be understood performing a research process and, based on its findings, new solutions should be developed. This research process-oriented approach is based on the theory of *scientific knowledge* and is part of the *epistemology*.

Epistemology deals with the identification of solutions that are available under realistic conditions. Such findings are defined as knowledge and a central object in the context of epistemology refers to scientific as well as non-scientific applications. In general, epistemology is considered as the "theory of knowledge" [323].

The philosophy of science as "*theory of scientific knowledge*" is concerned with those foundations presupposed within the scope of an *object science* and is used to acquire additional knowledge and skills [323]. Accordingly, there is a crucial difference between the philosophy of science and epistemology. On one side, the philosophy of science characterizes a specific theory of scientific knowledge that refers to results which were achieved by using general accepted scientific methods. On the other side, the philosophy of science represents some kind of meta-science that creates the basis for object sciences, like business information systems (extraction, transformation, applying results in scientific context) [323]. In the last years there has been an ongoing discussion about epistemological and scientific paradigm in the context of object sciences such as Information Systems (IS) [177,323,74,41,42], but this work is not intended to contribute on this scientific discourse. According to [186] and [74], selecting an epistemological position is both arbitrary and subjective and should not be taken randomly just by considering research strategies and methods.

In this context, two main strategies are mentioned in the ISR literature, which cannot be thought of being dichotomous [96,43].

1. The first strategy is formed by *behavioral research (BR)*, which was created in psychology science and thereby has its roots in natural sciences. In the context of IS, behavioral research seeks to develop and justify theories (i.e., principles and laws) that explain or predict organizational and human phenomena surrounding the analysis, design, implementation, management, and use of information systems. Behavioral science starts with a hypothesis, then researchers collect data, and either prove it right or wrong. Eventually a theory is being developed [96,6]. The behaviorist approach underlies logical positivism, which would not consider

the hypothesis as acceptable scientific knowledge as long as it had not been allowed for being tested through observations [43].

2. The second strategy is the *design-science research (DSR)*, which is construction-oriented and in which a designer answers questions relevant to human problems via the creation of innovative *artifacts*, thereby contributing new knowledge to the body of scientific evidence. An *artifact* is a solution made by humans with the intention to solve a problem. Unlike the natural sciences, the design science research is fundamentally a problem-solving paradigm, whose final goal is to produce an artifact that must be built and then evaluated. The knowledge generated by this research informs us: how a problem can be improved, why the developed artifact is better than existing solutions, and can more efficiently solve the problem being addressed [96].

Table 2.1 presents an overview about the characteristics of each research strategy considering its research goal and perception [177,74,47,48]. Moreover, knowledge evaluation, structure and development process, including the interaction with the field of research represent additional characteristics.

Table 2.1 Characteristics of Behaviorist- and Design Science Research strategies, according to [177].

	Behavioral Research	***Design-Science Research***
Goal	Description and declaration of the reality with the aid of theories (*focus on reality*)	Changing the reality by developing and using artifacts (*focus on benefits*)
Perception of Reality	There exists an ontic reality that is responsible for perceiving a subject (*realism*)	There exists an ontic reality which is bound to a subject that creates distortions (*relativism*)
Knowledge Evaluation	Differentiation between knowledge development and application. Methodological principles and procedures guarantee knowledge quality. (*positivism*)	A logical separation between knowledge development and knowledge application is either not possible or not desired; only a few methodological standards; the grade of knowledge is determined by the quality of the argumentation (*pragmatism*)
Knowledge Structure	It is assumed that socio-technical coherences are explicable by empirical data (describe, explain and predict) (*reductionism*)	Data form a basis for constructing an artifact but are not applicable for drawing conclusion within the overall context called contextual knowledge about the artifact (*emergence*)
Knowledge Development Process	Inquiry, evaluation, interpretation, generalization (*sequence*)	Problem analysis and formulation, Development and adaptation of concepts, evaluation and recalibration synthesis (*iteration*)
Interaction with the object of research	Actions that have an influence on the object of research should be omitted (*observer*)	Affecting opportunities for target-oriented modification of the environment are actively used (*participant*)

However, [186] points out that introduced characteristics do not necessarily have to be in a behavioral or design-science-oriented form only, combinations are also possible. Considering the research goal (*RG*), main research question *(RQ)* and follow-up questions (*RQ1 – RQ2*) the selection of the corresponding research strategy is chosen in the next section.

2.2 RESEARCH METHODOLOGY

By finding an answer to our main research question *(RQ)*, we will solve a practical problem under consideration of accepted research procedures in order to guarantee scientific rigor and achieve high-quality research results. Thus, this work is going to follow the DSR paradigm. The following paragraphs introduce the selected research strategy and the research process that is based on it, as well as the techniques used for data collection and analysis.

In general, the research activities of a DSR should provide a solution for a *problem, which* is caused from *practice* and represented by an *artifact*.

> *"A practice is defined as a set of human activities performed regularly and seen as meaningfully related to each other by the people participating in them." [21,p.14].*

Problems can be distinguished between wicked and tame problems. W*icked problems* are specified as "*difficult or impossible to solve, because of incomplete knowledge, contradictory and changing requirements, complex interplay between related problems, any added effort can improve on a solution to a wicked problem*" [21,p.2]. Whereas *tame problems* are equipped with all required information for solving the problem as well as criteria for determining are clearly defined.

To specify the practical problem solved in this work we define the term more precisely and distinguish two problem classes and two problem types:

> *A practical problem is defined as gap between a current state and a desirable target state, as perceived by the participants in a practice The current state could be represented by a neutral (type 1) or unsatisfying (type 2) situation whereas the target state embodies an improvement of existing solutions (for type 1 problems) or neutral situation (for type 2 problems) that should be reached by the help of an artifact involving a solution [21].*

Social- and practical problems are often wicked problems whereas many engineering problems are tame problems. Consequently the methods used to solve a wicked problem are partially different from those used to address tame problems [21]. However, *design-science research investigations* should solve such practical problems (wicked, tame, type 1, type 2) via the creation of *artifacts*, thereby contributing new knowledge to the scientific body of knowledge.

> *An artifact is a solution made by humans with the intention to address a practical problem. It could be described by specifying its functionality, components and relations as well as its environment and effects on it [96,21].*

In order to ensure that the artifact meets our *(RG)* in terms of scientific rigor and practical relevance the DSR guidelines ($\mu_{DSR}1$- $\mu_{DSR}7$) of [96] support the definition of an appropriate research process:

$\mu_{DSR}1$*: Design as an Artifact:* Generate a functional and operational artifact represented by model, construct, method or instantiation.

$\mu_{DSR}2$*: Problem Relevance:* Build a solution for a problem which is derived from a lack of operational concepts or shortcomings of existing approaches in theory and practice.

$\mu_{DSR}3$*: Design Evaluation*: The value, quality and effectiveness of the designed artifact must be accurately proven by well-executed- and multiple perspectives evaluation methods.

$\mu_{DSR}4$*: Research Contribution*: The research investigation must provide a clear and verifiable contribution to the knowledge base.

$\mu_{DSR}5$*: Research Rigor*: A strict application of recommended DSR methods is required in order to ensure scientific rigor.

$\mu_{DSR}6$*: Design as a Search Process*: Define an iterative process with at least an artifact generation and testing activity. Results of the artifact generation activity provide the input for testing against requirements or constrains from its environment in order to find alternatives for undesired outcomes. "*The search for an effective artifact requires utilizing available means to reach desired ends while satisfying laws in the problem environment.*" [152].

$\mu_{DSR}7$: *Communication of Research*: Technology- and management-oriented stakeholders (e.g., board level, business developers, line managers, application manager or developer) should be satisfied by communicating achieved results.

[96] provides a framework (Figure 2.1) that features three activity cycles in order to connect the environment, knowledge base and IS research area under consideration of the DSR guidelines *($\mu_{DSR}1$- $\mu_{DSR}7$)*. The environment column and knowledge base column serve as a starting point for the artifact creation (IS Research column). The connecting cycles are called: *Relevance Cycle, Design Cycle* and *Rigor Cycle*. The *Relevance Cycle* connects the environment/application area of the research project to the research activities by collecting business requirements (goals, problems, opportunities) and fulfillment tests (field testing). The environment describes the research field of application and involves the three dimensions: people (e.g. roles, skills, characteristics), organization dimension (strategies, structure & culture, processes) and technology (e.g. infrastructure, applications, communication architecture). The *Rigor Cycle,* instead, links the research activities to knowledge base (KB). The knowledge base provides foundations (e.g. theories, frameworks, instruments, methods) and methodologies (e.g. data collection and analysis methods) that can be used for artifact design, construction and evaluation to guarantee scientific rigor. The *Design Cycle* represents a construction component, because it is processed by the input of both the Rigor- and Relevance Cycle in order to build and evaluate the desired artifact. To contribute new scientific evidence in the field of business information systems the justification and evaluation activities are particular important in order to assess and refine the produced artifact. All three cycles must be visible within a research process in order to meet DSR conformity [13,96].

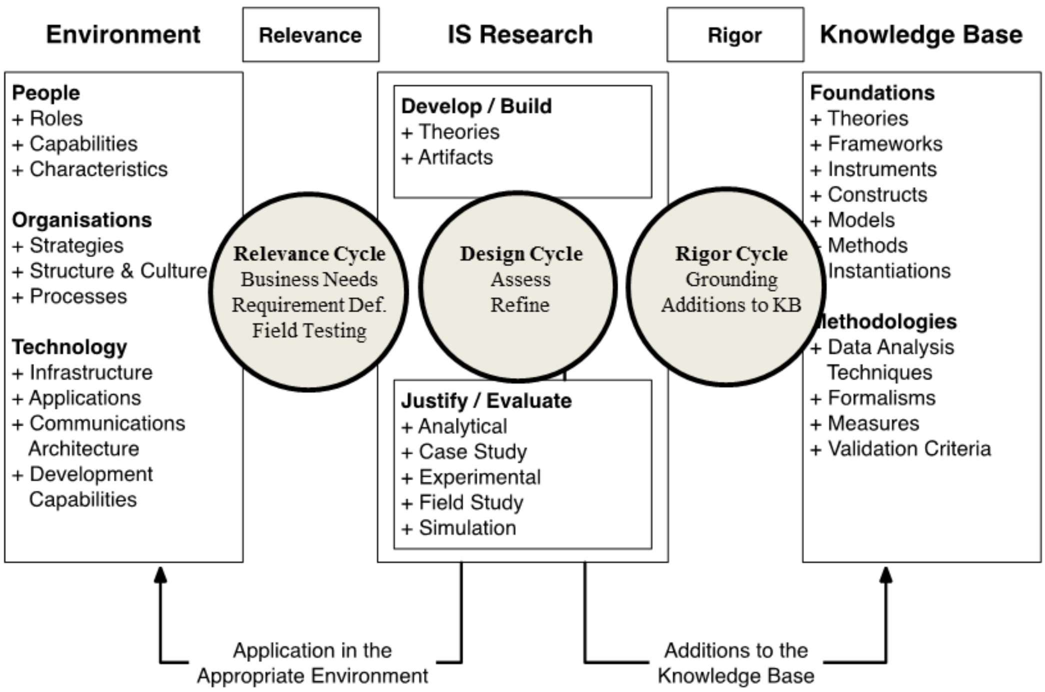

Figure 2.1 Design Science Research Framework [96].

Based on contributions of [152,6,177], DSR could be divided into *Design Science* and *Design Research*:

1. *Design Science* is concerned with methodological question of constructing and evaluating artifacts and aims at creating standards for its rigor.
2. *Design Research* deals with the development of a solution (new artifact/ adoption of an existing artifact) for a specific class of relevant problems under consideration of a rigorous construction and evaluation process.

This investigation continues with design research, because its intention is the development of a solution for a practical problem specified by a set of requirements gathered from local practices by following a DSR conform research process. In the case of creating new or adapting existing artifacts [186] notes that not every construction of an artifact could be easily allocated to design research, because a design research solution should attain a global practice (GP). Thus, this work is going to show, that the produced artifact is applicable to a variety of problems and could be used in a global manner.

In order to follow the design research guidelines and justify DSR as research strategy, our argumentation based on a three step research setup of [21,23], illustrated in Figure 2.2. The first step (1) consists the allocation of an initial problem situation including problems and requirements form local practices (LP) done by an environment analysis (*relevance cycle*). Furthermore, we described our research investigation which includes a clearly defined LP problem. In order to formulate a precise practical problem we performed an iterative problem definition process in terms of passing more than one adjustment cycle with the LP. In the second step (2), this work analyzed the existing knowledge base e.g. for existing theories and models that address similar problems as well as for scientific approaches supporting develop- and justification activities (*rigor cycle*). Finally (3), our research results and especially the generalized solution approaches will be discussed within the research community (ReC) by relating these results to the actual body of knowledge (relevant for ReC and GP) in terms of *scientific contributions*. Next to the ReC contributions like journals and conference papers the solution is disseminated to the GP through e.g. conferences for practitioners, book publications for professionals.

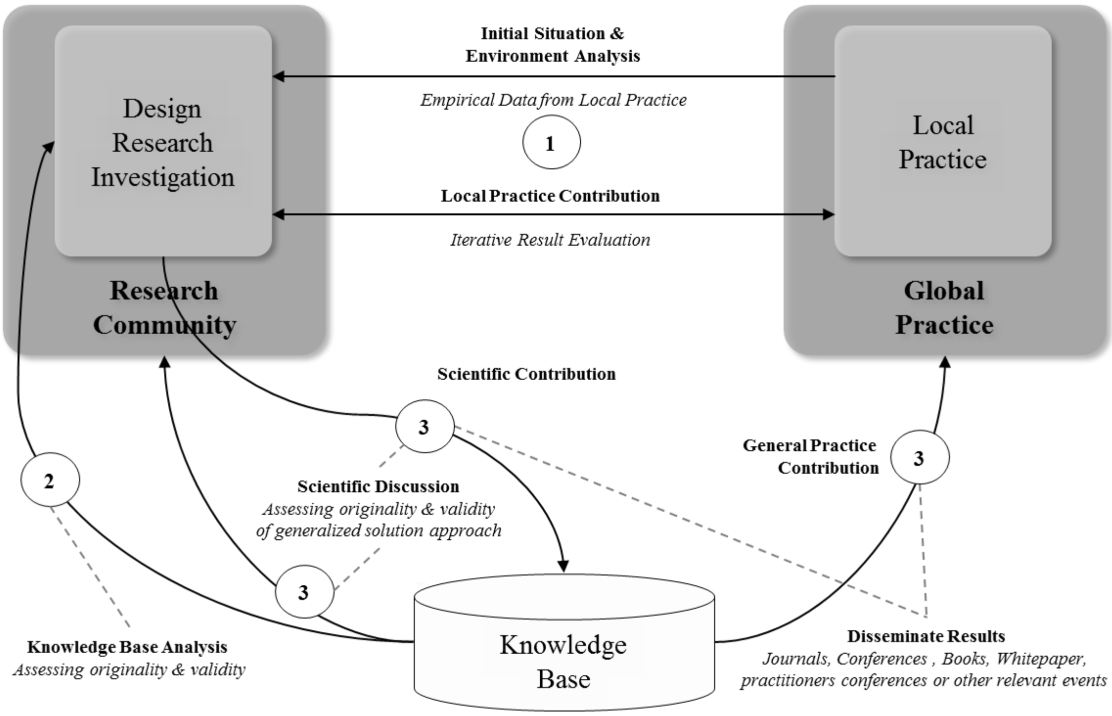

Figure 2.2 Local and Global Practices in a Design Research Investigation, adapted from [21,23].

Each research strategy uses a set of specific research methods, data collection- and data analysis techniques (Table 2.2). The requirements of each methods and techniques used within our investigation are described in more detail in Section 2.2.2 and Section 2.2.3.

Table 2.2 Research methods and techniques suitable for DSR projects, according to [21].

Defintion	Elements
Research Methods	Experiments (field, labor), Surveys, Case Studies, Ethnography, Grounded Theory, Action Research, Phenomenology, Simulation, Mathematical and Logical Proof.
Data Collection Techniques	Questionnaires, Interviews, Focus Group, Observations, Document analysis.
Data Analysis Techniques	Quantitative Data Analysis, Qualitative Data Analysis.

In order to comply with the DSR strategy characteristics (Table 2.1), guidelines for DSR projects *(μ_{DSR}1- μ_{DSR}7)* and the key activities of design research (Figure 2.1) the literature recommends to define a well-structured research process [96,21,26]. Therefore, the subsequent section presents how we specify our research process under consideration of the argumentation above.

2.2.1 RESEARCH PROCESS

In terms of illustrating the different research process phases this work used the IDEF0 Notation based on [21,137]. The key components of the IDEF0 notation are similar to most process modeling approaches. Its main components are *activities* (rectangle) and *channels* (arrows). The *activity* transforms knowledge or objects provided by input channel (arrow form left) and produces new objects or knowledge outputs (arrow to right) by consuming resources (arrow from below). The control channel (arrow from above) governs the activity in terms of e.g. guidelines or principles or policies. The key elements of the IDEF0 notation and samples for its utilization within our research context are summarized in Figure 2.3. Personnel and organizational records from local practices as well as knowledge base data are examples for *resources*. Research strategy and corresponding methods, data collection and analysis techniques are classified as *controls*. Both channels influence the activities of the individual research process steps specified in the subsequent section.

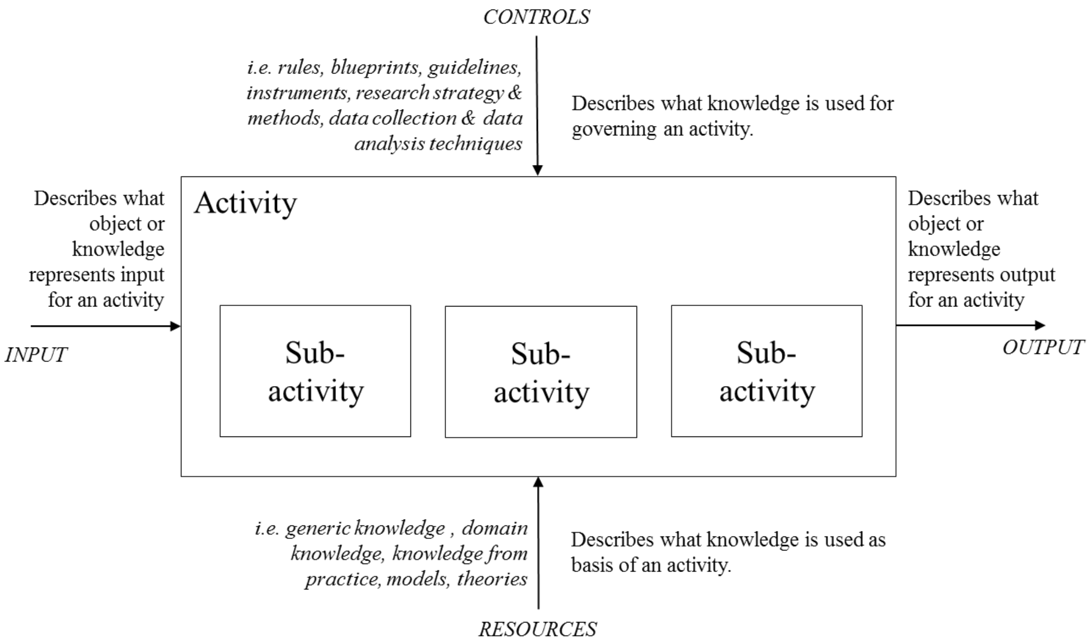

Figure 2.3 Research Process Notation using IDEF0, adapted from [21]

A variety of possibilities for DSR conform research processes are provided by academic literature [27,28,29,30,31,32,33,96,152]. We chose the design science research methodology (DSRM) by Peffers et al. [26], because it represents an aggregation of the previously referenced literature and it provides a *problem-centered design science research approach* as well. Problem-focused research projects investigate a root cause analysis in terms of comprehensive knowledge base and environment explorations. The findings provide indications for requirements for the artifact construction (design and development). Our research investigation followed this problem- focused procedure and thus this work performed the whole DSRM. According to [26] combined with the explanations of [21], we performed the following six process steps: *1. Problem Identification and motivation, 2. Define the objective for the solution, 3. Design and Development, 4. Demonstration, 5. Evaluation, 6. Communication.* Each step involves a set of activities that are exactly explained from Chapter 4 to Chapter 8. Nevertheless, the following explanations provide a conceptual overview about each step summarized by Figure 2.4.

1. *Problem Investigation:* At this stage the practical problem to be solved is extracted from local practices and its relevance for the global practice under consideration of the knowledge base is exposed. We do this to ensure that the developed solution does not solve a situational problem, but a problem of general interest. Due to its problem-centered initiation, the investigation is based on a review of EACN project motivation in order to extract an initial problem description. In order to analyze the initial problem in more detail, we selected and analyzed several expert interviews and project documents from different *local practice partner*s with similar problem prerequisites. Thus, a set of local practice problems were gathered which provides the base for a root cause analysis and a knowledge base review. Both analyses were conducted to encapsulate the central problem description and justify its practice- and scientific relevance. Outputs of this process step is the explicated problem as well as investigations about capability research, EAM in theory and practice published in [59,64,65,66,90,134,136,190], which are precisely described in Chapter 4.
2. *Define Requirements:* This phase delivers an accurate description of the artifact to be developed by the formulation of its type. Artifact requirements are derived from root cause analysis and collected practical problems of the previous phase. The requirements are categorized in conceptual-, method implied- and qualitative requirements. The specifications of the 31 identified requirements are described in Chapter 5.
3. *Design and development:* Based on creative methods, defined research goal, findings of knowledge base- and practice analysis the artifact is designed and developed (Chapter 6). Under consideration of specified requirements we gathered additional feedbacks and thought-provoking impulses using questionnaires carried out to both, scientific and practitioner audience. In order support conclusions on the artifact development we initiated additional literature reviews based on empirical results. Outputs of this process step are the first version of the artifact as well as developed concepts and procedures published in [52,84,85,87,133].
4. *Demonstration*: Within this phase the current state of the artifact is presented to users from local practices in order to test feasibility in single use cases (Chapter 7). By executing two expert interviews, we collected data that provides us indications about how and why the artifact works as well as receive change request in terms suggestions of improvement [243]. Thus, we got an overview about the development state and certainty that the artifact can solve an instance of our explicated problem. Due to our research process design, this step passed through iteration in order to realize minor adjustments caused by change requests. An output of this process step represents the demonstrated artifact which is published in [300].
5. *Evaluation*: Based on the demonstration phase the concept, quality and benefits of the developed artifact has to be evaluated by appropriated research methods (Table 2.2). The demonstration and evaluation activities lead to further refinements of the artifact in terms of different increasingly improved versions. For this purpose, we used appropriate measures and analysis methods that evaluate both qualitative- and quantitative data of the artifact evaluation in order to make statements about e.g. usability, quality, benefits and research goal achievement. The whole set of activities is described in Chapter 8. The evaluated and adjusted artifact represents the final output of this investigation and will be published in a monolithic doctoral thesis.
6. *Communication*: Individual research results have already been published in corresponding phases in form of peer-reviewed books, chapters and conference papers as well as technical reports. Section 1.4 provides an overview and categorization of relevant publications.

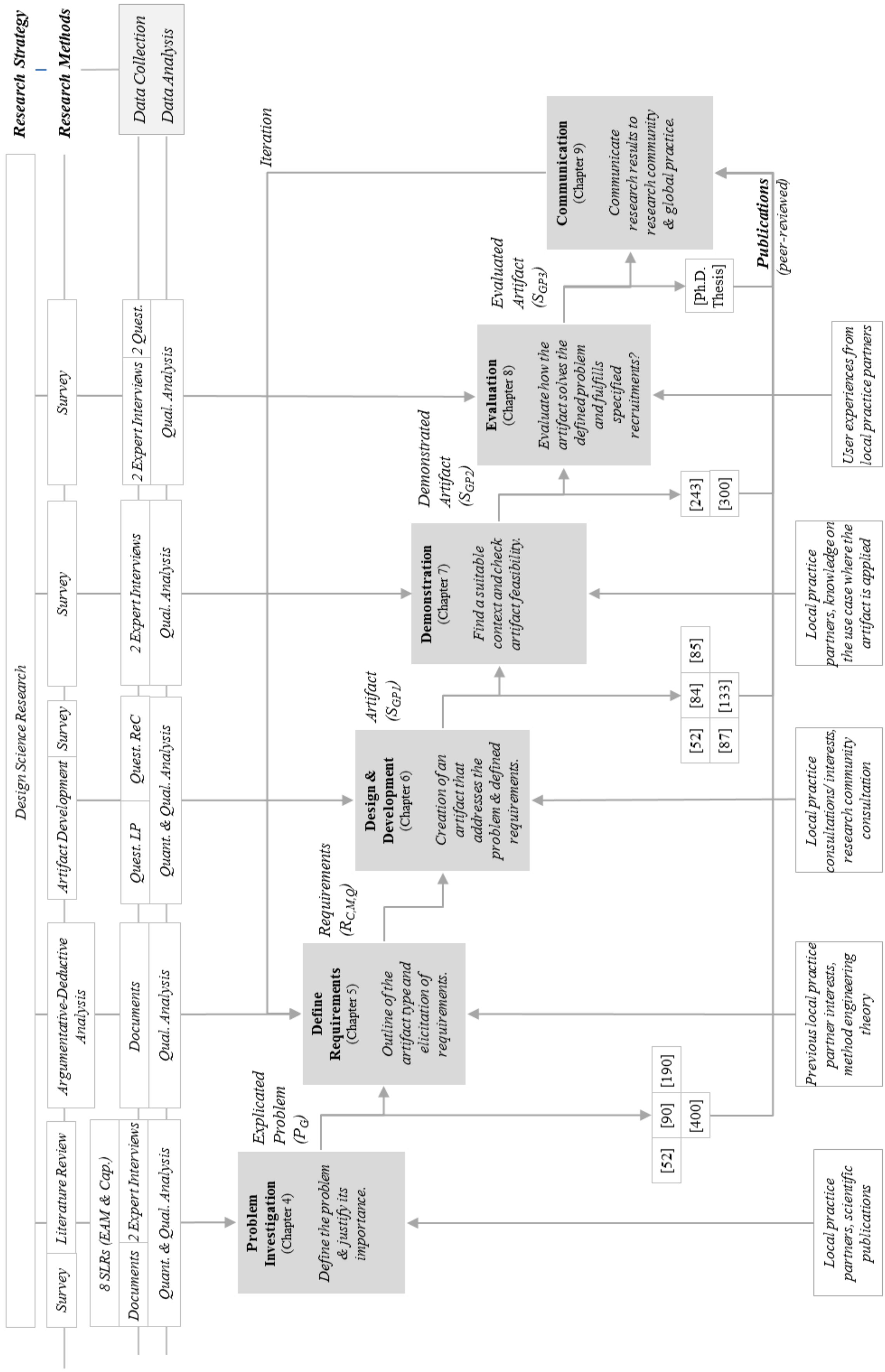

Figure 2.4 Overview Research Process.

2.2.2 DATA COLLECTION

For a better understanding of the practical research problem under consideration we used a set of different data collection techniques. In order to enhance accuracy of results we used a *mixed method approach* for data collection [287,288,289] by combining qualitative- and quantitative data collection methods performed by different people in different studies and publications (Figure 2.4). Therefore, we used surveys i.e. questionnaire and interview techniques as well as the document analysis i.e. literature review and organizational records. This section describes the used methods, its techniques and limitations.

2.2.2.1 SURVEY

Surveys are used for descriptive, exploratory, or explanatory research by gathering data about people in terms of e.g. its activities, beliefs, attitude and/or knowledge. For our investigation we used two common forms of a survey: the *questionnaire survey* like a self-administered *internet questionnaire* mainly used for quantitative data collection and the *face-to-face survey* in form of e.g. semi- structured *expert interviews* primarily used for qualitative data gathering [286]. The *questionnaire survey* includes a set of questions to be distributed (e.g. email, website, social network, mail, electronic documents) to a number of respondents intended to capture responses in a standardized way (Sect. 2.2.2.1.1). Whereas *interview survey* is based on personal face-to-face communication and interaction with an individual, who could be a person with access to privilege knowledge or experiences in terms of an expert interview (Sect. 2.2.2.1.2). For the sake of completeness, *observational surveys* are used to study the behavior of people (without using them as respondents) under consideration of a list of questions, which is not used within this investigation.

The major challenge determining results from a survey is represented by the involved amount of questioned individuals, which is called *sample*. Thus, the right selection of individuals within a population is essential for generalizing results to the population from which it has been drawn [21,291]. In this context it can be distinguished between a *representative*- and *exploratory sample* [285,286]. *A representative sample* tries to select a subset of individuals that are representative for an entire population. Therefore, the most common sampling technique is *random sampling.* In order to avoid researchers influence on the selection process of the subset, *random sampling* should ensure that each individual of a population has an equal chance to be part of the chosen subset [21,286]. *An exploratory sample* represents a first attempt to learn something about a phenomenon or explore new approaches without being representative for a population. In contrast to random sampling, *purposive sampling* tries to select a small number of individuals, which provide very specific and valuable information for a research investigation. According to [21], researchers may personally invite the respective individuals, because of its privileged knowledge or advanced experiences concerning a desired topic.

On one side, the speed as well as the possibility to gather large amounts of qualitative- and quantitative data by relatively low efforts represents the advantages of using surveys. On the other side, the usage of surveys is characterized by a set of limitations. Thus, [286] mentioned some general limitations of using surveys like low-response rates, social desirability in terms of avoiding negative opinions, recall bias terms of motivation to respond, and/or common method bias in terms of spurious covariance between independent and dependent variables measured at the same time by different methods. Furthermore, each survey form comes along with particular set of limitations that are described in corresponding subsections.

Table 2.3 summarized the purpose, key concepts and activities as well as forms and limitations of the survey method.

Table 2.3 Overview Research Methods: Survey, according to [21,286].

Purposes	Key concepts	Key activities	Used Forms	Advantages	Limitations
Investigate some aspects of a phenomenon to get an overview	Representative sample, Exploratory sample	Sampling (random, purposive)	Internet based surveys, interview based surveys	Real user, flexible due to a number of instruments, adaptable to focus and circumstances, quickly derived and performed, several kind of media are usable	Limitation to measurable aspects, low-response rates, social desirability, recall bias, common method bias, low-medium cost, low risk to participants

2.2.2.1.1 QUESTIONNAIRE SURVEY

Originally, a questionnaire was a pen-and-paper instrument to gather information by asking questions [285]. Nowadays, questionnaires can be classified by the nature of its *distribution type* (electronical vs. personal) and its *administration form* (self-administrated vs. group-administrated). Situational aspects, in terms of when a questionnaire is replied (e.g. at work vs. leisure time, frequently vs. delayed), has to be discussed for each form individually [285,286,291].

> *A questionnaire includes a set of questions to be distributed to a number of respondents intended to capture responses in a standardized manner.*

In general, we could distinguish between *electronical* and *personal* distribution of a questionnaire. Nowadays, the *internet / electronic questionnaire* represents the most common distribution type, because it could be setup, managed and distributed via several internet based communication channels like. Email, social networks (facebook.com, xing.com, linked.com), electronic documents (e.g. e-mail integrated, prepared PDF, MS Excel, MS Word files) or messenger services (e.g. WhatsApp, SMS). Due to its availability, recipients are location-independent in processing and completing the questionnaire [285]. The results are captured by a service provider, chosen for the hosting and administration of questionnaire. The service provider and its range of services has to be aligned with own requirements like access limitations (e.g. password, time limit), export functionalities (e.g. CSV, SPSS, database access), messaging services (e.g. Email or SMS reminder, bulk Email service) and evaluation services (e.g. participation rates, statistical calculations). Thus, this distribution type allows low cost distribution and easy participation, to some extent evaluation services and the possibility of reusing or modifying the questionnaire for further research activities [286].

A questionnaire is *personally distributed* when it is performed via *mail, telephone or face-to-face*. If a questionnaire is *mailed,* the recipients can answer the survey at their convenience and personally return it via postage-prepaid envelopes (in most cases). Next to low response rates, standard postal mail represents the most time consuming distribution type (distribution until participation) [285]. Telephone based questionnaires represent the first “real” personal based interaction between a respondent and an interviewer. Respective distribution type is quite expensive due to a sequential 1:1 respondent-interviewer process. Simultaneously, this type generates higher response rates and shortens the investigation period. A *face-to-face interview* represents the most personalized form of distributing a questionnaire and the interviewer directly interacts with the respondent asking questions and documenting the answers. Next to the required skill set of the interviewer this distribution type is classified as the most expensive one in terms of the allocation of resources. The face-to-face interview is characterized by the shortest time span between questionnaire distribution and participation as well as by the highest response rate. The *expert interview* represents one form of a face-to-face distributed questionnaire, which is explained more detailed in the next sub-section.

A *self-administrated questionnaire* is distributed to a large number of recipients. The recipients can respond at their convenience and return via a pre-planned procedure depending on the distribution type (mail, email, confirmation on a website). Thus, self-administered questionnaires have to fulfill certain requirements to be reliable, comprehensive and clearly evaluated data such as predefined series and precise formulated questions [285]. However, this kind of questionnaires next to the advantage to address a large number of people, researcher are challenged with low response rates, long delays and a continuously monitoring of tracking answers and sending reminders [286]. In order to counteract respective challenges, *self-administrated questionnaires* should be used to gather simple facts, preferences, and/ or opinions.

A *group-administrated questionnaire* is characterized by the spatial and temporal situation of the respondents, because they all have to (independently) answer its questions at a certain time and location [286]. Thus, high response rates and respondents support is assured by conducting group-administrated questionnaires. The respective administration form could be performed where the group to be interviewed is currently located and/or feels good, such as in its company, hotel or at a conference. Upcoming data can be electronically captured via video and/ or audio recordings, documents or protocols.

Within this investigation we conducted two self-administrated internet questionnaire for describing current EAM challenges and the *problem investigation* (Chapter 4) as well as one self-administrated electronical document based questionnaire and one group-administrated questionnaire within the artifact *design and development* phase (Sect. 6.2.4). Table 2.4 provides an overview about the conducted questionnaire types, topics and participants.

Table 2.4 Overview Data Collection via Questionnaires.

No.	Questionnaire type	Topic & Participants	Activity (Section)
1	self-administrated, internet based, random sampling, local practices	Current state and challenges of EAM: *IT Industry, small and medium-sized enterprises, Germany, 2013*	Description of EAM challenges (Sect. 3.3.4) Problem Investigation (Sect. 4.2)
2	self-administrated, electronical document based, purposive sampling, local practice partner	Integrated Capability Approach: *alfabet AG, Boston, USA, 2013*	Design and Development (Sect. 6.2.4)
3	group-administrated, printed document based, purposive sampling, research community	Integrated Capability Approach: *Master Class, Practices of Enterprise Modeling conference, Riga, 2013*	Design and Development (Sect. 6.2.4)
4	self-administrated, electronical document based	CMG v2.0: *ACL Ltd., Vancouver, Canada, 2016; AIDA Cruises - German Branch of Costa Crociere S.p.A., 2016*	Evaluation (Sect. 8.3.1)

2.2.2.1.2 EXPERT INTERVIEW SURVEY

In empirical research interviews are frequently used as reconstructive procedures (the interviewee reconstructs his knowledge and experience) with asymmetric communications (the interviewee develops and formulates his own thoughts, whereas the interviewer switches between silent listening and dedicated dialogue partner) [241]. For the success of the interview the interviewer needs to retain control over the course of interview, without disturbing the communication process [284]. Nevertheless, the interviewer needs to be neutral and open to new knowledge and interpretation patterns [284]. The result must be intersubjectively verifiable by conducting a scientific interview with utmost care. This includes, among others, recording the whole conversation on tape [281]. Interviews can be categorized by its level of structure or number of interviewees. Regarding the interview structure, there are basically three gradations: open / little structure (basically no rules), partially / semi-structured (interview guideline sets out questions, the order could, but not has to be strictly followed), fully structured (written questionnaires, given answers) [283]. The number of interviewees is divided into the individual interview, the group interview, and a study [283].

> *Expert interview is a theory-based method of data collection and is used for producing specific and concentrated knowledge by particularly selected individuals relating to a confined topic [280,281].*

These particularly selected individuals are defined as experts in this context. An expert has domain-specific knowledge / skill and experience of many years. On one side, intelligence and memory is only of minor importance, whereas the dependency of the experts' performance area and years of experience are extremely important on the other side [281].

> *An expert is a person with privileged access to information in a particular field of study, because he is focused on problem-solving responsibility in design, development, implementation and / or control [282].*

Experts can be a direct target group of research and can evaluate various hypotheses and questions with experts' knowledge and perspective [280]. Basically, all interviewed experts had many years of experience in the practical handling of EAM - more expertise is described in the individual interview preparation phases.

The expert interviews carried out in this investigation are semi-structured each with a guideline as basis. The interview guideline is a coarsely structured, written question scheme serving the interviewer as a memory aid [290]. The guideline shall not restrict the interview, but ensures that all issues are fully addressed and supports the conversation organization [281]. The guideline contains all questions and connecting passages for each question block [281]. The content of each question block represents the research problem in specific interview questions [241]. Furthermore, we used the guideline to ensure the comparability of different interview results.

In order to ensure that the conclusions of the interview appropriately reflect what we were investigating (*internal validity*), we consider a number of control questions within the scope of the interview guideline creation. Therefore [283] suggests the following six control questions: (1) *Is every question necessary?,* (2) *Does the interview contain repetitions?*, (3) *Are all questions clearly formulated?,* (4) *Can interviewees answer the questions potentially?*, (5) *Is there a danger to ask question, which can embarrass interviewees?*, (6) *Have leading questions been avoided?* In regard to preparation, execution and quality management, we conducted the expert interviews based on the following process [284]:

1. Development of the interview guideline.
2. Pre-test of the interview guideline.
3. Choice and contact approach of interviewees.
4. Execution of expert interviews.
5. Recording the expert interview.
6. Saving the results (record or transcription).

The development of the interview guideline, the course of pre-tests, the execution as well as the evaluation are described in the respective sections in more detail.

In addition to the quality of the interview design, several effects must be considered, which can affect the quality of results. These *interview effects* are caused by the interviewer (most often unaware), for example by difference in age, gender, or appearance of the interviewer [283]. Another aspect is *response distortion*, which is caused by the experts. A low level of self-disclosure or the effort to please the interviewer, are often the reason for response distortion. Furthermore, there is the so-called *Hawthorne effect*, which describes that the sole participation in a scientific study can have impact on the response of the experts [283]. Another effect is based on the *information asymmetry* between the parties as well as the terminology of the experts, which effects the proper evaluation of results due to superficial standard answers or answers which require too much prior knowledge [280]. A final category of interview effects can be described as *interaction effects*, which relate to the cooperation between interviewer and experts in the interview conduct [296]. For instance, the expert can withhold obviously available information due to mistrust and lack of interest (*iceberg effect*); a good-natured but dominant communication guidance of experts will determine the importance of information (*paternalism effect*), the feedback of question-response in which the expert asks the interviewer counter-questions (*feedback effect*) and, finally, the staging of oneself is focused by the interviewee (*catharsis effect*). The presented effects usually occur only temporarily [284], therefore the avoidance has to be ensured in the design and implementation phase through an adequate process (see above) and the occurrence has to be particularly reflected in the data analysis, which also has to be ensured by a standardized process.

During this research investigation six *expert interviews* were conducted, in each case two are distributed on *problem investigation* (Sect. 4.2), *demonstration* (Sect. 7.2) and *evaluation* (Sect. 8.3.2). Table 2.5 provides an overview about the conducted interview types, topics, experts' roles and companies.

Table 2.5 Overview Data Collection via Expert Interviews.

No.	Interview Type	Topic & Participants	Activity (Section)
1	unstructured interview	EACN project demand analysis: board member, alfabet AG, Berlin, Germany, 2012	Problem Investigation (Sect. 4.2.1)
2	Semi-structured interview	EAM capability demand analysis: advisory board member, alfabet AG, Berlin, Germany, 2012	Problem Investigation (Sect. 4.2.2)
3	Semi-structured interview	Feasibility test of the capability management guide version 1.0: EA Architect, Stadtwerke Rostock AG, Rostock, Germany	Apply Artifact (Sect. 7.2)
4	Semi-structured interview	Feasibility test of the capability management guide version 1.0, IS Strategy Manager, Bombardier Transportation GmbH, Berlin, Germany	Apply Artifact (Sect. 7.2)
5	Semi-structured interview	Usability test of the capability management guide version 2.0: Consultant, ACL Ltd., Vancouver, Canada	Design & Execution Evaluation (Sect. 8.3.2)
6	Semi-structured interview	Usability test of the capability management guide version 2.0, Digital Transformation Manager, AIDA Cruises - German Branch of Costa Crociere S.p.A., Rostock, Germany	Design & Execution Evaluation (Sect. 8.3.2)

2.2.2.2 LITERATURE REVIEW

Literature reviews are common data collection techniques based on documents (e.g. academic publications, books, organizational records, social media streams, government publications, personal communications, newspaper). In order to accomplish robust and sustainable data analysis results [21,98,99], we primarily used academic publications i.e. peer-reviewed journal-, conference-, book publications as well as organizational records and publications provided by private research institutes and industry consortiums. Therefore, we used two literature review approaches:

- *explorative / ad hoc literature reviews* (ALR) [100] and
- *systematic literature reviews* (SLR) [38,100].

The *explorative/ ad hoc literature review* starts to form initial search activity in terms of looking for sources of the desired topic by using appropriated terminology as search terms. Initial search results (single document or pool of literature sources) provide insights into the bibliography and references that are used to look up additionally related literature and communities in terms of key researcher, research groups, scientific journals and conferences. For refinement purposes, research results, used methods and frameworks solving a problem are analyzed. Within an iterative process the accuracy and focus of related work or root causes is improved.

In contrast to explorative/ ad hoc literature reviews [101], a *systematic literature review* provides the systematically identification, evaluation and interpretation of relevant sources to answer defined research questions by using a standardized process. In this regard, the review process guarantees scientific rigor in terms of considering related work, ensuring traceability, originality and validity [38,98,99,102]. Consequently, in order to secure a transparent and repeatable knowledge base analysis, we have chosen the systematic review approach for our data collection and analysis. Referred to Kitchenham et al. [38] we performed three key stages and corresponding sub-steps that need to be processed to conduct a SLR. The first stage deals with the *review planning* and provides research questions, literature resources and time frame definitions for the investigation. In order to differentiate research questions from our research statement (Sect. 1.2) we renamed "research question" into "analysis question" for this work. The second stage is called *performing the review*; here we selected relevant articles and collect data for answering the analysis questions (AQ), realized in the final step: *review report*, the conclusion is summarized.

Within three years seven teams from the Universities of Reutlingen and Rostock performed the same structured SLRs procedure. The entire procedure and respective results are summarized within this work and distributed in *problem investigation* (Sect. 4.3) as well as *design and development* (Sect. 6.2.4). Table 2.6 provides an overview about the conducted literature review types, its sources and time period of the individual reviews.

Table 2.6 Overview Data Collection via Literature Reviews.

No.	Literature Review Type	Sources and Time Period	Activity (Section)
1	Systematic literature review, conducted 2013	IEEE Enterprise Distributed Objects Conference (EDOC); International Conference on Advanced Information System Engineering (CAISE); European Conference on Information Systems (ECIS); Journal on Information Systems; Journal on Software and Systems Modeling, 2000 -2013.	
2	Systematic literature review, conducted 2014	AIS Electronic Library (AISeL) basket of conferences, 2000 – 2014.	Problem Investigation (Sect. 4.3), Design and Development (Sect. 6.2.4).
3	Systematic literature review, conducted 2014	AIS Electronic Library (AISeL) basket of journals, 2000 – 2014.	
4	Systematic literature review, conducted 2014	The Practice of Enterprise Modeling (PoEM) - 2008 – 2014; Perspectives in Business Informatics Research – 2001-2014; IEEE International Conference on Commerce and Enterprise Computing (CEC) 2009 – 2014.	
5	Systematic literature review, conducted 2014	IEEE Hawaii International Conference on System Sciences (HICSS), 1999 – 2009.	
6	Systematic literature review, conducted 2014	IEEE Hawaii International Conference on System Sciences (HICSS), 2010 – 2014.	
7	Systematic literature review, conducted 2015	Journals and Conferences: SpringerLink, ACM Digital Library; IEEE explore; AIS Electronic Library (AISeL); Wiley Online Library; Sciencedirect; only 2015.	
8	Exploratory literature review, conducted 2016	Private research institute & industry consortiums: Gartner Inc., The Open Group, Architecture & Governance Magazine and CEB CIO Leader Council.	Demonstration (Sect. 7.2.4)

2.2.3 DATA ANALYSIS

In order to find answers on the motivation question or explain a phenomenon under investigation, respective data has to be prepared, analyzed and evaluated. Therefore, data analysis derives valuable information form gathered raw data to draw conclusions on the phenomenon under investigation [21]. Therefore, we use the inductive and deductive argumentations within our work. Deductive reasoning is understood as the following "*From a general theoretical understanding, the researcher derives (deduces) an expectation and finally a testable hypothesis." [34,p.49]*. Consequently it starts with asking "Why" and moves to "Whether". Inductive procedures mean the opposite direction gaining a general conclusion by specifying e.g. single observations from local practices [34]. Two different approaches can be distinguished: *Quantitative- and qualitative analysis* of the collected data, summarized in Table 2.7 .

Table 2.7. Overview quantitative- and qualitative Data Collection Techniques, according to [301].

	Quantitative Analysis	Qualitative Analysis
Research Perspective	Centered around the (subjective) hypothesis of the researcher	Centered around the meanings and experiences of affected individuals, phenomenon
Objective	Data quantification and extrapolation of results	Receive detailed understanding of an issue and the underlying thoughts
Research Context	Replicable data	Realistic data
Data	Numbers, numerical data	Text, images, videos, sounds
Research Process	Static	Dynamic
Theory relation	Agreement of predefined hypothesis	Definition of hypothesis by the research results
Analysis	Statistical	Interpretive
Prior Focus	Analysis of causal relations within huge populations	Research of environment and interactions
Popular Methods	Experiments, observations, interviews, population surveys	expert interviews, group discussions, observations
Number of Participants	Large	Small

2.2.3.1 QUANTITATIVE ANALYSIS

The quantitative data collection can be basically conducted by any research method. Questionnaires and observations are primarily used for this purpose and corresponding quantitative mechanisms are used for its evaluation [21]. For the measurement, a number of data types have to be defined on which the following evaluations are based on [302]. Therefore, firstly the type of data and secondly the type of evaluation can be differentiated. The type of data essentially determines the possible evaluation mechanisms, which are mainly based on statistical methods. In this context, the data types can be distinguished as follows:

- *Nominal Data:* This data type has a finite set of characteristics (no numerical characteristics) and cannot be ranked (categorical data).
- *Ordinal Data:* These data also have only a finite number of possible characteristics. However, they can be ranked (ranked data), but no intervals between the individual characteristics can be calculated. It is only possible to determine if a characteristic is larger than another.
- *Interval Data:* Interval data can take all characteristics within a specified range. In this context, it is usually real numbers on a scale. On this particular scale distances can be calculated.
- *Ratio data:* This data type is similar to the interval scale, except the fact that absolute zero is defined like the age of a person. All arithmetic operations are only useful for this data type.

These data types can be analyzed in the quantitative analysis by two evaluation mechanisms, on the one side by *descriptive statistics* and on the other side by *inferential statistics* [21]. Descriptive statistics is a sub-section of statistics and relates only to a given sample of data, which are depicted by tables, graphics and characteristics such as mean, median, mode, range, standard deviation. For conclusions on the statistical population based on the samples, the *inferential statistic* is required. The relationships are considered in particular between individual variables (correlation coefficient) and their generalization to the whole statistical population. The mechanisms used are explained within the corresponding analysis sections (Sect. 4.3.3, Sect. 6.2.4, Sect. 8.3.1).

2.2.3.2 QUALITATIVE CONTENT ANALYIS

Qualitative data analysis techniques are commonly used to investigate data in the field of social science, which should measure phenomena within its real world settings. In particular, *qualitative content analysis* is based on large amounts qualitative data in terms of text and mainly produced by e.g. *un- or semi-structured interviews, open questionnaires, group discussions*, but it can also be include photos, images, sounds and video clips [21]. According to [297], *qualitative content analysis* is desirable when an investigation aims to understand a phenomenon in-depth.

This section describes the qualitative data analysis approach (*content analysis*) we used in order to analyze contents of conducted expert interviews in detail. The technique describes the procedure for systematic / methodical text analysis [209]. The respective analysis is commonly based on recorded interviews and documents in text format, due to the fact that this is the only option to perform a fully rule-based analysis [208]. Therefore the interview has to be converted into text format, which can be done by tape transcription or by writing a memory protocol. Memory protocols have to be written immediately after the interview to ensure a significant contribution to the analysis. The disadvantage of this text format is the fact that the content has been significantly reduced by the author and that it only depicts a limited range of information [208], because transcripts strongly rely on the interviewer. This aspect has been weakened by adding a third person for generating an appropriate memory protocol besides the expert and interviewer.

Due to the fact that *qualitative content analysis* is a scientific method, it must be conducted methodically by explicit rules, guided by theory and thereby inter-subjectively verifiable [208]. In this context the text analysis were performed using the following process [210]:

1. *Text selection:* The text selection determines underlying material of the analysis, which may only be altered during the analysis in certain cases.
2. *Situation analysis:* The situation analysis describes the conditions, under which the material has been generated. The author, the plot background, the target group of the research and the specific situation origin are essential.
3. *Formal characteristics:* Formal characteristics describe the form of the material. The starting point of the analysis is usually a specific text and spoken content as interviews / discussions (recordings), which have to be converted accordingly into text format (transcription). The entire procedure has to be documented. Furthermore formal characteristics describe what kind of data has been added and in what way the document has been created.
4. *Analysis focus:* The starting material can be analyzed in different directions. The analysis focus determines if, for example, the text object, the effect on the target group, or the background of a specific text should be considered in particular.
5. *Theory-driven differentiation of the issue:* The analysis follows a theoretically justified question / target position. Theory-driven implies a progress in knowledge, based on the gained experience over a specific research subject. Therefore the question of the analysis needs to be clarified.
6. *Definition of analysis method:* A summary, explication, structuring or a combination of the three methods can be selected as analysis method. A summary reduces the material to its main content. An explication adds further material to vague text parts for better understanding. Structuring filters specific aspects by fulfilling predefined criteria (Table 2.8).

Table 2.8 Analyzing Techniques, according to [210].

Analyzing Technique	Variants
Summarizing	Summarizing; inductive category definition
Explication	Strict explication, wide explication
Structuring	Formal, content, typecasting and scaling structuring

7. *Definition of analyzing entities:* The definition of analyzing entities determines the entity of codec, content and evaluation. The codec entity defines the smallest part of the text, which is allowed to be evaluated and can be categorized. The content entity defines the greatest text piece. The evaluation entity determines the ordered sequence of entities, which are to be evaluated.

This process is executed and documented for all conducted expert interviews. The individual executions are described within the corresponding analysis sections (Sect. 4.2.1, Sect. 7.2.3, Sect. 8.3.2).

3 THEORETICAL FOUNDATIONS

"EAM has become a prominent discipline for managing complex Business- IT relationships in organizations" [86].

This chapter introduces important foundations and concepts of this work. It describes the nature of enterprises, the characteristic environments in which enterprises operate and the architecture enterprises consist of. Furthermore, it addresses how changes can be implemented through strategies and how these are related to IT, because the seamless integration and coordination with IT is still a major challenge for enterprises. Based on that, enterprise architecture management (EAM) and its mediator role between business- and IT is outlined as well as the importance of its required EAM specific capabilities related to the mediator role. The characteristics of these enterprise-dependent EAM capabilities affect the success of business-IT alignment (BITA) considerably. The chapter initiates the research process by providing a fundamental introduction and definition of the term "capability" and an interim conclusion at the end of the chapter.

3.1 ENTERPRISES AND THEIR ENVIRONMENTS

Enterprises employ people, develop new technologies, produce goods and generate the wealth of nations. But what exactly is an enterprise? How can it be characterized? How is it structured? The term enterprise is used originally for activities reaching well-defined goals [9].

> *Enterprises are complex, highly integrated systems comprised of processes, organizational units, information and supporting technologies, with multifaceted interdependencies and interrelationships with their environments in terms of economic related activities [114,115].*

Nowadays the term could be used for a number of companies or institutions, which work together to reach a common goal. In this sense, an enterprise could be understood as a whole company, a business unit/ division, a government organization, a single department or a network of geographically distant organizations linked together by common goals [148]. Caused by industrial changes like automation, standardization and innovation, enterprises began to structure its economic position in a market by analyzing its *macro-*, *micro-* and *internal-environment* (Figure 3.1). The *macro-environment* could be structured by the help of the PESTEL dimensions that evaluate specific aspects like political, economic, social, technological, ecologic and legal aspects [114]. Requirements related to entities of the *macro-environmental* dimensions an enterprise can only respond without any influence i.e. legal regulations, economic fluctuations, political directions. The situation is somewhat different with requirements related to entities of the *micro-environment*. Since enterprises interact and negotiate continuously with their entities, it is possible to influence this environment. Consequently, enterprises are formal organizational structures, using resources of the respective environments for manufacturing and offering products or services.

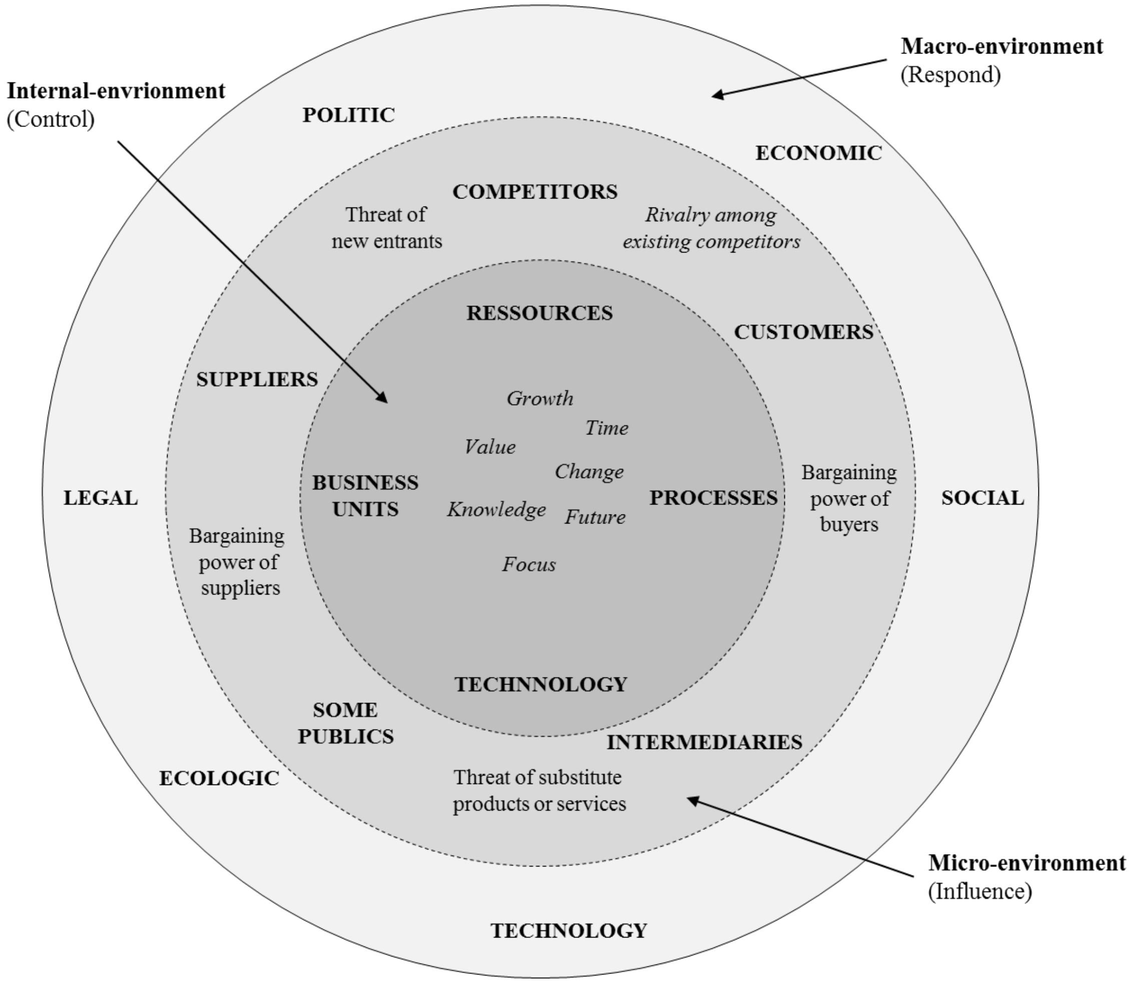

Figure 3.1 Enterprise and its Environments, according to [114].

In order to face challenges from mentioned environments, an enterprise has to plan, transform and control its internal structures. For instance, due to new legal regulations, global digitalization, fast changing business models and short technology lifecycles, agility, alignment and integration are typical success factors for enterprises' *internal-environment*. Furthermore, rights, privileges, obligations and responsibilities are collected and distributed over time and could lead to conflicts within an enterprise. Therefore, enterprises' internal structures need to be developed and re-architected continuously in terms of "*Enterprises are living things*" [141, p.67]. Thus, controlling the speed and quality of transformation initiatives represents a huge competitive advantage and is one reason for using capabilities.

Transformation, agility, alignment and system integration are main challenges of enterprises today [104] - to control the upcoming requirements, enterprises have to identify, to structure and to maintain its components with corresponding interrelation to each other which results in a highly integrated system [115]. In order to understand and manage this system, modelling it in a suitable structure with a suitable approach has to be established as a common procedure [9,116]. Enterprise modeling methods and resulting enterprise architecture models are suitable procedures and structures being introduced in the next section.

3.2 ENTERPRISE MODELS AND ARCHITECTURES

In this section, the concept of enterprise modeling and structuring architecture concepts are explained. *Enterprise modeling (EM)* is a process that creates an integrated, coordinated and multi-perspective enterprise model. This section contains previously published content of our related publication [15].

The modeling and mapping of integrated systems in an enterprise context to an architectural scheme has been a frequently discussed topic for years. EM by itself is not a new topic (enterprise modeling support of business processes has been around since 1960s), there is a large amount of literature dealing with this topic. The lack of a standardized, generally accepted definition is due to differing viewpoints as to how formal enterprise models should be and for what purposes they can be used. There are two common definitions by [110] and [111] describing the general purpose of enterprise modeling from an industrial and a scientific viewpoint. The following definition, proposed by Vernadat [110], has its roots in industrial organization and the field of enterprise engineering:

> "*Enterprise modeling is the art of externalizing knowledge which adds value to the enterprise or needs to be shared. It consists of making models of the structure, behavior and organization of the enterprise*." *[110,p.1]*.

Vernadat advocates an industrial approach, in which he regards an enterprise as being similar to a product and therefore divides it into modules and components, proportional to the complexity of handled products. The models, which are produced in enterprise modeling display the externalized knowledge structure of an enterprise, but are usually only a snapshot and therefore only valid for a short period of time. The participants in an enterprise modeling activity should be able to use these models to plan the enterprise's future situation or to allow new processes or structures to be designed, e.g. by using submodels for this purpose. They are principally intended for managers and employees in the enterprise. In other words, processing or execution by computer is not a priority. In contrast Fox and Gruninger [111] advocate a different view of what enterprise modeling is:

> *"An enterprise model is a computational representation of the structure, activities, processes, information, resources, people, behavior, goals and constraints of a business, government, or other enterprise. It can be both descriptive and definitional – spanning what is and what should be. The role of an enterprise model is to achieve model-driven enterprise design, analysis and operation." [111,p.1].*

In this approach of creating enterprise models, complete formal definitions of the information contained in each perspective are produced by rule sets. These are very well suited for computer-based enterprise model representation. The major benefit of this approach is that the enterprise model is formally described with a focus on executability and completeness, and thus allows already modeled components to be reused. For this reason, enterprise models are used in the context of knowledge representation and artificial intelligence. Moreover, the high degree of formalization is not entirely suitable for communication with executives or other decision makers. However, to model the integrated system of an enterprise the identification of distinct number of elements and perspectives is required, whereby this number and corresponding models can be huge. In order to structure and enhance comprehensibility of these models and sub-models different levels (layers) or views (perspectives, views) are used. Thus, the result of the different modeling activities is commonly joined to enterprise architecture (EA). Therefore and according to [131], this investigation uses the following definition:

> *Enterprise modeling represents the process of creating an integrated enterprise model, which captures the aspects of the enterprise required for the modeling purpose at hand. An enterprise model consists of a number of related sub-models, each focusing on a particular aspect of the enterprise, e.g. processes, business rules, concepts/information, vision/goals, and actors, which results in an Enterprise Architecture.*

Enterprise models include all required components to represent a certain situation. These representations could involve a great number of elements. In order to reduce complexity the concept of distinguishing and splitting the models into different views and layers evolves [145].

Next to the different EM interpretations evolving models can describe different situations of a company. In general we distinguish between current (as-is or baseline situation) and the target (to-be, future) situations and corresponding models. These two states represent a fundamental viewpoint for evolving enterprise architecture transformations and its management.

The beginning of describing enterprise architectures goes back to the 1980s and comprised the descriptions of structured collection of elements and models [120]. First publications focused on frameworks and architecture models were developed within research projects by universities and business associations [113]. The number of scientific publications in this field steadily increased in recent years [112,117,121]. Nevertheless, no common understanding of the term enterprise architecture has emerged yet [126,127], which could be confirmed by own research findings as well [65]. Thus, for example, the term enterprise architecture and the term enterprise architecture management are still used as synonyms [114], whereas EAM is demarcated in Section 3.3. Nevertheless, at least a basic understanding regarding the need of architecture layers and some basic elements has been established in the recent years and therefore, we start our disambiguation with the definition of the architecture concept.

The term *architecture* originates from the building and construction industry. The Latin term "*architectura"* includes the art to build and describe buildings. This art is based on different elements like techniques, materials, plans, tools and characteristics. In the context of IT the term has been used in various versions since the last century [9]. For example the ISO/IEC 42010.2011 describes its understanding of architecture as:

> *"Fundamental concepts or properties of a system in its environment embodied in its elements, relationships, and in the principles of its design and evolution." [118,p.2]*

Applying the definition on enterprise context, enterprise architecture could represent a formal declaration of basic structures of an organization, its components and relations, as well as the processes used for architecture development [145,146,147]. Therefore, an EA defines several layers and aims to cover these different enterprise-wide aspects. Buckl and Schweda [121] point out that an entire EA results from the number of the different architecture layers. Each layer represents an abstracted perspective of an enterprise like organizational- and operational structure, business model(s), IT, strategy or processes. In order to substantiate our argumentation, we use findings from [117] analysis of 608 EA research documents published from 1987 to 2010 by using different bibliometric and quantitative methods [117]. In line with [117] EA layers embody conceptual domains [122] that end up in the basic structure of an enterprise architecture model [123] by capturing related elements through the utilization of enterprise modeling techniques [124,145].

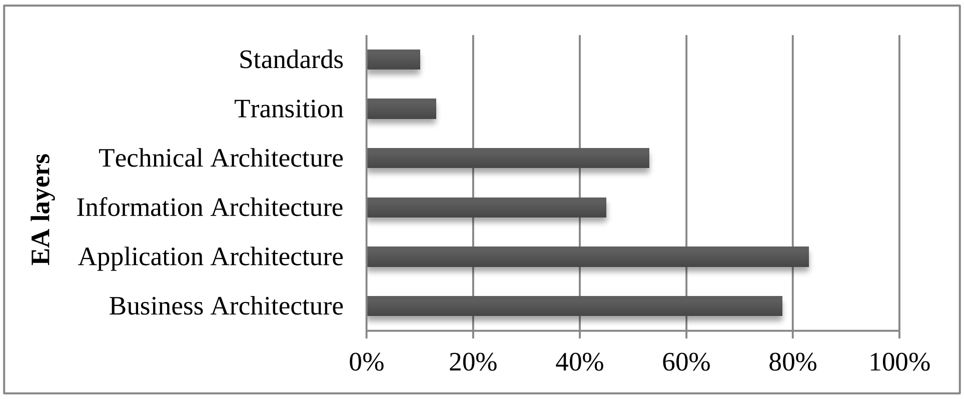

Figure 3.2 Covered EA Layers in scientific publications [117].

The respective literature review covers inter alia a content analysis of EA approaches. Figure 3.2 illustrates the findings regarding the question which architectural layers are most frequently discussed. 410 documents covered at least one of the following architecture layer: *business architecture* (78 percent), *application architecture* (83 percent), *information architecture* (45 percent) and *technical architecture* (53 percent) represent the most often used architecture concept. Layer concept concerning a *transition- or standard* perspective attracts with 13 percent and 10 percent less attention.

Consequently, the majority of publications understand business architecture and application architecture as the two basic EA layers. In terms of presenting our EA understanding we apply these layers for our work. Moreover, according to [145,146,147,148], we supplement this understanding by considering an information- and technical architecture layer and its elements as well (Figure 3.3). Architecture *elements* in this context are all entities that are required to define the character of its encompassing architecture layer like strategies, business drivers, principles, locations, budgets, domains, functions, processes, services, information, application, platform, infrastructure, hardware, etc. [148]

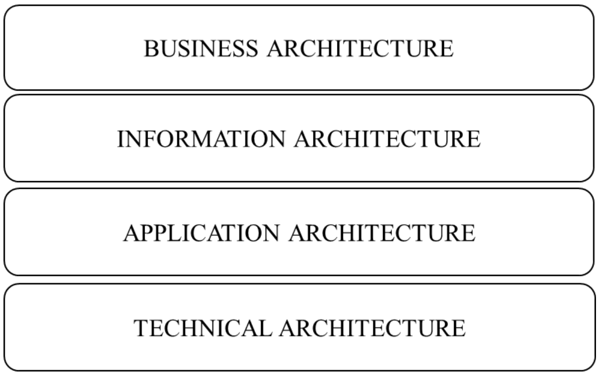

Figure 3.3 Typical Enterprise Architecture Layer.

In general *Business Architecture (BA)* describes the business perspective of an enterprise considering appropriated elements and relations like business processes, organizational units, goals, principles and/or strategy. Moreover, the BA can be further divided into sublayers considering additional elements for product and service development, creation and distribution as well as elements required for supply chain and operation purposes. Sublayers like business motivation-, model- and execution layer [144] or business strategy and business organization [145] are possible. The BA sublayers rely on the approach of [22]. The elements of the *business motivation* layer cover the strategic context of an enterprise [145,155]. The *Vision* characterizes a long-term overall view of how an enterprise either is or desires to be perceived in the future. The *Mission* defines the essential task(s) of an enterprise. *Values* describe the ideals of an enterprise, reflected for example by a code of conduct which influences actions taken of the enterprise. A *Goal* abstractly represents a desired state, which can be achieved by a series of steps and can be made measurable by linking indicators. *Directives* represent either action or implementation regulations such as policies, principles and rules. There are additional components, e.g. competitive forces (*Drivers*) and risks/ limitations (*Constraints*). The *strategy* describes the general course of actions to achieve a specific set of goals by channeling efforts towards objectives [22]. The elements of the *business model layer* involve perspectives about generating and distributing products or services to customers, generating revenues for these by considering required supplier and accruing costs [2,14,154,156]. According to [14,22] we consider six business model perspectives: *Unique value proposition* (value proposition including need, approach, benefit and competition of the product/service, design themes, branding), *supplier/partner perspective* (supplier/ partner segments, channels and relationships), *customer perspective* (customer segments, channels and relationships), *value chain perspective* (value chain configuration, coordination and cooperation, core assets, operating model), *financial perspective* (costs structure and revenue model). The *business execution layer* describes the governance structures (legal enterprise structures, organizational/functional/geographical structures), processes, resources (technical, human) and information entities. Furthermore, [22] allocates enterprise's capabilities in the business execution layer in form of a logical aggregation of its elements. Due to the focus of this investigation a deeper insight into the capability concept is delineated in Section 3.4.

The *Information* Architecture (IA) describes the information view of an enterprise in terms of its logical data assets and data management resources that handles data like business objects (e.g. customer, order, contract, invoice) [46]. Its instances, called business data, are manipulated by applications or appropriate elements of the IA. For this reason that IA can also be found in literature as *Data Architecture* (DA). An additional IA object examples represents information flow, which describes the exchange of business objects between a source and a recipient like business applications, software components or devices. An *Application Architecture (AA)* covers the logical information system view of the business. It could involve elements like applications, its variants and interrelations whereas it collectivity represents the enterprise's application landscape that provides business services for its required purposes. Moreover, concepts like service orientation or interfaces could be included in this layer. The *Technical/ Technology Architecture (TA)* includes all required elements to operate the application landscape. Therefore, the TA provides computing- and communication hardware, infrastructure and associated standards such as components, deployment, platform technologies, servers, networks, etc.

However, EA is accepted as an essential concept for ensuring agility and consistency, compliance and efficiency [145,149,150], but its concrete implementation can be derived from a rich set of frameworks, modelling approaches and specific circumstances considering the enterprise environments [9,157]. Appendix C1 provides frameworks guiding EA development initiatives.

For our investigation no precise EA element definition is used, because the presence of certain architecture elements (enterprise architecture perspective) must be only provided for the artifact development, but not its individual design. Thus, it is essential that an enterprise at least is open to EA-oriented thinking and understands its value. Nevertheless, in order to provide examples for upcoming explanations we exemplary assign a set of elements to the defined architectural layers illustrated in Figure 3.4.

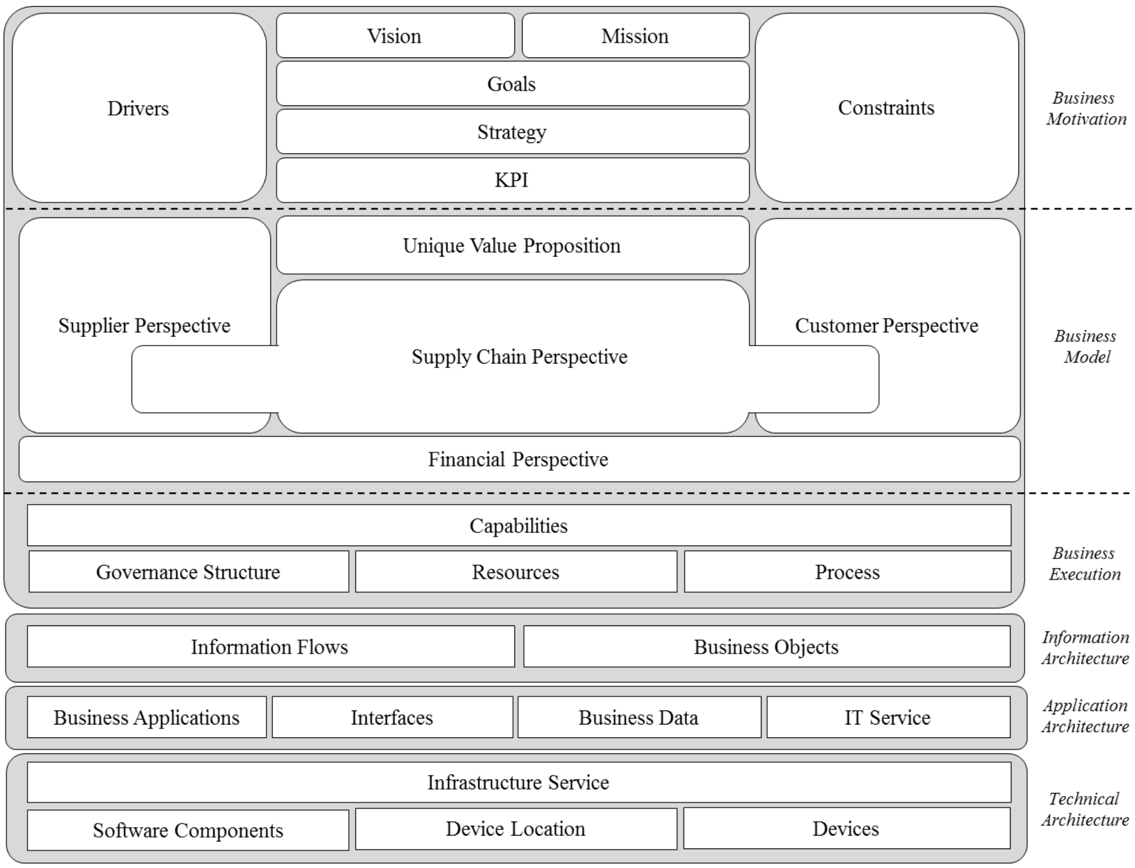

Figure 3.4 Enterprise Architecture and Characteristic Elements, adapted from [59,144].

Why is the knowledge about the enterprise architecture crucial for an organization? The Institute for Enterprise Architecture Development (IFEAD) published studies on this subject in the years 2003 to 2005 that identified the main reasons for creating enterprise architectures of an organization. In accordance with these studies, organizations consider the planning and realization of strategies, business models and corresponding processes including IT support as well as the support of the decision-making process as important booster. The importance of respective key success factors has continuously increased over time until now [54, 56]. In 2015 an analysis of the Gartner Inc. Institute predicts that approximately 95 percent of all questioned organizations used approaches regarding enterprise architecture topics [55].

EA means the comprehensive structure of an organization with all dependencies of the artifacts necessary for business performance. In this context, the observations are not limited to relations, which describe the connections between IT, processes or roles, but also include dependencies of goal- and problem hierarchies from business plans. In order to optimally support these goals, decisions must be allowed transparently and comprehensibly, considering their positive and negative consequences on existing structures.

In the future it becomes increasingly important to allow an integrated view on the enterprise, which replaces views of single separate business- and/or IT silos. This attitude of a holistic architecture is used to evaluate and refine IT in accordance with the business strategy, which may generate benefits in case an enterprise is able to derive answers to the following questions in a short time:

- Which applications have to be adjusted when a new business strategy is implemented?
- How quickly and with what impact either a merger & acquisition or new business model could be integrated?
- What are the effects in case previous legacy systems have to be replaced?
- Which systems are affected if a certain application component version (e.g. operating system, database, middleware) is no longer supported?
- How can the amount of technology and application platforms be reduced?
- Are IT-supported processes in compliance with statutory requirements/ rules?

A well-designed enterprise architecture helps to reply to respective questions. On the other side documenting enterprise architecture is only efficient in case it satisfies specific quality criteria [13] such as a cultivated, updated and high quality information base or clear allocation of responsibilities. However, these criteria consume additional resources. In order to make best use of respective resources, a structured management approach is required. The enterprise architecture management represents such a structured approach and is applied to coherently plan, implement and govern the way from current-state- to the future-state architectures under consideration of corporate strategy targets. The next section examines the theoretical foundations and relationships between corporate strategy management and enterprise architecture management.

3.3 STRATEGIC ENTERPRISE ARCHITECTURE MANAGEMENT

An enterprise represents an entity, which is involved in a set of economic activities. It consists of a variety of subsystems influencing its environments (Sect. 3.1). Influencing factors of the *internal-, macro- and micro environment* have to be considered and enterprises are required to combine its capabilities in an optimal way in order to respond agile and cost effective. This is done through adjustments and transformations activities, which in turn require accompanying approaches for its execution in terms of *Strategy-* and *IT- Management* views [160,178,179].

3.3.1 STRATEGY MANAGEMENT

The origin of *management* can be traced back to the 1920s and generally implies activities like planning, organizing, staffing, directing, coordinating, reporting, decision making, budgeting and controlling [172]. These functions represent major management tasks excluding specific focus, instruments, methods or stakeholders. Obviously, the variety is wide and it primarily depends on the management focus. IT and business management are examples for different focus areas that require different management strategies in order to align enterprise`s operations towards achieving the defined goals [158,178,180].

The term "*strategy*" originally comes from the military field and represents an adjustable construct used to transform an actual state into a target state [158,159,160]. In general, strategies could be understood as impulses for actions to be taken to reach defined goals.

> *"Goals state what is to be achieved and when results are to be accomplished. But they do not state how the results are to be achieved. All organizations have multiple goals existing in a complex hierarchy […]."[173,p.44].*

Therefore, a strategy refers to a complex set of "*[…] thoughts, ideas, insights, experiences, goals, expertise, memories, perceptions and expectations[…],* [158]" to find, implement and control an optimal set of actions.

> *"A strategy is the pattern or plan that integrates an organization's major goals, policies, and action sequences into a cohesive whole. A well-formulated strategy helps to marshal and allocate an organization's resource into a unique and viable posture based upon its relative internal competencies and shortcomings, anticipated changes in the environment, and contingent moves by intelligent opponents."[173, p.44].*

Since 1965 planning and controlling functions generally contain strategic, organizational and technical perspectives [162]. The perspectives, its tools and effects have to be controlled, consciously selected and maintained. *Strategic aspects* mean the position of an enterprise towards customers, suppliers and competitors. The *organizational aspects* are differentiated in structural and procedural organization. The *technical* aspect includes the security, data and systems elements. Enterprise-wide and integrated management tries to control the system holistically. It is assumed that there are not enough information at no time to act determined. Consequently, documenting information states of the past, the present and the future represents a useful concept. Plans are derived from these states. The main challenge is to extrapolate which decisions are responsible for the present situation. For analyzing, different strategy approaches with different governance and controlling mechanisms could be differentiated [179].

One common approach for strategy classification distinguishes between *intended* and *deliberate strategies* evolving from prescription theories and *emergent strategies* from description theories [178,184]. [184,188] understand both types as poles which leaves a range for hybrid-types i.e. *deliberately emergent strategies*. *Intended strategy is* characterized as top-down approach by precisely articulated goals considering the right level of details for its communication to its recipient within an enterprise in order to implement defined goals. The *deliberate strategy* represents the part of an intended goal that an enterprise continuously pursues over a given period of time. *Emergent strategies* are characterized as bottom-up approach that is self-improving during operations and do not define goals and its achievement a priori. Therefore, enterprises execute a set of consistent actions over time that forms unintended patterns and enterprises discover and extract profitable behaviors and methods of operations from those. *Emergent strategies* arise in response to unexpected opportunities and challenges from the different *environments* (Sect 3.1). Finally, *realized strategies* are those, which an enterprise currently follows and represents the combination of its *intended*- and *deliberate* strategy by considering *emergent strategy*.

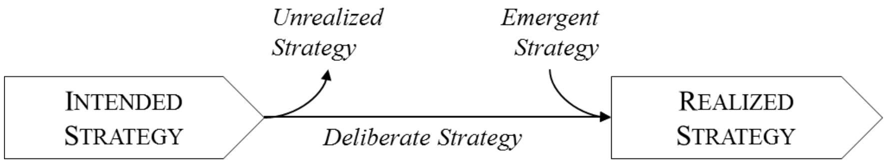

Figure 3.5 Formation of the intended, deliberate, emergent and realized Strategy Concepts [184].

The basic difference between the two input strategy types for a realized (implemented) strategy could be characterized that the deliberate is focused on direction and control in order to achieve defined target situations on the one hand, whereas emerging strategy creates opportunities in terms of agility and strategic learning on the other hand. Table 3.1 shows some examples for the different strategy classifications in which "Planned" represents the deliberate strategy pole and "Imposed" the emergent strategy pole.

Table 3.1. Features of different deliberate and emergent strategies [188].

Strategy Type	Characteristics
Planned	Strategies originate from formal plans: precise intentions exist, formulated and articulated by central leadership, backed up by formal controls to ensure surprise-free implementation in benign, controllable or predictable environment; strategies most deliberate.
Entrepreneurial	Strategies originate from central vision: intentions exist as personal, unarticulated vision of single leader, and so adaptable to new opportunities; organization under personal control of leader and located in protected niche in environment; strategies relatively deliberate but can emerge.
Ideological	Strategies originate from shared beliefs; intentions exist as collective vision of all actors, in inspirational form and relatively immutable, controlled normatively through indoctrination and/or socialization; organization often proactive vis-à-vis environment; strategies rather deliberate.
Umbrella	Strategies originate from constraints: leadership, in partial control of organizational actions, defines strategic boundaries or targets within which other actors respond to own forces or to complex, perhaps also unpredictable environment; strategies partly deliberate, partly emergent and deliberately emergent.
Process	Strategies originate from process: leadership controls, process aspects of strategy (hiring, structure, etc.), leaving content aspects to other actors; strategies partly deliberate, partly emergent (and, again, deliberately emergent).
Unconnected	Strategies originate from enclaves: actors(s) loosely coupled to rest of organization produce(s) patterns in own actions in absence of, or in direct contradiction to, central or common intentions; strategies organizationally emergent whether or not deliberate for actors(s).
Consensus	Strategies originate from consensus: through mutual adjustment, actors converge on patterns that become pervasive in absence of central or common intentions: strategies rather emergent.
Imposed	Strategies originate from environment: environment dictates patterns in actions either through direct imposition or through implicitly pre-empting or bounding organizational choice; strategies most emergent, although may be internalized by organization and made deliberate.

There is no universal consensus within the academic discourse which strategy type is better than the other, because each type has its advantages and disadvantages for certain situations. Therefore, a suitable strategy formulation is up to the enterprises' environments and should be individually chosen for a given situation. Thus, a successful strategy implementation already depends on the capability to choose the right strategy type or rather a similar set of actions that could be assigned to a strategy type.

Strategies enable enterprises to focus its operations and resources to develop strengths and support their stakeholders to work toward common goals and evaluate options how to implement those goals [12,178,179]. Those implementations affect an enterprise as a whole [179] in terms of transforming a current state into a target state that is characterized by a specific goal set. Thus, strategies serve as a mediator between goals and their realization by providing action catalogs for transformations considering elements such as directive, values, constraints, and drivers. In reference to the coherence of goals and strategies as elements of a BA also an extensive influence on all other levels of the enterprise architecture could exist (depends on EA model and transformation details) [175,179]. In terms of strategy planning and implementations considering or forecasting effects of transformations within the EA structures could enhance enterprises' effectiveness [178,179,181,182].

"Enterprise Transformation is driven by experienced and/or anticipated value deficiencies that result in significantly redesigned and/or new work processes as determined by management's decision making abilities, limitations, and inclinations, all in the context of the social network of management in particular and the enterprise in general." [138,p.280].

Consequently, strategies and occurring transformations should be supported by an iterative, structured, overarching, organization-wide set of management functions that aligns decision-making, planning, execution and monitoring with an enterprise's long term goals, called strategy management.

Strategy management comprises all activities that guide and control the realization of strategies by planning, analysis, implementing and controlling desired enterprise transformations [174].

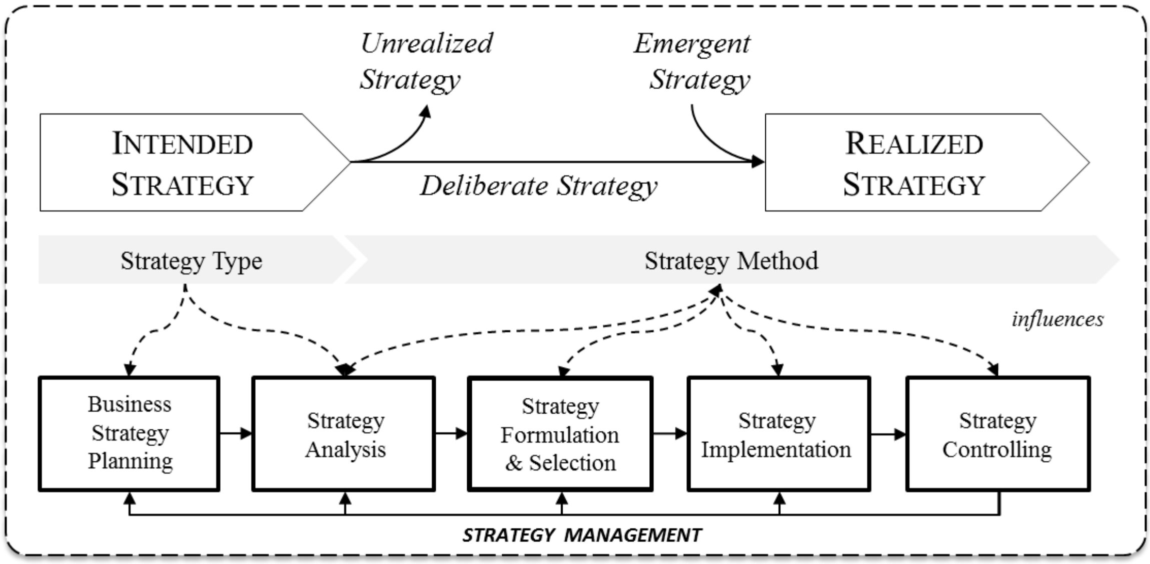

Figure 3.6 Overview Strategy Management Process, adapted from [142,184].

The process starts with a *business strategy planning* phase where vision, intentions, standards and prioritized long term goals are articulated and backed up by corporate controls to ensure goal implementation quality [174]. The *strategy analysis* step identifies crucial information to understand enterprise's current situation from an internal-, micro-, macro- environment perspective (Figure 3.1) using e.g. SWOT, balanced scorecard, gap analysis, regression models, trend analysis or computer simulations [183]. The review of the analysis phase represents a major activity of the *strategy formulation and selection phase* for reflection, prioritization, development of scenarios/ options, making decisions and defining objectives for execution. Within the *strategy implementation* phase initiatives, projects and action plans are executed and firmly embedded within the operational and organizational structure fulfilling defined objectives. *Strategy controlling* measures formulated controls, performance indicators and/or objectives in order to review the status of achieved results and compares these with defined goals (e.g. gap analysis, balanced score card) from the first step. Controlling results are input for next iterations. In order to support the different strategy management process steps [125] provides a set of methods, which we mapped on strategic management process (Table 3.2).

This allocation shows exemplarily that there are already a number of established methods, which are used as part of the strategy management. The understanding and methodical connection to the strategy management will be a task of the EAM later (Sect. 3.4).

Table 3.2 Selection of Strategy Methods and its relation to the Strategy Management Process, adapted from [125].

Method	Objective	Concepts	Inputs	Outputs	Relation to strategy management process
Business Model Canvas [156]	Develop a new business model or document and refine an existing one.	Key partners, Key activities, Key resources, Value proposition, Customer relationships, Channels, Customer segments, Cost structure, Revenue streams	How a business is generating value or how it intends to generate value.	Overview of the nine building blocks that can help an organization create, deliver & capture value.	*Strategy Planning*
Five Forces Framework [318]	Analyze all the competitive forces from an enterprise's industry.	Bargaining power of suppliers, Bargaining power of customers, Threat of new entrants, Threat of substitute products/services, Competitive rivalry in an industry	Information about the industry of an enterprise.	Analysis of the most important five forces from the industry that can have an impact on an enterprise.	*Strategy Analysis*
Quantitative Strategic Planning Matrix [321]	Selections between alternative strategies that are built upon environment factors from an enterprise's environment.	Key factor statements, Alternative strategies, Weights, Attractiveness score, Total attractiveness score, Sum total attractiveness score	Internal, micro- & macro environment factors, & the alternative strategies that can be chosen.	Differentiation between the alternative strategies based on their attractiveness score.	*Strategy Formulation and Selections*
Business Case [324]	Thoroughly motivate the initiation of a project. Aid in the allocation and prioritization of resources between multiple existing and future projects that are going to run simultaneously.	Define business drivers and investment objectives; identify the benefits, measures and owners; structure the benefits; identify the organizational change; determine the explicit value of each benefit; identify costs and risks	Information about the projects & their objectives, stakeholders, changes that might occur.	Detailed overview of the most important implications of starting a specific project.	*Strategy Implementation*
Balanced Scorecard [325]	Monitor and evaluate the progress and success of the implementation of the defined goals and strategy.	Objectives: Financial, Customer, Internal processes, Learning and growth; Measures, Targets, Initiatives, Outcomes	The Financial, Customer, Internal processes, Learning and growth objectives.	Set of measurements, targets, & initiatives for the defined goals.	*Strategy Controlling*

Modern strategy management approaches usually concentrate on customers and market positioning of its products and/or services that should be supported by high flexible digitalized business models. In this context, agility, speed and complexity of enterprise architecture transformation represent challenges [163]. These challenges need a distinct set of methods considering different enterprise perspectives. In this sense enterprise complexity can be measured by relations between processes, roles, organizational units, resources, applications, IT infrastructure, locations or information flows [315,316]. Many of these complexity-relevant relations are increasingly caused by elements in technically oriented architecture levels, which are managed by IT management and which will be discussed in the following section.

3.3.2 IT- MANAGEMENT

The *strategy management* determines the schedule how to set up strategic potentials for the success of an enterprise to put it in a competitive position. The strategic potentials for success are generally understood as structures of all enterprise relevant conditions, which must be available when you want to achieve strategic objectives [303]. Due to the increasing digitalization of the last decades, the relevance of IT has increased significantly and is now one of the most important areas [314,319].

Nevertheless, the complete integration and alignment of IT with the business strategy is still challenging for enterprises. Caused by the technical separation of business and IT in the past decades, IT departments have focused on introducing technologies and their stable operation [310]. Furthermore, it was assumed that complex systems can be controlled by vertical separation of technology (e.g. business applications, business objects, business data and databases). However, the resulting divisions increased complexity with regard to no overarching view, high coordination efforts and investments were difficult to evaluate [326].

In recent years a paradigm shift took place increasing service-orientation putting more emphasis on business requirements and impact to enhance the quality of IT support/implementations. Thus, the position of IT has shifted from an isolated unit to an integral part of strategy management, which could be actively used for building up new competitive advantages. This service-oriented support requires a higher sensitivity of enterprises towards the interaction of strategy management, customers, IT systems and organizational units, which is supported by an own management discipline.

> *IT management is responsible for the effective and efficient design and use of IT resources of an enterprise. It strives to continually improve the performance of IT considering economic efficiency and the requirements of the strategy management.*

ITM ensures optimal provision and operation of IT services and infrastructure to provide the best support to business processes relying on it [103]. IT Services and its operation are essential for all processes in a company supervised by the IT Service Management that cares for "*any component that needs to be managed in order to deliver an IT service*" [312] what in turn includes the IT Infrastructure. According to [334], ITM improves a set of enterprise-wide affecting aspects such as service standardization and quality, customer satisfaction and enhances the ROI of IT expenses. Therefore, IT in enterprises has a much higher strategic importance nowadays due to IT being part of products and services in new digital business models. In this context, the strategic focus has to be linked to the enterprise, which must be ensured by a corresponding process and suitable methods.

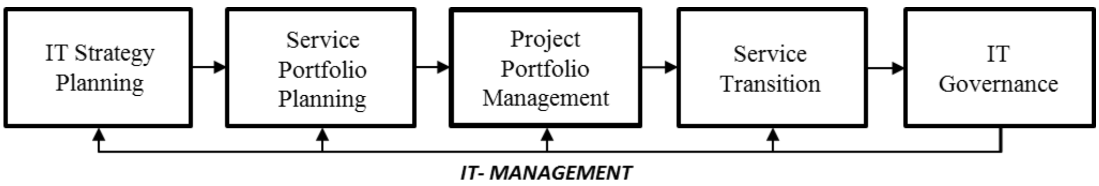

Figure 3.7 Overview IT- Management process.

Figure 3.7 illustrates a typical ITM process, that starts with *IT strategy planning* specifying KPI, responsibilities and budgets as well as considering business requirements. The *service portfolio planning* step checks whether the existing service portfolio can already fulfill the requirements (e.g. fit for demand evaluation) or whether new services need to be developed (possibly by recombination, bundling). Evaluating and prioritizing project proposals as well as implementation are part of the *project portfolio management* phase. The *service transition* phase primarily delivers and checks formulated IT- services and ensure quality of releases and deployments implemented by the previous phase. *IT Governance* reviews risk, compliance, maintenance and security issues of planned and achieved results and compares these with defined indicators of first step. In order to support the different ITM phases [326,330] provides a set methods, which are assigned to the phases of the ITM process (Table 3.3). This allocation illustrates that there are also well-established methods, equally to the strategy management, which are used for certain components of the ITM. Thus, the understanding and methodical connection are also important tasks for the EAM (Sect. 3.4).

Table 3.3 Selection of IT- Management methods and its relation to the ITM process, adapted from [326,330].

Method	Objective	Concepts	Inputs	Outputs	Relation to ITM process
ITIL [331]	Indicates which processes, roles and responsibilities are necessary for administration and operation of the IT infrastructure.	Service Strategy, Service Design, Service Transition, Service Operation, Continual Service Improvement	Budget, services, Strategies, customers, patterns of business activity, resources, requirements	26 individually customized core processes, which describe the components and processes of IT service management of an enterprise	*IT Strategy Planning, Service Portfolio Planning, Service Transition*
CobiT [332]	Framework for managing, planning, procurement, processing and monitoring of all applied resources in IT processes	EDM – Evaluate, Direct and Monitor, APO – Align, Plan and Organize, BAI – Build, Acquire and Implement, DSS – Deliver, Service and Support, MEA – Monitor, Evaluate and Assess	Principles, Policies and Frameworks, Processes, Information, Organizational Structures, Culture, Ethics and Behaviors, Services, Infrastructure and Applications, People, Skills, Competencies	210 process practices (over 1,000 process activities) to govern IT processes.	*IT Strategy Planning, IT Governance*
PMBoK [393]	Process-oriented project management standard, which describes corresponding methods, tools and procedures for each step.	Integration, scope, time, cost, quality, HR, communication, risk and procurement management, strategic scoring, NPV, IRR	Project charter, schedule, resources, change requests, organizational process assets (e.g. policies, standards, culture, practices)	Priotized project portfolio, ready to use service(s) generated by a PM process.	*Project Portfolio Management*

In order to support or enable business strategies ITM itself constantly faces new technological and organizational challenges. In this context, the Table 3.4 shows an analysis of IT trends survey results, which surveyed companies about major technology -related challenges and trends since 2005 [335]. In the last 13 years, BITA was mentioned nine times as the most recurrent high-priority goal in ITM, followed by objectives regarding business agility / flexibility, business productivity / efficiency, cost reduction, speed and security.

Table 3.4 Overview IT- Management concerns 2003-2015, according to [335].

ITM goals	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005	2004	2003
Alignment of IT with the business	**1**	1	1	2	1	3	2	1	2	1	1	1	1
Security/ Privacy	**2**	2	7	9	8	9	9	8	6	3	2	3	3
IT Time-to-Market/Speed of IT Delivery	**3**	5	New; was with "Velocity" in 2013, and "Agility" through 2012.										
Innovation	**4**	8	Introduced in 2014.										
Business Productivity/ Efficiency (a)	**5**	4	3	1	4	1	1	7	4				
IT Value Proposition in the Business	**6**	6	Introduced in 2014.										
Business Agility/ Flexibility (IT) (b)	**7**	13	Introduced in 2014; "Architecture Agility" in 2008										
Cost Reduction/ Controls (IT) (c)	**8**	17	5	5	10	8	5	7	4	5	10		
Agility/ Flexibility (Business) (b)	**9**	3	2	3	2	2	3	13	17	7	-	5	7
Cost Reduction/ Controls (Business) (c)	**10**	9	4	Combined with "Business Productivity" through 2012.									

(a) "Business Productivity" and "IT Efficiency" were merged into a single "Productivity/Efficiency" category with separate Business and IT items to select.
(b) "Business Agility/Flexibility" and "IT Agility" were merged into a single "Agility/Flexibility" category with separate Business and IT items to select.
(c) "Business Cost Reduction/Controls" and "IT Cost Reduction/Controls" were merged into a single "Cost Reduction/Controls" category with Business and IT items to select.
(-) Blank cells, unless otherwise noted, indicate that the issue was not asked in that year of the study

Additionally, the survey identifies that ITM *"[…] is becoming more strategic and business-focused; and it appears that organizations are becoming more digitized with their focus shifting away from tactical and operational IT issues like efficiency, service delivery, and cost reduction to more strategic and organizational priorities like business agility, innovation, the velocity change in the organization, IT time to market, and the value of IT to the business."*[335,336]. Thus, IT is getting more and more efficient, but at the same time it becomes more complex.

To handle the aforementioned concerns an enterprise-wide and integrated management approach is required to mediate and control upcoming alignment, agility and productivity issues. Therefore, the discipline of EAM is a proven concept [12,151] and is going to be introduced in the next section.

3.3.3 ENTERPRISE ARCHITECTURE MANAGEMENT

Elements from different enterprise departments and corresponding architecture levels are also inevitably affected by strategy implementation. Hence, planning, analysis, formulation, implementation and monitoring of respective architectures are main activities of EAM. In this context, literature often refers to business-IT alignment (BITA), whose key activities are caused by the theoretical and managerial separation between business and IT [11].

> *Business-IT alignment (BITA) refers to all activities dealing with coordination / harmonization of business areas and IT sector, which develop with different speeds on strategic, tactical and operational level.*

In this context, the fundamental challenge of BITA is represented by the lack of an overarching understanding as well as different speeds in implementing changes, which has gained much more attention through the increasing usage of IT in recent years, both by theorists and practitioners [104,109]. Referring to this, improving the harmonization has both financial and structural advantages for enterprises [105]. Advantages are e.g. improving enterprise-wide aspects like shortening the coordination processes, reducing risk of project failures, making value contribution of IT more transparent and accelerating the implementation of change, which will not affect the flexibility of an enterprise at last [11]. Nevertheless, numerous scientific papers and the high-priority interest of companies demonstrate that this issue is of utmost importance for the future [105,306,Appendix B1]. Thus, BITA is a key task for enterprises, which have high dependency between business units and IT [108,109]. EAM has been developed as a proven solution for this key task in recent years. Achieving corporate goals by implementing strategies leads to transformations within business- and IT. Figure 3.8 shows the mediating role of BITA and the relationship to EAM, which takes over the coordination between these two perspectives as a management approach.

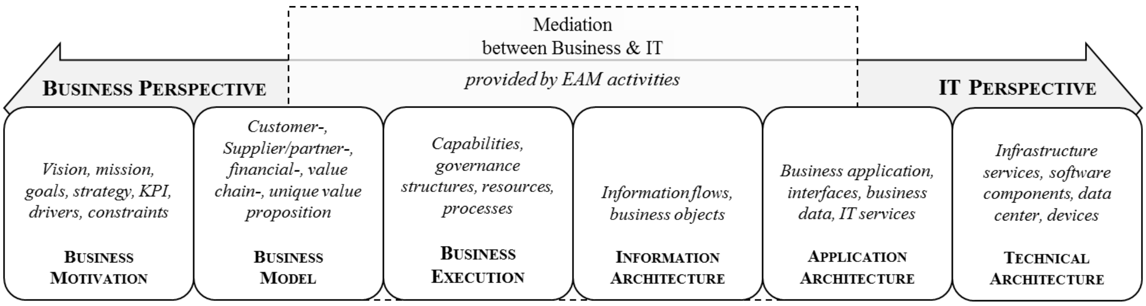

Figure 3.8 Enterprise Architecture Management as mediator between Business and IT perspective.

The business perspective is characterized by elements of the *business architecture* (Sect. 3.2) e.g. goals, business model and their realization in value chains or processes considering motivational elements like corporate policies & standards, constraints, and drivers. The IT perspective could be characterized (among others) by elements of the *information, application and technology architecture* like information flows, business application landscape, middleware, networks or hardware resources. In order to harmonize both perspectives EAM horizontally *"[…] aligns business change with technology and vice versa*". Vertically, EAM *"[…] integrates strategic directions with tactical concepts, design decisions, and operations*" [12]. According to [12,307], EAM supports a variety of horizontal- and vertical activities, such as:

- Alignment of IT strategy and its implementation to business strategy requirements in order to support corporate goals.
- Design and development of business models with right balance between IT efficiency and business innovation.
- Management and exploitation of information flows to provide strategy- and IT management with desired information, which are key to business success and competitive advantage.
- Management of business concerns that need to be addressed by application design and IT landscape configuration.
- Enhancing transparency by reducing the effort for collecting information relevant for decisions.
- Reducing complexity costs.
- Reduction of project implementation risks by monitoring architecture relevant changes.

According to [12], Figure 3.9 illustrates which architecture levels are affected by business- and IT strategy and which core activities have to be coordinated on the respective architecture layers. Consequently, EAM involves a set of management practices and multi-perspective architectural knowledge in order to reach harmonized enterprise-wide transformations and represents a holistic way to understand, plan, develop and control organization´s architecture.

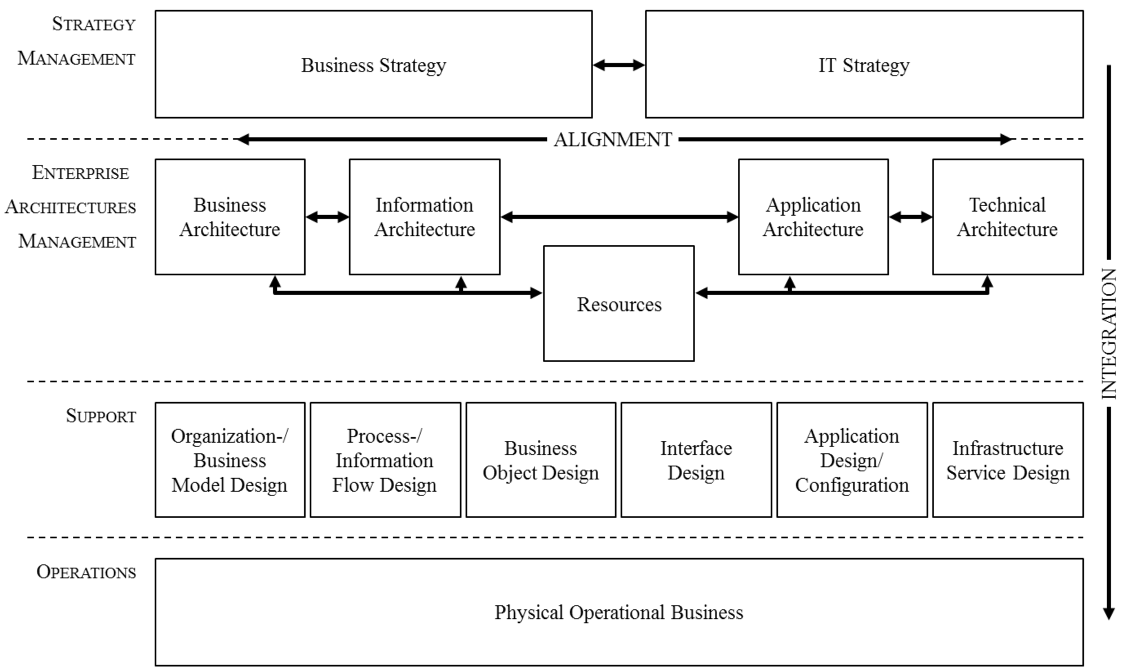

Figure 3.9 Alignment and Integration Activities, adapted from [12].

According to [121] EAM could be understood as "*[…] a continuous, iterative (and self-maintaining) process seeking to improve the alignment of business and IT within an (virtual) enterprise. Based on a holistic perspective on the enterprise provided with information from other enterprise level management processes it provides input to, experts control over, and defines guidelines for other enterprise management functions.*" In order to align both perspectives successfully, former and upcoming as well as (inter) dependencies should be known and discussed. Therefore, it is important to continuously gather information about organizational knowledge, corresponding responsibilities, available resources and processes required for the strategy implementation by using appropriate mechanisms [104]. If not, problems are emphasized by the fact that e.g. business critical projects fail in 2 out of 3 enterprises, because decision making failures are caused by conflicting interests, insufficient information quality or decisions taken elsewhere [61]. EAM can be understood as a discipline of the IT- Management [308], the Strategy Management [309] or even a separate one. In this work EAM is described as a separate management discipline..

> *"EAM is defined as a management practice that establishes, maintains and uses a coherent set of guidelines, architecture principles and governance regimes that provide direction and practical help in the design and development of an enterprise's architecture to achieve its vision and strategy." [12,p.3]*

Consequently „*EAM builds on the transparency provided by EA models and documentation of the as-is and to-be situations, but includes the continuous process of developing, realizing and operating the EA*" [12, p.19] and thus it includes management functions like understand, plan, change/transform and control/monitor organization's architectures. Figure 3.10 illustrates these general EAM functions within strategy- and IT perspective. EA models provide information about the as-is structure of an enterprise and thus serve as an informational basis for decisions within the strategic analysis. Based on strategic objectives of the strategic dialog the change of the as-is architecture is planned and produces outcomes like to-be architecture considering corporate strategy aspects, migration plan and EA principles. This information provides the basis for the IT strategy and service portfolio planning. The transformation step guides the changes by delivering advisory services and compliance test for the affected organizational units considering IT project proposals. Within these units, projects execute the change, which are monitored by the EAM from an EA. In terms of a successful strategy implementation the monitoring step delivers the as-is architecture as input for strategy controlling, whereas the IT management delivers all required information.

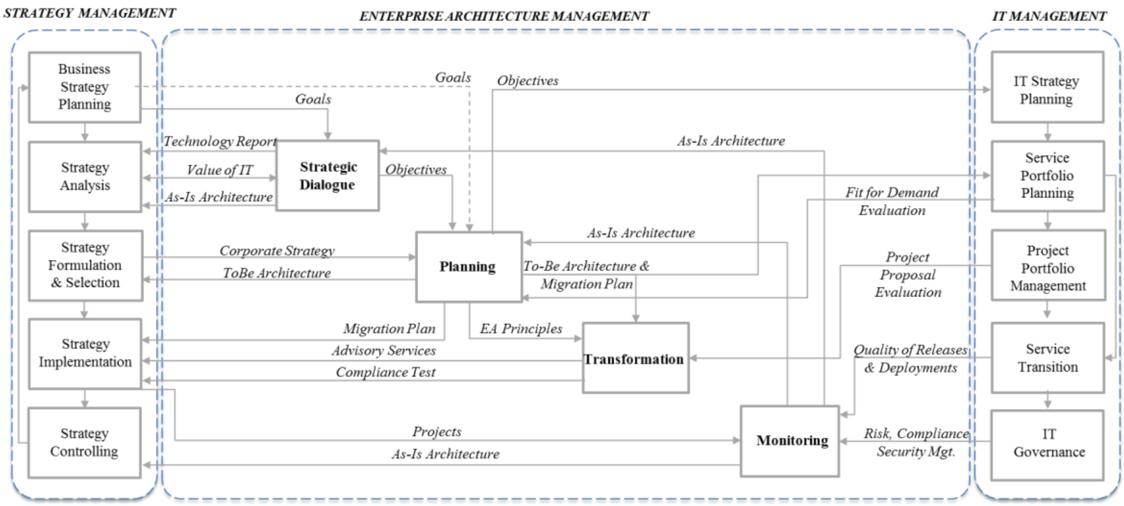

Figure 3.10 The Role of Enterprise Architecture Management, according to [13,142].

To get deeper insights to the EAM activities we introduce an adapted version of EAM navigator proposed by [12]. Therefore, Figure 3.11 shows the EAM process integration approach that comprises a strategic dialog cycle, planning cycle, transformation cycle and operation and monitoring cycle based on [12,13,187].

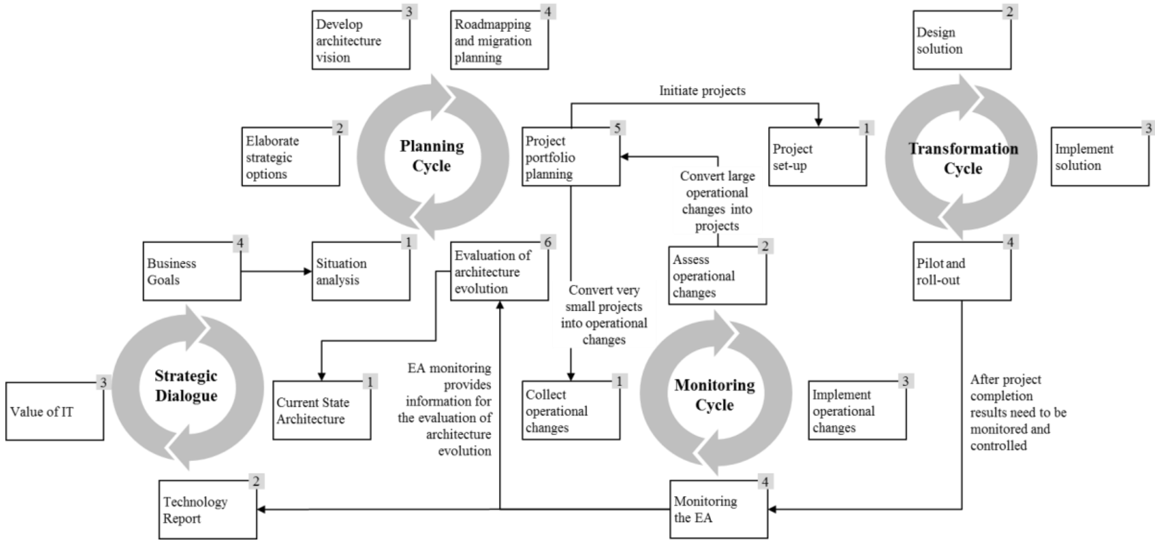

Figure 3.11 EAM Process Integration, adapted from [12].

- *Strategic Dialogue Cycle*: Interactive and multidisciplinary alignment of strategic business goals served as input for the situation analysis of planning cycle in addition to different reports on value of IT, current state architecture and technology trends.
- *Planning Cycle*: EA development and transformations are mostly long term and incremental set of activities. This cycle takes the output from strategic dialogue and planning step (Figure 3.10) into account and links strategy management to EAM from the process point of view. Besides analyzing the current situation and elaborating strategic options, this cycle develops migrations paths to transform existing architecture elements with respect to business goals and creates a shared understanding of multi-perspective dependencies. Moreover, the planning step structures the project portfolio by prioritization of intended projects considering its strategy contribution, synergy potentials with other projects and budget restrictions.
- *Transformation cycle*: Initiatives programs or single projects represent a common instrument of organizations to execute EA transformations, because they are temporary, clearly scoped and staffed with resources. This cycle includes the definition of typical project management activities like the definitions of milestones, provision of information, staffing, escalation handling, implementation and rollout reporting.
- *Monitoring:* In order to track the quality of short term operational changes and/or mid-/long term enterprise wide transformation initiatives, companies define suitable key performance indicators (KPI). Measuring, risk and compliance checks are additional activities to execute and evaluate adherence to goals, principles-, policies- and security standards.

The purpose of these frameworks is to coordinate the business goals with the IT. According to [9], EAM is supported by a set of different management frameworks as well as guidelines and best practices [86,Appendix C1]. Table 3.5 shows an overview of a variety of frameworks, which additionally includes a process methodology besides the EA and management focus. As part of its mediator role EAM uses the outputs of the presented methods for strategy management and IT management as inputs (Table 3.2, Table 3.3). In this context, an EAM framework is understood as a common practice for modeling, interpreting, analyzing, controlling and maintaining EA in order to support alignment and transformations by establishing required processes and methodologies.

Table 3.5 Selection of EAM Frameworks its relation to the EAM process, according to [9].

EAM frameworks (*)	Description	Inputs	Relation to EAM Process
TOGAF - The Open Group Architecture Framework [146]	Comprehensive framework for the design, planning, implementation and maintenance of enterprise architectures.	Depending on the used methods in the respective enterprise of Strategy Management (Table 3.2), and the IT management (Table 3.3).	*Strategic Dialogue, Planning, Transformation, Monitoring*
GERAM – Generalized Enterprise Reference Architecture and Methodology [168]	Allows modeling all information and communication systems and all enterprise processes necessary for the design, deployment and maintenance. According to the generalized characteristics of the GERAM reference model, it defines a sequence for IT projects as well as enterprise engineering and integration projects.		*Strategic Dialogue, Planning, Transformation, Monitoring*
E2AF – Extended Enterprise Architecture Framework [374]	Reference model including a 4-step method to expand business architecture to an Extended Enterprise Architecture (E2A).		*Strategic Dialogue, Planning*
EAP – Enterprise Architecture Planning [376]	It is seen as a supplement to the conceptual Zachman EA Framework. For this purpose, it provides a methodology for implementing scope / planner and enterprise model / owner, starting with project initiation through to implementation.		*Planning, Transformation*
ARIS – Architecture of Integrated Information Systems [373]	Framework and tool set for primarily modeling and optimization of business processes. In this case, it performs a structuring in five perspectives and supports each respective view with a consistent description, starting with the economic problem to implementation of data processing.		*Transformation*

** Not included government-, military-, manufacturing-specific-, technology-focused- or interoperability framework, It should be noted that this is only a selection of possible EAM frameworks - a comprehensive overview is provided by [9,221].*

Finally, strategic decisions are usually taken with incomplete knowledge (considerable uncertainty) that results from an unsatisfactory supply of information in terms of quality and quantity. Consequently, the assessments of possible architectural effects are incomplete as well. EAM tries to avoid this situation by using frameworks. Consequently, the availability of an effective and efficient EAM represents a significant issue in terms of a holistic enterprise management within a digitalized environment.

3.3.4 CURRENT SITUATION IN EAM PRACTICE

Against the background that Section 3.3.1- Section 3.3.3 refer to the theoretical foundations of the relevant management disciplines, we developed a number of challenges in this section, which are based on our related work considering practical EAM issues [64,65,134,136,338,348]. EAM challenges are the obstacles that an enterprise has to overcome to establish long-turn success when mediating between business and IT. Cost and complexity of introducing EAM as well as its operation is a central challenge for a variety of reasons such as: *setup EAM as cross-functional line activity*, *organizations are not prepared to establish EAM roles*, *insufficient awareness*, *inability to express information demands* as well as *insufficient data quality, handling of new compliance requirements* or a *missing common language*.

(a) Setup EAM as cross-functional line activity: EAM is not just a task for enterprise architects who only communicate with the development team without taking the general view of fundamental structures and their interplay into consideration due to lack of transparency and understanding, but for the whole enterprise. Thus EAM has moved from being an expert-group task to a cross-functional line activity that requires the participation of different departments. Enterprises need to be convinced that the relevant community is larger than assumed and convincing the employees can be difficult if the EA team is not prepared for more collaboration with different departments. The models have to be kept alive by introducing processes that can update the models continuously to avoid modeling from scratch, but rather concentrate on the changes and benefits from the reuse of models [338]. Instead of managing a certain domain, like IT-focused architectures in the past, the connection between different architecture layers has to be

established in response to the dynamic environment, forcing adaption and internal change of enterprises as well as understanding the complex structures and enterprise-wide processes [59,65].

(b) Organizations are not prepared to establish EAM roles: EA is the idea of modeling the elements, roles, responsibilities and systems, as part of the enterprise structure, and their relations [339,340]. In an enterprise this task is structured through corresponding roles and clearly defined roles are of vital importance when implementing EAM. In this context, the essential roles are only to some extent available in enterprises, e.g. enterprise architect, information architect, application architect, or solution architect, because only if the right people equipped with the necessary competencies fulfill the tasks correctly according their designated roles, the full concept of EAM can be deployed [341]. In the small and medium enterprises (SME) other EAM challenges exist in terms of roles and responsibilities [59,65]. SME usually have a small selection of employees with the required competencies to occupy the role, and if this employee is available the loss of such expert knowledge is a high risk for SME [134].

(c) Insufficient EAM awareness: having emerged from a technical perspective (Information Systems Engineering), EAM did not fully realize the importance of social factors like humans, organizational behavior and communication [12]. Moreover, there is commonly a behavioral resistance against usage of a new methodology [342]. An alfabet AG[1] study of 39 companies shows that the delivery of a tangible EAM value proposition is one of the biggest challenges for enterprises. Hence, EAM value proposition needs to be communicated to the right stakeholders in the right way and its implementation has to be perceived as beneficial. Success of any new process or topic comes with the perceived benefits and the realization thereof. In the SME perspective the value proposition and implementation has to be supported also by a suitable communication since there are doubts about cost - benefit ratio and the needed personnel, which might produce resistance [59].

(d) Unable to express information demands: Without managing the overall context it is difficult for enterprises to satisfy customers and to extend market shares [59]. Organizations are often unable to express their information demand, which makes it difficult if not impossible to design a fit-to-purpose EAM solution [134,136]. As stated above and in [344], EAM "is such a complex topic that easy and general solutions are unlikely to appear". Still 9 out of 10 people responsible for an EAM rollout counter the questions about information needs of customers with "*what is the best practice for this?*". In most cases, best practices help to some extent but company specific information are necessary to customize best practices to the enterprise appropriately. In addition to that enterprises want to have fully developed solutions although they are not able to implement the required processes and to use the provided tools. For example, an organization has requested the fully elaborated functionality of an EAM-Tool due to anxiety to miss a feature and the inertia not to analyze its information needs. Later it turned out that most of the occasional users were not able to run the process and to use the tool because they have not been adapted to the specific information needs. The cost and complexity of introducing EAM as well as the initial one-time documentation effort to satisfy imprecise information demands are central problems (e.g. selection, maintenance and quality of information) [68]

(e) Data quality and consolidation: Under consideration of the above, data consolidation issues seem to be one of the biggest obstacles on the way to implement EAM as the continuously changing business requirements caused by new technology, legal regulations or increased demands on security and compliance are not being integrated well to the existing infrastructures, thus leading to heterogeneity and complexity in the entire application landscape which results in a technological diversity, low number of application interfaces and a high number of process interfaces [345]. There are different dimensions to data quality like completeness, reliability, integrity and consistency. Due to heterogeneous application landscapes (information silos) and low data quality, the stakeholders and managers cannot be supplied with

[1] Customer satisfaction survey of alfabet AG (CSAT) 2012.

the right information at the right time. Moreover, enterprises are confronted with the challenges of data consolidation due to business transformations or technological changes [311].

(f) Compliance requirements: Increasing compliance requirements and new regulations are challenging especially for enterprises in the banking, insurance, utilities and telecommunication sector [348]. Facilitating the transparency in the organization is a prerequisite for an efficient compliance management [354]. For an efficient and agile implementation of the compliance requirements the architectural dependencies have to be revealed. Furthermore, due to its focus on different layers and structural dependencies between information objects as well as its complexity, the architecture compliance check cannot be performed manually; thus tool support is an absolute necessity [347].

(g) Missing common language: Since the roles and responsibilities in an organization have to be defined clearly, a consensus on a common terminology has to be achieved (for instance answering the questions like “what is an application?”, “what is a service?” and “how does it relate to an application?”) for an efficient EAM. One would certainly discuss how rooms, windows or balconies should be constructed when contracting an architect to design the house [343]. Likewise a city planner would have to know the interplay between complex objects like streets, land use or waste disposal and communicate with the customer using the domain vocabulary [12]. Both examples prove the necessity of a framework to achieve a shared understanding. A shared conceptualization can be achieved by deploying knowledge modeling methods, for example developing a domain specific ontology [92] and ranking it under the higher ontologies. Benefits of such ontology would not only be the accomplishment of a common vocabulary in an organization but also the detection of inconsistencies due to the reasoning mechanism and assertion of new knowledge that can be shared in the enterprise.

Even if you have the smartest approach, you need to convince people to execute it in an organization and working with people implies to deal with emotions, which can be quite unpredictable. Thus, people in the organization have to be motivated to learn new ways of working/ thinking and eventually break with their existing working habits. Handling of complex tasks requires sometimes complex approaches which are difficult to teach and often difficult to depict graphically [60,350]. Increasing complexity of enterprise models and architectures are a continuing trend, inevitably caused by the efforts to create ever better products. Visualizations of dependencies need to be produced from supporting tools such as ADOit (BOC AG), planningIT (Software AG), BiZZdesign EA Tool Suite (BiZZdesign) or MEGA (MEGA International) [123,352,353]

In order to enable enterprises to assess its capabilities of facing (a-g) challenges, a capability-based approach is proposed with this work. Capability concepts have already been used for some time in the EAM to describe business- or IT capabilities. However, before continuing with investigations regarding an EAM capability type, a brief overview of the existing approaches, capability concepts and the respective definitions are given in the following section.

3.4 ENTERPRISE CAPABILITIES - OVERVIEW

The term capability is part of the natural language over centuries and *“[...] the underlying concepts are being used to represent the inner working of societies, enterprise, organizations, man-made artefacts, biological systems and organisms*” [189,p.1]. During the last two decades an increasing number of new theories, conceptualizations and paradigms in many different disciplines was created based on capability-oriented thinking [89,189,192]. For instance, military domains use capability approaches for defense purposes e.g. NATO defense planning [196], resource management [195], architecture management [193] led by military majorities like the United States of America, Canada, United Kingdom or Australia [197]. The US Department of Defense (DoD) describes a capability as:

> *"The ability to achieve a desired effect under specified [performance] standards and conditions through combinations of ways and means [activities and resources] to perform a set of tasks."[193,p.25].*

The definition comprises aspects like structure, modernization, readiness and sustainability to achieve a desired effect [195]. The Australian Defense Force declares the following definition:

> *"The power to achieve a desired operational effect in a nominated environment, within a specified time, and to sustain that effect for a designated period." [194,p.7].*

Here, aspects like personnel, organization, training, major systems, suppliers are combined in order to reach a desired effect [195]. Motivated by its usage within the military domain, capability approaches are more and more used in the economic environment [192]. Therefore, academics and practitioners use the term to describe an expertise in order to engage an organization to do something [191,225]. For example, [191] considering capabilities as the combination of resources, competencies, information, processes and the business environment to reach customer satisfaction by equal product quality. [225] expands this by addressing customers or even shareholders and stresses the combination of processes, people and physical assets. However, capabilities answer questions of: What are we doing? What do we want to do? To answer these, in most cases capabilities describe an actual summary of named expertise as well as the required ones to fill gaps. These sets of expertise are embedded in structures and processes and should enhance the productivity of the resources possessed by an enterprise [192]. According to [189,200,201], in general, capabilities could be characterized as:

- intangible,
- non-redundant,
- stable over time,
- process-independent, even if influenced,
- hierarchical and combinable,
- heavily influenced by human resources (e.g. personnel, training),
- attributed to clear (management) responsibilities within an enterprise and
- delivering direct business value.

How to interpret them in practice and how to establish them next to its synonyms? Personal and organizational attitudes, abilities, skills, processes and/or competencies as well as their specific level of knowledge are mentioned within the capability literature [198,199,222]. In order to clearly distinguish our understanding of the term capability from commonly used and related concepts like *competencies, abilities, skills* or even *processes,* we start classifying the concepts by the approach of [201] followed by introducing a set of classification criteria, which is based on previously published content of our findings in [85].

The focus element to distinguish competencies and capabilities are people- and business perspective. In line with [201] the individual- and organizational and social and technical focus. According to [201], competencies are related to technical areas while capabilities and abilities are referred to social issues (Table 3.6). Technical areas refer to individual and organizational competencies, whereas competencies could be described as defined routines in combination with investments to activate specific functions (directly correlated to solve problems) [202]. Social issues refer to individual leadership abilities (level of available intelligence and disposition to achieve an outcome [203] using individual leadership skillset). A skill is referred to intangible human resources that are exclusively developed and can be encourage and/ or enhanced (e.g. abstraction, sensibility, imagination). They are repeatable and combinable in form of a skillset to deliver some value to an individual- leadership ability or functional competence. Finally, "O*rganizational capabilities emerge when a company combines (and delivers on) individuals' competencies and abilities.*"[201,p.3]. An organizational capability *"[...] represents an organization's underlying DNA, culture, and personality. These might include such capabilities as innovation and speed."*[201,p.3].

Hence, an enterprise capability summarizes the idea of organizational competencies, abilities and their combination due to elective and efficient performance [261,207].

Table 3.6 Competence, Ability and Capability, according to [201].

Dimensions	**Individual**	**Organizational**
Technical	Individual functional competence (e.g. expertise in marketing, finance, manufacturing)	Organizational core competencies (e.g. financial services firm must know how to manage risk)
Social	Individual ability (e.g. to communicate a vision, to motivate people)	Organizational capabilities (e.g. innovation and speed)

[223] defines competencies as routines combined with enterprise investments due to activate specific functions, whereas capabilities relate to the mechanisms and processes creating new competencies.

"Ability refers to the level of available competence, where competence is understood as talent intelligence and disposition." [203]. Both of them are addressed to achieve a goal. *Skills* describe abilities of a person within the organization. The distinction of capabilities and processes is not favored by the variety of possible nomenclatures. Especially the noun expression for capabilities (e.g. product line business planning, channel management) forces misunderstanding of the terms. An enterprise capability expresses "*what the enterprise does*" whereas a business process is about "*how an enterprise operates*" [224]. Processes can require granular or complex capabilities as well as the other way around, but this is not compulsory. One process can map different capabilities having conflicting, matching or independent requirements [225].

> "*Capabilities and organizational processes are closely entwined, because it is the capability that enables the activities in a business process to be carried out. The business will have as many processes as are necessary to carry out the natural business activities defined by the stage in the value chain and the key success factors in the market." [223,p.1]*

Within this research, we focused on the study of organizational dimension, which can be seen in Table 3.6. Therefore, we used a systematic literature review (Sect. 6.2.4) as well as mentioned differentiations arguments from above in order to provide a more detailed set of differentiation criteria summarized in Table 3.7. Whereas abilities are specific competencies, that just differ within its focus. Both of them are based on routines, abilities call specific combinations of competencies. Capabilities answer, what a business does, whereas all other terms describe how it does.

Table 3.7 Capability, Competence, Ability, Skill and Process Classification, according [87].

Criteria	Capability	Competence	Ability	Skill	Process
Focus	Strategically (Is- and future state)	Operationally (routine based activation)	Operatively (specialized combination)	Operatively	Operatively
Solidity	Enduring and stable	Enduring and stable	Enduring and stable	Stable and repeatable	Flexible, but fixed start and end
Scope	Entire Organization	Individual and organizational	Individual and organizational	Individual	Task
Purpose	What	How	How	How	How
Lowest Decomposition Level	Capability	Competence	Competence	Ability of work	Activity or task

After a broad definition and concept distinction, the following fundamentally addresses the different capability varieties. In addition to a large amount of publications, there are also a large number of different varieties (from here onwards referred to as capability type).

For instance, [97] states that 1534 articles were solely written about the capability type "dynamic capabilities" between the years 1997 and 2007. These articles were quoted over 6800 times in the period of 2011 and 2012, which represents a doubling in quoting compared to the period 2006-2010 [356]. However, a variety of type classifications is possible such as *"[...] value, competitive, and dynamic capabilities as three distinct types [...]." [329,p.253]*, which are grounded on respective capability *application area*.

> *An application area describes the environment, underlying conditions or subject a capability is required for or should be required for.*

In this context Table 3.8 shows in consideration of the limitation on organizational skills, a potential capability type classification scheme by [357] from the year 2007. For his study, how technical, behavioral, and business capabilities are related with IT infrastructure capabilities, he summarized existing capability approaches characterized by a general definition and provides examples.

Table 3.8 Example for a Capability Type Classification, adapted from [357,p. 442].

Type	Definition	Examples	References
Business Capability	The ability of an enterprise to understand the overall business environment and the specific organizational context.	Organization-specific knowledge, ability to learn about business functions	[358] [359] [360]
Technical Capability	The technical ability of an organization based on its specific expertise in technical areas.	Database management, competencies in emerging technologies	[261] [360]
Behavioral Capability	The interpersonal and management ability of an enterprise to interact with and manage others.	Effective interpersonal communication, working in collaborative environments, planning and leading projects	[358] [261]
Infrastructure Capability	The ability of the IT organization to provide extensive firm-wide IT infrastructure services that support the organization's business processes	Extensive communication services, data management services, IT management services	[361] [362] [363]
IT-Dependent System Agility	The ability to accommodate change in information systems without incurring significant penalty in time or cost	Reducing system modification or enhancement costs, developing applications faster	[364] [365] [366] [367]
IT-Dependent Information Agility	The ability to easily accommodate change in the way organizational users access and use information resources	Faster retrieval of information, increasing the flexibility of information requests	[367] [368] [370]
IT-Dependent Strategic Agility	The ability to respond efficiently and effectively to emerging market opportunities by taking advantage of existing IT capabilities	Responding more quickly to market changes, gaining competitive advantage	[264] [363] [369]

The summary indicates that a large part of the classified capability types are focused on IT to support the design and conception of new strategic competitive advantages (Sect. 3.3.2). This aspect considering the increasingly important role of the EAM (Sect. 3.3.3, Sect. 3.3.4), reinforces our motivation for a future consideration of EAM capabilities as own capability type. These foundations are a starting point for our further research activities.

Thus, we preliminary start with the general exploration and classification scheme above, which could be summarized as follows:

(1) An enterprise capability describes an organization's characteristic to successfully perform repeatable pattern of activities by consuming resources, competencies and abilities to create a specific outcome [22,204,205,349].

(2) "*The use of capability as the representative of what the business does and needs without describing the technical implementation (how) serves as a powerful communication tool among technology and business specialists."[206, p.2]*.

(3) Capabilities could be classified into different types depending on its focus [201,207,261,357].

Those concepts are specified in detail within the *problem investigation* and *design and development* phase (Chapter 4, Chapter 6).

3.5 SUMMARY

Caused by changes in its *macro-, micro- and internal-environment* enterprises need to adapt its *intended strategy* continuously, which is structured by a corresponding process in the context of *Strategy Management* (Sect. 3.3.1). To generate competitive advantages this process needs to cope with requirements such as agility and speed by using special methods. In this context, the digitalization and the related IT penetration are the leading drivers of change. Thus, the role of *IT- Management* is also growing steadily in recent years, because it ensures optimal provision and operation of IT services to the best support of business processes relying on it (Sect 3.3.2). However, a successful strategy implementation is accompanied by an appropriate alignment or, more correctly, coordination between business strategy and IT management. EAM supports this condition of business and IT during the corresponding changes (Sect. 3.3.3). Thus, the capabilities of an enterprise to harmonize, plan, transform and monitor changes are key success factors (Sect. 3.3.4).

Exactly for this purpose our work introduces an EAM capability approach (Sect. 3.4), because it provides information supporting the alignment of issues of the different poles (Figure 3.10). It has to be considered, if an enterprise can provide the required capabilities of sufficient quality for specific transformations at all. By reviewing these aspects mistakes/ wrong decisions can be avoided and the probability of the transformation success of certain projects can be increased. Each company is equipped with various capability types that are specific to its organizations. Within this investigation we are focused on concepts and characteristics of organizational related EAM capabilities, which are required to plan, implement and control the coordination between the *Strategy Management* and *IT- Management* efficiently. Capabilities can support this intermediary role by the following attributes [192,224,225,232]:

- high-level representation of organizational acting based on profound architectural elements,
- decision support for e.g. mergers & acquisition, out- and insourcing or budgeting,
- provision of transparency and a common language between business and IT responsible,
- identification of new competitive advantages,
- relating IT perspective to business value.

Moreover, from our related work, we recognize that there are already a number of indications that could justify the usage of EAM capabilities [65,134]. Based on these first indications combined with local practice cooperations we start the upcoming research process.

4 PROBLEM INVESTIGATION

"What is the problem experienced by some stakeholders of a practice and why is it important?"[21]

In order to meet the fundamental demands of scientific relevance and rigor of DSR a precise problem definition is required (Sect. 2.2). The following chapter describes the initial undesirable state of a local problem situation, followed by the problem selection and its transfer into a *practical problem* with global relevance to be solved in our investigation (Sect. 4.1). With regard to preparing an adequate and relevant definition of a practical problem, we gathered similar problems from different *local practices* (Sect. 4.2) and deduced a generalized problem description relevant for *global practice* considering a *root cause analysis* (Sect. 4.3).

The importance of solving such a global practical problem has to be assured by analyzing the knowledge base (*rigor cycle*) and further practical environments (*relevance cycle*) using appropriate data collection and analysis techniques. The problem definition represents the beginning of the presented research process (Sect. 2.2.1) and it has to be particularly attentive to the coherence and its effects on artifact specification. The following IDEF0 [132] diagram represents the process for our problem investigation (Figure 4.1).

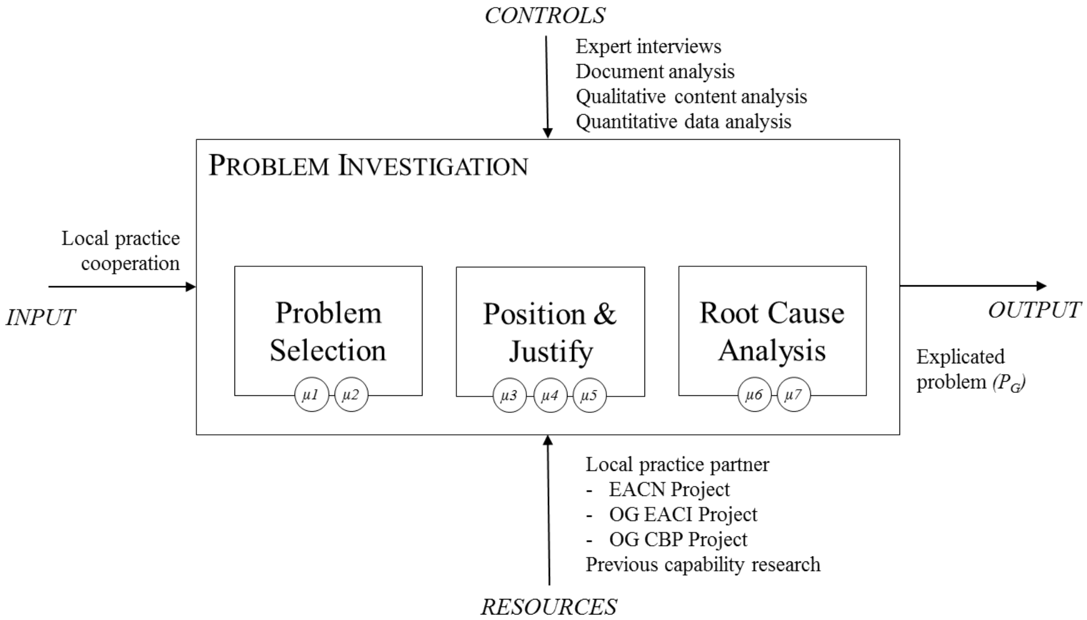

Figure 4.1 Research Process Step 1: Problem Investigation.

In order to follow the proposed activities of [21,177] , we considered a set of principles *($\mu 1$- $\mu 7$)*:

$\mu 1$. Describe the problem: How and where do problems occur? Determination of the application domain, identification of participant, gathering of problem cases from local practices.

$\mu 2$. Formulate the problem: Accurate and understandable problem description as a summary / aggregation of found local practice cases in *($\mu 1$)*.

µ3. Justify the problem: Who could be interested in a problem solution and why? Formulation of benefits/ added value - information could be selected from application domain and/or stakeholders.

µ4. Ensure the problem is of general interest: Argument and demonstrate why the problem solution is not only interesting for a single local practice case.

µ5. Ensure the problem is solvable: Decomposition of problems, modularization of the problem in order to reduce its complexity, decomposition served as a basis for developing a process model and characterizes certain phases, find approaches to solve sub-problems.

µ6. Specify the source of the problem: Analyzing the body of knowledge and the problem environment in terms of scientific discourses or experienced practitioners that already have identified the global problem, local problems, sub-problems or problem surroundings.

µ7. Describe how the problem has been explicated: Elaboration of a comprehensible representation of how the problem is solved under consideration of the DSR approach, reuse of already established approaches, models, methods, theories, practices, validation criteria, methods of data analysis, reuse of the developed artifact.

Starting point of our process is an initial problem situation that serves the first phase "*Problem Selection*" with inputs from local practice. This phase selects and describes a single local practice problem (P_L) and reduces the number of ways in which it can be understood. The next phase "*Position & Justify*" proofs (P_L) interests by investigating additional local practice situations, searching in its environments and use cases for similar problem types. After selecting one local practice problem and recovering it within additional local practices, its origins are explored in the "*Root Causes Analysis*" phase. The different kinds of underlying causes like lack of information, procedures, deficiencies of knowledge or missing definition are investigated. The output of this process is an explicated global problem *(P_G)* that is precisely defined, justified and relevant for global practices. In order to do so, we used different research methods and techniques, which are involved in the process as control flow. Our local practice partner and the scientific body of knowledge were required resources for the respective phases. The outputs of this research process phase are previously published in [52,90,190,400], which are referenced at the beginning of each section.

4.1 PROBLEM SELECTION

The beginning of our investigations was initiated by a research cooperation between the University of Rostock, chair of business information systems and alfabet AG. The research findings of this cooperation are already published in [52,90] and this section may contain content of the aforementioned publications.

From 05.05.2012 to 31.12.2013 we collaborated with the alfabet AG (06/2013 acquisition by software AG[2]) which is located in Berlin, Boston and Singapore. Founded in 1997, alfabet serves a global user community of more than 135,000 IT, finance and business professionals in more than 40 countries with its software suite planningIT®. Alfabet 's customers include many of the Forbes Global 2000 Companies[3] and cover a broad range of industries, especially the financial, automotive, telecommunications, logistics and high-tech industry. According to Gartner, the alfabet AG was denoted as one of the most innovative software houses in the planning of EA [398].

This cooperation aimed to develop a maturity model to assess and improve capabilities required for a successful EAM called Enterprise Architecture Capability Navigator (EACN). The methods of the enterprise modeling and the EAM contribute to the identification of knowledge in enterprises by illustrating,

2 http://www.softwareag.com/de/Press/pressreleases/20130603_SoftwareAG_acquires_alfabetAG_and_strenghtens_market_position_page.asp, last visit 29.04.16

3 http://www.forbes.com/global2000/list/

gathering and transparently documenting for further use structures, processes and relationships and establishing a planning and development based thereon. The project was triggered, because alfabet AG consultants recognized the challenge for large as well as small and medium sized enterprises to efficiently put the right information into practice and the right knowledge under EAM, which is required for the assessment and development of enterprise architectures in context of strategic transformation (Sect. 3.3), whereas its value depends on an organization's EAM capability status. Enterprise specific capability catalogs should be developed to support this issue, which enable a simple performance assessment of EAM capabilities and suggest methods for its further development when the current quality is insufficient. For the purpose of specifying the initial requirements of the EACN existing EAM approaches, indicator systems and methods were examined regarding their application areas, handling and development through different stages of life. Moreover, studies and uses cases on this subject were developed and analyzed based on experiences of alfabet AG customers. The following Table 4.1summarized the *goals, trigger, benefits and concepts*.

Table 4.1 EACN Project Overview - goals, trigger, benefits and progress.

EACN:	Description
Goals (G_{En})	Central purpose of the research project was the development of an Enterprise Architecture Management capability catalog (G_{E1}, G_{E3}) and its transformation to a flexible, feature-related measurement and analyzing system (G_{E4}, G_{E6}), which contains both the methodology for (re-) structuring the catalog (G_{E2}), evaluation (G_{E5}) and concepts for the further development (G_{E7}, G_{E8}) of the relevant EAM capabilities of an enterprise. The catalog should provide additional information to the management, which should improve the quality of strategic decisions *(G_{E9})*. Overview project goals: G_{E1} : Development of a comprehensive capability definition. G_{E2} : Development of an EAM capability catalog. G_{E3} : Development of a concept for identifying capabilities. G_{E4} : Target-state analysis for capability quality. G_{E5} : Quality assessment approach . G_{E6} : Gap analysis. G_{E7} : Best-practice recommendations for improvement actions. G_{E8} : Project templates for capability improvement. G_{E9} : Improve quality of strategic management decisions.
Trigger	• After change of long-term objectives (3-5 years) • Annual current state assessment to monitor progress
Benefits	• Support CIOs and IT management with best-practices to implement fit-for-purpose EAM capabilities • Ability to make more informed decisions → improved decision quality • Enable industry benchmarks by relying on a standard EAM capability model • Organizational improvement to reliably adhere to compliance regulations
Concepts	• Identify enterprise strategy • Detect information relevant for strategy implementation using an information demand analysis • Identify EAM capabilities that are relevant for strategy implementation and provide detected information in combination with related objects from the capability definition • Deduce capability target state definition in terms of descriptive object quality • Perform current state assessment • Identify gaps and capability improvement actions • Communicate new quality

The unique characteristics of the maturity model arose from the following settings. The main objective of the project was the development of a holistic capability maturity approach that can be used for EAM functions like road-mapping, migration planning or project portfolio planning. In contrast to already existing Capability Maturity Models (CMM) no generally transferable, conformist approach for the classification in tightly demarcated maturity levels should be chosen, but rather maturity levels should be determined via an individual and goal-oriented diagnosis i.e. performing an Information Demand Analysis (IDA) [53] that is adapted for its special use in terms of a strategy implementation analysis.

However, within the EACN project, strategies were understood as impulses for actions to be taken in certain topics. Enterprise strategies describe the structured operationalization of enterprise objectives. To identify the relevant capabilities that help to implement a strategy, an adapted version of IDA method should be executed. The analysis supports the determination of the target state (to-be) maturity of the identified EAM capabilities gathered and evaluated in the capability catalog (G_{E4}). But what if the enterprise does not have the required capability to perform a strategy or the capability is not yet an element of the catalog? In such a case the catalog has to be enriched with the missing capability entries by the help of a concept (G_{E3}), (G_{E2}). If the required capabilities are in the catalog, a gap analysis is conducted to assess the current (as-is) state of the present capability (G_{E6}). If a gap between target and current state is identified, recommendations for improvement action follow, which in turn should improve decision quality on the corresponding capabilities (G_{E7}). EAM Capabilities should be evaluated by an evaluation matrix including different kinds of assessment questions. The respective improvement actions derived from the maturity level are then implemented by project packages (G_{E8}).

The following explanations describe the problem selection from the local practice situation. Our research collaboration ended with the unexpected acquisition of the alfabet AG by Software AG in 2013. The key findings of the cooperation have already been published in [52,90] so far. Due to the quick end of the project not all of the project objectives G_{E1}-G_{E9} could be completely implemented. The final state of predefined goals summarized in Table 4.2.

Table 4.2 EACN Project status on target achievement.

ID	Description	Inputs for problem investigation phase	Output
G_{E1}	Development of a comprehensive capability definition.	*Unit of analysis:* Capability approaches/ frameworks *Cases/ Inputs*: Several workshops with experts, internal alfabet AG documents. *Data collection:* Focus group discussions, industry documents, literature review. *Data analysis:* Qualitative content analysis and quantitative inferential statistics. *Outcome:* First version of a capability definition for further refine- and assessments.	[52]
G_{E2}	Development of an assessable EAM capability catalog.	*Unit of analysis:* Filling an initial EAM capability catalog with content. *Cases/ Inputs*: Continuous expert working group. *Data collection:* Focus group discussion. *Data analysis:* qualitative discourse analysis. *Outcome*: Set of EAM capability definitions (application architecture specific).	[52] [90]
G_{E3}	Development of a concept for identifying EAM capabilities	*(canceled after acquisition), open*	
G_{E4}	Target-state analysis for EAM capability quality.	*(canceled after acquisition), open*	
G_{E5}	Quality assessment approach.	*Unit of analysis:* Current State Analysis of Application Architecture Capabilities *Cases/ Inputs*: ITMZ, University of Rostock, Germany *Data collection:* Semi structured interview *Data analysis:* Qualitative content analysis *Outcome*: Beta concept for assessment procedure and indicator candidates	[52]
G_{E6}	Gap analysis.	*(canceled after acquisition), open*	
G_{E7}	Best-practice recommendations for improvement actions.	*(canceled after acquisition), open*	
G_{E8}	Project templates for capability improvement.	*(canceled after acquisition), open*	
G_{E9}	Improve quality of strategic management decisions.	*(canceled after acquisition), open*	

Results for *(G_{E3}, G_{E4}, G_{E6}, G_{E7}, G_{E8} and G_{E9})* could not be worked out and delivered. Thus, they are left in a conceptual status and still open from a local practice perspective and the canceled goals represent candidates for our *problem selection activities*.

Due to the problem-oriented initiation of this research investigation, this research process phase conducts the *problem selection and definition* [26]. This phase extracts and precisely defines the initial practical problem *(P_L)* for our research investigation that is initiated by an open goal from our abovementioned local practice partner.

(µ1): While the EACN project execution, the identification of EAM capabilities, required for developing new capability catalogs or filling already existing ones, comes along with a set of recurring challenges. The identification of EAM capabilities were organized in various workshop series with different business and IT experts from different industries, who are not necessarily familiar with the capability topic. Consequently, it took time until all participants had a common understanding of the whole capability concept required for strategic decision support in terms of its mediator role between business and IT (Sect. 3.3.3). Furthermore, different knowledge sets and attitudes of workshop participants towards the capability topic (positive, neutral, critical or negative) represented another problem, because these workshops were often lost in definition- and value discussions. In particular, these results were difficult to understand for new participants at follow-up workshops, because a set of information implied within these discussions were only partially or not explicitly documented. Furthermore, temporal distribution of workshops made the situation even worse, because redundant results were developed when implied information were lost as some of the participants exchanged or the capability understanding, descriptions and/or the identification process changed after time. The activities described above were sufficient enough for an initial (partial-) filling of an EAM capability catalog, but content quality of single capabilities as well as completeness of entire catalogs were continuously different.

(µ2): Against this background, *(G_{E3})* of the EACN project (Table 4.2) serves as starting point for our local problem definition (P_L):

(P_L) *A concept for identifying EAM capabilities is missing.*

According to the problem definition from Section 2.2, *(P_L)* represents our initial *local practical problem situation,* which involves the demand of a solution that closes the gap between the unsatisfying current state in order to receive a neutral target state. Both current and target state of the problem situation were perceived by participants of the local practice (Figure 4.2).

One reason for canceling goals (G_{E4}, G_{E6}, G_{E7}, G_{E8}, G_{E9}) was the lack of an independent conceptual approach that standardized the identification procedure for EAM capabilities. The solution to be realized should standardize the identification procedure by defining a structured process involving required stakeholders, capability concepts, efforts and desired value. Resulting in a complete unmistakably traceable defined set of enterprise specific EAM capabilities should enhance the assessment of different strategy implementation scenarios as well. Thus, can also support capability catalog development activities, because it provides a qualitative basis for achieving (G_{E4}, G_{E6}, G_{E7}, G_{E8}, G_{E9}).

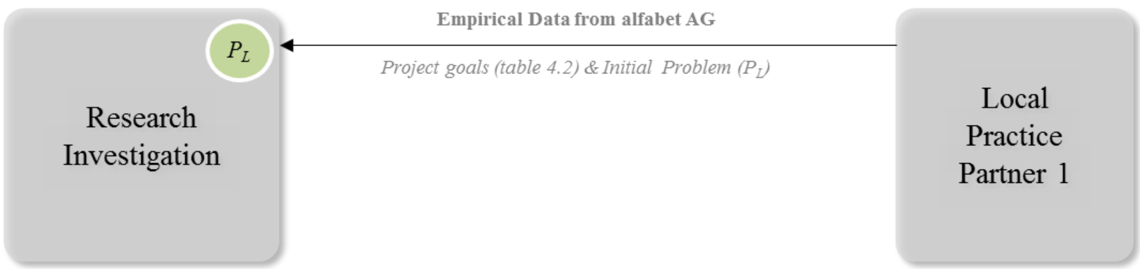

Figure 4.2 Overview – selection of the initial Local Practice Problem.

4.2 POSITIONING AND JUSTIFICATION

In order to follow *(μ3)* and analyses *(P_L)* in more detail as well as enhance its scientific and practical impact, we extract a set of sub-problems from different *local practice partner*s. The inductive prepared set of sub-problems *(μ5)*, its root cause- and knowledge base analysis represent the quintessence of our positioning and justification activities to derive originality and validity of our *global practice problem* (*μ4*).

4.2.1 ALFABET AG - LOCAL PRACTICE ANALYSIS

In order to identify *(P_L)* relevant sub-problems of the EACN project we started analyzing right at the beginning of the alfabet AG cooperation. We used a semi- and an unstructured expert interview for the data collection (Sect. 2.2.2) and a qualitative- content analysis (Sect. 2.2.3) for the identification of sub-problems in the particular local practice case. Providing interview data in form of protocol documents provides the basis for our rule-based analysis process [208]. Therefore, the interviews have to be available in text form. This is done by transcription of tape recordings or preparation of in-session-protocols. For an in-session-protocol it is important to guarantee that it is created during or immediately after the session in order to provide meaningful contributions. Interviews used within alfabet AG local practice analysis were conducted in German and created during the interview sessions without any available recordings. This type of data gathering technique is characterized by a significantly reduced version of the original conversation. Consequently, it represents just a compromised set of all possible information [208]. It should be considered that the quality of compressed information strongly depends on the person who transcripts the interview [210,212]. In order to ensure that we captured the majority of relevant information we used a third person besides the interviewed expert and the interviewer. This third person was always familiar with the table of contents, local problem situation and theoretical backgrounds. In order to guarantee inter-subjective transparency and meet scientific rigor interview planning and analysis must be carried systematically by explicit rules and theory guided [208]. Therefore, our text analyzes are based on the procedure of Mayring [210] that is carried out in separate documents referenced by column two in Table 4.3. Furthermore, table 4.3 outlines the meeting date, meeting topic, expertise of the interview partner, data collection and analysis technique.

Table 4.3 Data Collection for Local Problem Analysis from alfabet AG.

Date	Expert interview partner reference	Topic	Expertise	Data collection type	Data analysis type
2012.01.31	[FSch]	EACN Project Demands	Board Member alfabet AG, CSO	Unstructured interview	Qualitative content analysis
2012.07.19	[DSch]	EAM Capability Demands	Senior Management Consultant in various enterprise, former CIO Volkswagen AG	Semi- structured interview	Qualitative content analysis

Our text-coding extracted expert statements from data sources shown in Table 4.3 that are associated with *(P_L)* and summarized its contribution in form of local practice sub-problems *(P_{L1n})*. Therefore, we inductively derived appropriated categories by isolating and reducing text items without distorting the content-related essence of the material [210]. Finally, we derived a set of requirements by summarizing the category systems [interview partner.category ID] of the different analysis cases in Table 4.4. Both expert interviews [FSch,DSch] were documented in German and had to be translated from German to English. The interview transcript and content analysis are available at the author.

Table 4.4 Results of the Local Practice sub-problem Analysis – alfabet AG.

Local sub-problem	Description	Content analysis reference [interview partner.category ID]
P_{L11}	A unified and standardized description for a transferable capability approach is missing. For this purpose, a reusable and general definition should be worked out with an appropriate term differentiation e.g. capability, process or function.	[FSch.K3], [DSch.K4]
P_{L12}	A standard procedure for the identification and measurability of capabilities is missing, which supports a simple, but structured administration combined with a certain degree of flexibility.	[FSch.K2], [DSch.K7]
P_{L13}	No solution in place supports adequate visualization- and result granularities in order to meet the information demands of a various set of stakeholders.	[DSch.K3], [DSch.K9]
P_{L14}	Detailed description of characteristic elements (e.g. activities, roles, resources) of a capability, which involves differentiation concept of various capability types (e.g. industry-generic or enterprise-specific) is absent, that is structured into different levels by considering relationships and effects.	[DSch.K5], [DSch.K6], [DSch.K8]

"*Need for a generally transferable capability approach*" [FSch.K3] and a need for a "*uniform standardized content descriptions*" [DSch.K4] represents two examples for the problem of a missing consistent capability understanding (see P_{L11}). Furthermore, statements like "*identification and assessment of capabilities are important → we need a standard procedure for our consulting services* "[FSch.K2] or *"How does a company find its capabilities - It should be easy!"* [DSch.K7] demonstrate examples for deriving (P_{L12}). Arguments of showing the right set of capabilities to stakeholders on an adequate level of granularity are summarized by (P_{L13}), containing statements like *"the benefit of using EA capabilities* should be communicated as easy as possible…" [DSch.K3] or "*Granularity depends on individual stakeholder*" [DSch.K9]. Finally, sub-problem (P_{L14}) based on statements like "*What kind of structures, activities, roles or resources are required for a capability?*" [DSch.K8]. Under consideration of our inductive procedural model (Sect. 2.2, Figure 2.2), Figure 4.3 shows our conceptualized findings and relationships to (P_L) of our first local practice analysis.

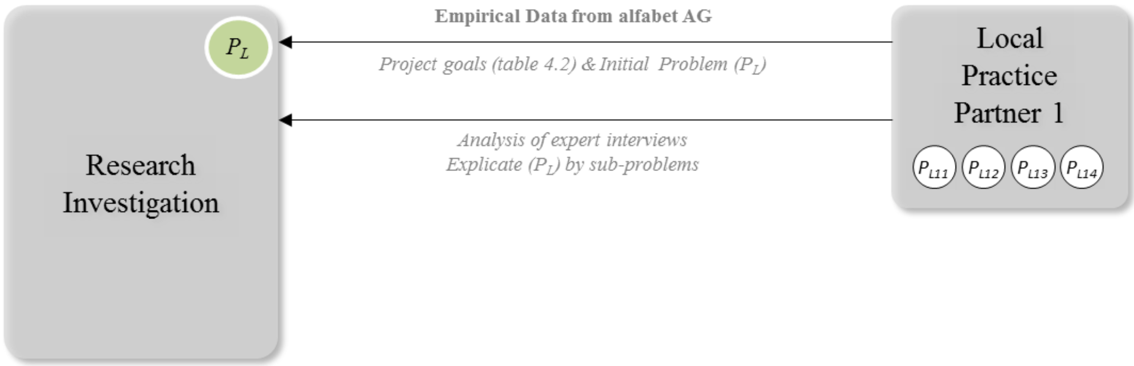

Figure 4.3 Overview – Local Practice Problem Analysis – alfabet AG.

4.2.2 OPEN GROUP PROJECTS - LOCAL PRACTICE ANALYSIS

The Open Group represents a global operating consortium developing vendor-neutral IT standards and certifications collaborating with more than 500 member organizations [211]. The Open Group Architecture Framework (TOGAF®) represents one of the best known and trusted enterprise architecture management standards worldwide including methodology and references to its ArchiMate® modeling standard [64].

The local practice analysis is based on the following Open Group projects:

- *EA Capability Improvement Project* (*EACI),*
- *Capability Based Planning Project (CBPP),*

which are introduced and analyzed separately. Due to the conceptual interlinking of both projects we analyzed corresponding documents based on *(P_L)* and enhance it with newly detected perceptions. Both projects are subject to a non-disclosure agreement (NDA) and due to this fact the following includes only conceptual and no specific content.

During the Open Group Conference - Business Transformation in Finance, Government and Healthcare Motivation 2013 in London, UK we participated in a workshop defining the scope for the *EA Capability Improvement Project (EACI)*[4]. Primary objective of the project was the development of a high-functioning EA capability approach as well as identifying and improvements mechanisms for capability benchmarking by validating available purpose-based capability approaches that use a standard EA service model, capability model and/or maturity model. In course of presenting insights from the EACN project, we were invited to join the project team to support the capability definition and validation phase. Therefore, it was necessary to get access to the Open Group internal architecture forum provided by a signed "invited expert" non-disclosure and intellectual property agreement in January 2014. Thus, the documents and content analysis can be requested at the author.

Table 4.5 Data collection for local problem analysis from the OG- EACI Project.

Date	Document & project abbreviation	Project	Expertise	Data collection type	Data analysis type
2013.01.29	20130129_OG_EACI [OGEACI]	Enterprise Architecture Capability Improvement Project - Strawman Framework	Group of TOGAF and/or capability practitioner from different companies and/or institutions.	Document	Qualitative Content Analysis
2013.11.26	20131126_OG_EACI_London [OGEACIL]	Enterprise Architecture Capability Improvement Project – Workstream KickOff	Group of TOGAF and/or capability practitioner from different companies and/or institutions.	Document	Qualitative Content Analysis

The analysis extracted statements from data sources shown in Table 4.5 that could be linked with *(P_L)* and summarized its contributions in form of local practice sub-problems *(P_{L2n})*. Therefore, we followed the same qualitative- content analysis procedure [210] as mentioned for *(P_{L1n})* (Sect. 4.2.1) and we derived a second set of local practice sub-problems *(P_{L21} – P_{L24})* (Table 4.6). The corresponding references to the content analysis are indicated with [project abbreviation.category ID].

Table 4.6 Results of the local practice sub-problem analysis – OG- EACI Project.

Local sub-problem	Description	Content analysis reference [project abbreviation.category ID]
P_{L21}	A development process, method and tool independent unified capability approach represented by a set of related measurable architecture elements in order to continuously enable strategic vision clarity, strategy adaption and improvements issues is missing.	[OGEACI.K1], [OGEACI.K4], [OGEACI.K2], [OGEACI.K7], [OGEACIL.K2]
P_{L22}	An approach that supports strategic and operational investment decision by involving a comprehensive and characterizing set of EAM capabilities is not available.	[OGEACI.K5], [OGEACI.K1]

[4] http:// opengroup.org

P_{L23}	Nonexistent of an individual and repeatable quality assessment concept in order to reflect how individual capability elements contribute towards achieving defined target states.	[OGEACI.K3], [OGEACIL.K1], [OGEACI.K7]
P_{L24}	Absence of a reference procedure with recommendations, guidelines and illustrations to define and administrate EA capabilities.	[OGEACI.K6], [OGEACIL.K3], [OGEACI.K4], [OGEACI.K7]

"*Separation of Service & Capability"* [OGEACIL.K2], "*Suitable for adaptation and integration - Development Process, Method and Tool independent "* [OGEACI.K4] represent examples for the challenge of a concretion of EAM capability elements and characteristics (see P_{L21}). „*Enable strategic vision clarity to drive architecture development* ", "*Enable good architectures to be developed*" or "*Used to guide an influence investment decisions by the organization to achieve strategic and operational objectives"* represent examples for deriving (P_{L22}). The problem of a missing maturity and assessment concept *(*P_{L23}*)* was derived from statements like *"Reflecting how individual Capability Elements contribute towards achieving each maturity stage"* [OGEACI.K3*] or "Associated with and expanding on Capability Elements at various maturity stages with recommendations, guidelines, illustrations, etc."* [OGEACI.K7]. *(*P_{L24}*)* summarized issues for a standardized course of actions is based on statements like "*The timing, steps, and governance of the measurement, assessment, improvement planning, and improvement execution cycle are important*" [OGEACI.K6].

The invitation to the EACI Project was followed by participations in another capability-related Open Group initiative. The *Capability-Based Planning (CBP) Project (CBPP)* should specify the actual used concept in TOGAF® 9.1, develop a modeling concept for CBP and propose an extension for the ArchiMate® 2.1 modeling standard. Therefore, transformation concepts and principles for the next TOGAF version have to be aligned considering the outcome of CBPP.

Table 4.7 Data collection for local problem analysis from the OG- CBP Project.

Date	Document Name	Topic	Expertise	Data Collection	Data Analysis
2014.04.12	20140412_OG_CBPP_KickOff [OGCBPP]	Capability-Based Planning Project - KickOff	Group of TOGAF and/or capability practitioner from different companies and/or institutions.	Document	Qualitative Content Analysis
2014.05.20	20140520 OG_CBPP_Status [OGCBPPS]	Capability-Based Planning Project - Status	Group of TOGAF and/or capability practitioner from different companies and/or institutions.	Document	Qualitative Content Analysis

The analysis extracted statements from data sources shown in Table 4.7. We followed the same qualitative- content analysis procedure [210] as mentioned before (Sect. 4.2.1). In order to close the CBBP analysis, we summarized the identified set of sub-problems *(*R_{L3n}*)* in Table 4.8.

Table 4.8 Results of the local practice sub-problem analysis – OG- CBP Project.

Local sub-problem	Description	Reference Data Analysis
P_{L31}	No real consensus on what capabilities are and no general concept of how to characterize them by EA elements.	[OGCBPP.K1], [OGCBPPS.K3]
P_{L32}	Capabilities should provide high-level view and communication of current and desired capabilities of the organization under consideration of micro- and macro environment as well as internal environment like departments, disciplines and/or stakeholders like business and IT, but an approach is missing.	[OGCBP.K2], [OGCBPPS.K1]
P_{L33}	No concrete management approach dealing with capabilities could be found.	[OGCBP.K4], [OGCBPPS.K4]

"*No real consensus on what capabilities are*" and "*A clear description how capabilities relate to: Strategy, Enterprise Architecture, Portfolio Management*" [OGCBPP.K1] and *"Capabilities should contain elements that can be described by Enterprise Architecture models"* [OGCBPPS.K3] represent statements for the lack of a concrete capability understanding by considering its elements (see P_{L31}).

Sub-problem *(P_{L32})* and the absence of an executive management support is based on statements like "*Capabilities should provide high-level view of current and desired abilities of the organization - In relation to strategy and environment*", "*Capabilities should form the bridge between the business leaders and the enterprise architecture practitioners*" and *"Provide a common vision all stakeholders understand"* [OGCBPPS.K1] . The problem of a missing capability management procedure *(P_{L33})* was derived from statements like *"A concrete description of how to deal with capabilities"* [OGCBPPS.K4], *"What is not there: A concrete toolkit."*, *"How do we analyze capabilities?"* and "*In which capabilities should you invest to realize your strategy*" [OGCBP.K4].

During the analysis of the LP documents we recognized an increasing amount of similarities regarding the inductively specified category systems. These similarities led to the conclusion that the core of the local practice problem has been detected in terms of an acceptable extend [153,210]. Thus, the LP analysis has been completed at this point and it conceptual overview is shown in Figure 4.4.

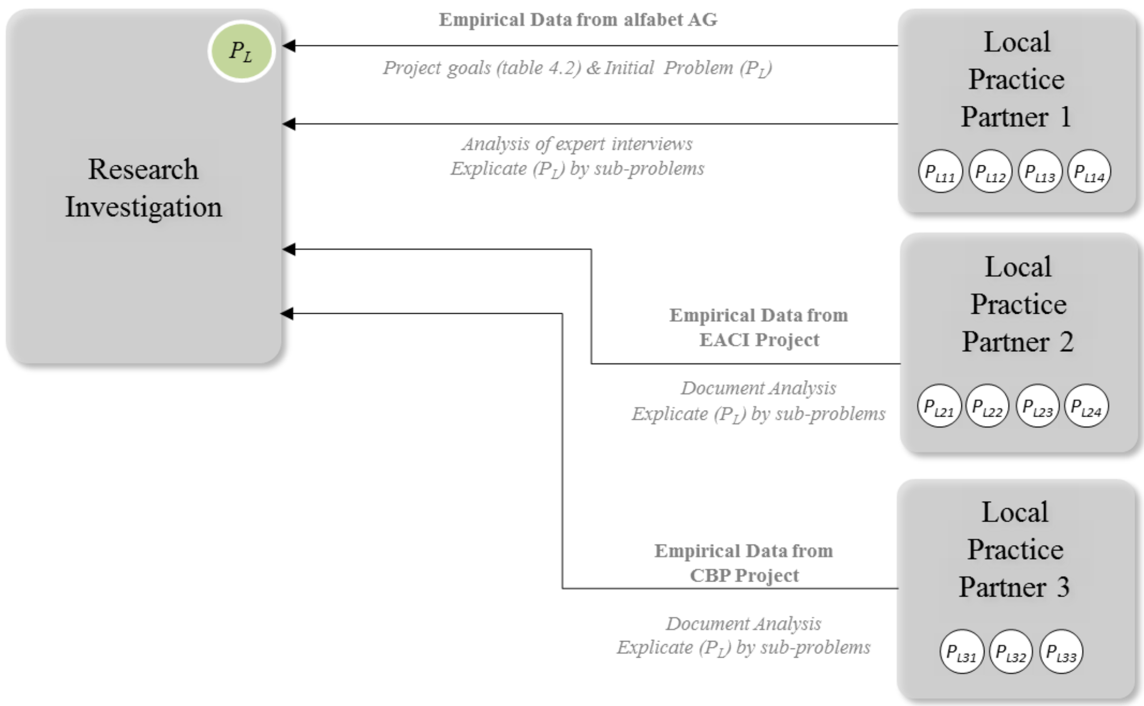

Figure 4.4 Results of the Local Practice Problem Analysis.

(μ3): The pure identification of structural enterprise components is quickly done in most cases. Even the differentiation of those components into departments is possible. Our research offers a close relationship between strategic decisions (e.g. strategic initiatives & projects), its impacts on EA and the EAM capabilities needed for successful implementation. Consequently, it is crucial to evaluate which capabilities are currently available and which ones are required in the future, when e.g. handling the EAM challenges from Section 3.3.4. In order to prepare the value argumentation of a possible solution, we start gathering already formulated benefits from our local practice partner. In this context we recognized two basic categories:

(1) A concrete capability approach could be used for communication purposes in terms of a common understanding of business and IT stakeholders regarding e.g. vision, set of strategy- or business model options, change activities and its contributions to the business outcome

under consideration of the impacts on the current situation. This understanding provides the basis for an enhanced and faster decision-making especially regarding investment and planning decisions. Moreover, our local practice partner argued that faster decision-making process combined with a modular capability approach leads to a more flexible organization that easier adapts to change. Change impacts on target architectures could be derived more precisely, because the language gap between business and IT architects decreases [OGEACI.K5], [OGCBP.K3], [DSch.K2].

(2) Especially the knowledge of EAM Capabilities is helpful for all BITA activities, because this capability type is necessary to execute required changes in an enterprise. Thus, a procedure able to find and manage those capabilities represents an important success factor for all change processes, because its quality, inter alia, depends on the maturity of its EAM capabilities. Enterprises are living and constantly changing systems, what implies that EAM capabilities constantly change as well. To detect and react to this change, capabilities must be continuously maintained and governed. A standardized process could take all these activities into account and make them reusable for different possible use cases [DSch.K7].

4.3 ROOT CAUSE ANALYSIS

The root cause analysis represents the structured process to identify and document the fundamental reason of a particular problem [221].

For this purpose the root causes are set up within this section first, which are then examined in detail with respect to the knowledge base. In order to analyze the body of knowledge, we performed a systematic literature review (Sect. 2.2.2.2), which is comprised of a planning- (Sect. 4.3.1), execution- (Sect. 4.3.2) and interpretation (Sect. 4.3.3) phase. Finally we provide a comprehensible specification of the global practice problem *(P_G)* to be solved (Sect. 4.4).

Based on problem identification *(P_L)* and its localization in different practical cases *(P_{L1n} - P_{L3m})* we derived the root causes from single sub-problems by asking "*Why did that happen?"* We ask as many why-questions as necessary in order to thoroughly explain the single sub-problem [221]. The results of this procedure are described in Table 4.9.

Table 4.9 Overview - Root causes.

ID	Root Cause Description	W- Question answer on:
RC_1	**Lack of a consistent EAM capability understanding** - The term capability is established in different local practices even though there is no generally agreed and standardized EAM capability approach.	P_{L11}, P_{L14}, P_{L21}, P_{L31}
RC_2	**Standardized approach is not available** - different local practices do not have a standardized procedures for managing EAM capabilities	P_{L22}, P_{L31}, P_{L32}
RC_3	**Missing stakeholder communication concept** - different local practices do not have a capability based communication concept in order to provide adequate information to affected stakeholders	P_{L13}, P_{L22}, P_{L32}

The analysis of the knowledge base under consideration of (RC_1- RC_3) should provide an overview of related work in terms of capability definition, approaches and frameworks as well as indications for unsolved problems for future research. Thus, the next sub-sections deal with an extensive qualitative analysis within the field of capability research intending to find a current state for our research investigation. In order to figure out which research topics, capability types are referred to and to find similarities or differences between commonly used capability approaches, we used a systematic literature review approach executed in a larger exploration defined by [38].

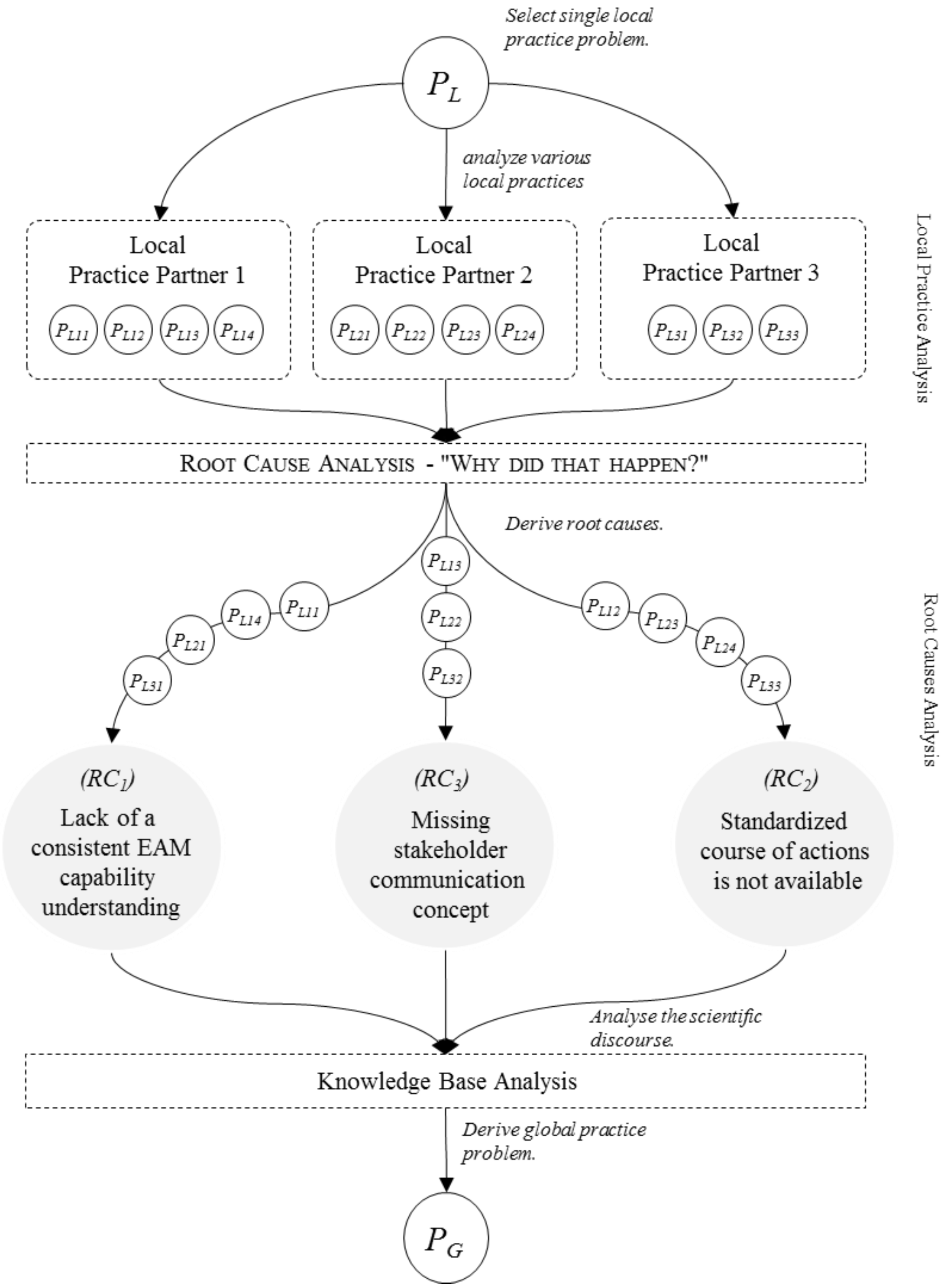

Figure 4.5 Root Cause Analysis Process.

4.3.1 PLANNING THE REVIEW

23 persons within three years in seven teams from the Universities of Reutlingen and Rostock performed same structured SLRs procedure. Considering the purpose of scientific rigor to be transparent, conclusive and provide comprehensive results considering RC_1-RC_3 defined research questions had to deal with topics concerning definitions, research activities and used approaches, and statistics of identified issues for evaluation and interpretation.

Therefore, all teams received the same precisely described SLA process and the same set of AQs. Just literature sources and/or databases as well as time frames were adapted to the respective team. The first five reviews were executed in November/December 2014. Due to the fact that not all reviewed conferences and journals submitted their articles at the end of 2014, we performed a second and a third review for 2014 and 2015 by following exactly the same SLR process.

The first stage of our review starts with the definition of SLR analysis questions illustrated in the following Table 4.10. In order to differentiate research questions from our research statement (Sect. 1.2) we rename "research question" into "analysis question" for this section.

Table 4.10 Analysis questions and its global practical and scientific evidence.

Analysis Question	Description	Justification for
AQ1: How has capability research been conducted within the last 16 years?	Review whenever the capability topic is of scientific and practical relevance.	*Relevance*
AQ2: What research subjects are being investigated?	What kinds of subjects/ focus areas were examined? For instance activities that are connected to Business Strategy Management, Knowledge Management, Software Development, Project Management, Architecture Management, IT- Management, Supplier & Contract Management as well as development- and assessment processes.	*(RC_2)*
AQ3: Who is active in this research area?	This analysis includes individuals, research institutes, academic institutions or industry that already delivers fundamentals to the scientific discourse.	*Groundwork identification*
AQ4: What capability types are being used?	In order to get a detailed overview about used capability variants we considered descriptions and worked out relationships/ similarities for its categorization.	*(RC_1)*
AQ5: What kind of descriptive elements are being used?	Looking for a standardized EAM capability approach that defines its descriptive elements and describes the integration to an overarching capability category structures.	*(RC_1)*
AQ6: Frameworks and Methods	To answer this question, we searched for methods, frameworks and processes for the identification, structuring, engineering, assessment, governance and/or maintenance of EAM capabilities.	*(RC_2), (RC_3)*

After defining the analysis questions the selection of literature sources has to be specified. With the intention to work on journals and conferences with high scientific impact, we formulated several criteria for the selection. The first criterion relates to the journal and conference ranking assigned by the CORE Journal [255] and CORE Conference Ranking [254]. Due to the fact that not all selected journals and conferences rankings are provided by [255] and [254] we have been constrained to include another ranking provider like the Journal Quality List [256]. Additionally we included the H-Index (calculated by SCImago [257]) to support the ranking criterion SCImago [257], which serves also as an indicator for scientific impact. According to these criteria, the selected journals and conference have to be well established, to be published on a regular basis in order to cover recent research topics and trends.

The published journals and papers had to be freely available. Therefore, the selected journals and conferences had to provide their publications on databases (DB) that are accessible by both university networks. Furthermore, these databases have to support the formulation of user-defined search-strings, which ensures that the reviewer teams could use unified terms and search rules.

Table 4.11 illustrates just an extract of thirty literature sources that fulfil these criteria. The first column includes the literature source, the second informs about the utilized databases and the third about the impact. For instance, we analyzed the whole AISeL basket of journals and conferences supplemented by a selection of impact and content relevant journals and conferences known for former investigations [85], like the Journal of Management, Information Systems Journal, The Practice of Enterprise Modeling, Perspectives in Business Informatics Research or IEEE International Conference on Commerce and Enterprise Computing.

Table 4.11 Knowledge base analysis - Literature source extract.

Literature Source Description	DB	Rank / H- Index
ISJ - Information Systems Journal	(Journals 2015)	A (CORE 2010), (Journal 2015a) H-Index: 52 (SCImago 2015)
SoSyM - Journal on Software and Systems Modeling	(Springer 2015)	B (CORE 2010) H-Index: 28 (SCImago 2015)
JoM - Journal of Management	(Journal 2015b)	A (Journal 2015a) H-Index 114 (SCImago 2015)
SMJ - Strategic Management Journal	(Journals 2015)	A (Journal 2015a) H-Index 166 (SCImago 2015)
MISQ - Management Information Systems Quarterly	(AISeL 2015), (EBSCOhost 2015)	A (Journal 2015a) H-Index 132 (SCImago 2015)
JAIS - Journal of the Association of Information Systems	(AISeL 2015)	A (CORE 2010) H-Index 31 (SCImago 2015)
CAIS - Communications of the Association for Information Systems	(AISeL 2015)	A (CORE 2010) H-Index 15 (SCImago 2015)
BISE - Business & Information Systems Engineering	(AISeL 2015)	n/a H-Index 18 (SCImago 2015)
SJIS - Scandinavian Journal of Information Systems	(AISeL 2015)	A (CORE 2010) H-Index 2
CAiSE - International Conference on Advanced Information Systems Engineering	(Springer 2015)	A (CORE 2014)
ECIS - European Conference on Information Systems	(AISeL 2015)	A (CORE 2014)
HICSS - Hawaii International Conference on System Sciences	(IEEE 2015)	A (CORE 2014)

Identifying an appropriate time frame is considered to be the second step and reflects a contemporary state of research. Nevertheless, what period of time seems to be an appropriate one? For example, Simon et al. [117] selected a time frame of 23 years, DeLone and McLean [258] reviewed quite a half (1992 to mid-2002) whereas Riempp et al. reduced the period again by selecting articles published between 2003 and 2007 [259]. In the light of the above and in consideration of the journal and conference lifecycles we have chosen the period from 2000 to 2016. Thus, we searched for articles dealing with capability related topics published in the defined literature sources within the last 16 years.

4.3.2 PERFORMING THE REVIEW

This phase includes selection of articles, relevance evaluation, data extraction, and data synthesis tasks. Based on this stage, we figured out which articles should be included in the final data extraction and synthesis regarding answering the defined research questions.

In order to choose relevant articles from journals and conferences, search terms must be figured out and corresponding search strings have to be defined for all teams in the same way. Search terms should cover all possible keywords that are used to gather content-related articles. Moreover, in order to achieve an adequate result it was important to consider possible abbreviations and synonyms of the origin search term. The term ‘Capability’ is a quite strong term itself, because a common abbreviation is not available [260]. According to [260] competence, skill, ability, aptitude are common synonyms, but are commonly referred to individuals (Sect. 3.4), consequently these terms are irrelevant to describe organizational related capability concepts (Sect. 3.4). The following basic search terms were defined: capability and capabilities. In order to get articles primarily dealing with a capability topic, it is assumed that the search terms are included in the title or abstract. In particular, to answer AQ five and six we added secondary search terms to our search string that are optionally related to the basic ones. Thus, the following conceptual search string for all reviews was defined:

(("Capability" OR "Capabilities") AND ("Identification" OR "Assessment" OR "Evaluation" OR "Framework" OR "Engineering" OR "Development" OR "Maturity" OR "Definition"))

In this context, conceptual means that the search string syntax has to be slightly adjusted to the specific advanced search features of used data sources (Table 4.11). Under consideration of the defined time frame and the titles and abstracts search all six teams performed the same relevance check procedure in order to eliminate the articles of the whole set of search results that do not refer to the following restrictions:

(1) The article has been deemed relevant based on by reading the abstract.
(2) A search for primary and secondary search terms within the article was performed and the content found was classified as relevant.
(3) If in doubt of the classification, the article was flagged for a second review (possibly relevant).

Different team members have performed the relevance classification of single articles to increase the quality of the article selection process. In order to evaluate the article relevance we defined three categories: irrelevant, possibly relevant and relevant. Articles classified as possibly relevant have always been reviewed by a second team member (second control). All articles classified as relevant were finally checked by the project lead (third control).

Finally, after eliminating non-relevant articles and a third relevance check by the author we identified a total number of 232 (full text read) relevant articles to answer our AQs. 178/232 articles were published in 25 conference proceedings and 54/232 articles in 16 journals. 36 countries and over 460 different authors were involved.

For data collection purposes, relevant classified papers were completely read, analyzed, data extracted and documented under consideration of the following aspects: journal/conference name, title, publication year, focus, research topic and method, authors and affiliation, capability definitions & descriptive/context elements, methods/ frameworks/ processes affiliation. We used these aspects as columns for our literature database and saved the found information for each article, which provides the base for our review report.

4.3.3 REVIEW REPORT

In order to answer the defined AQs this section presents and illustrates the findings and interpretations of the extracted data.

AQ1: *How has capability research been conducted within the last 16 years?*

In general, capability research has become more and more popular exemplified by an increasing trend of publications since 2000 (dotted line in Figure 4.6). The first research activity we identified covered a resource-based perspective on IT capabilities and was published by the MISQ in 2000 [261], followed by an ECIS conference article regarding a theory of architectural knowledge integration capability in 2001 [262]. The first two peaks could be identified within half of the whole time frame. In 2005 and 2006 we counted 12 publications each with a 2/3 conference distribution. Nevertheless, from a journal perspective, especially the MISQ published three of four noticeable articles regarding business and dynamic capability topics in 2006. We recognized most intensive activities between 2010 and 2015 with over 27 articles per year in average with a majority of conference publications (76%). Furthermore, we documented a huge rise of published articles in 2011 compared to 2010.

In this year the number of conference articles rose from 8 to 17 whereas the number of journal articles increased just by one. We detected an increasing interest in IT capabilities by researchers and practitioners, because more than half of the articles (10) were focused on that IT capability type. In 2008 we recognized a trend fall by more than 50 percent from average 12.3 articles/year down to 6 papers. One reason for such an abrupt drift could be that the strongest publisher failed their average e.g. conferences like HICCS (0/2,1) with an average of 2,1 articles/ year published no article in 2008 or ECIS (1/1,8) with just one article. Journals like MISQ (0/1,34) and CAIS (0/0,54) published no articles as well in 2008.

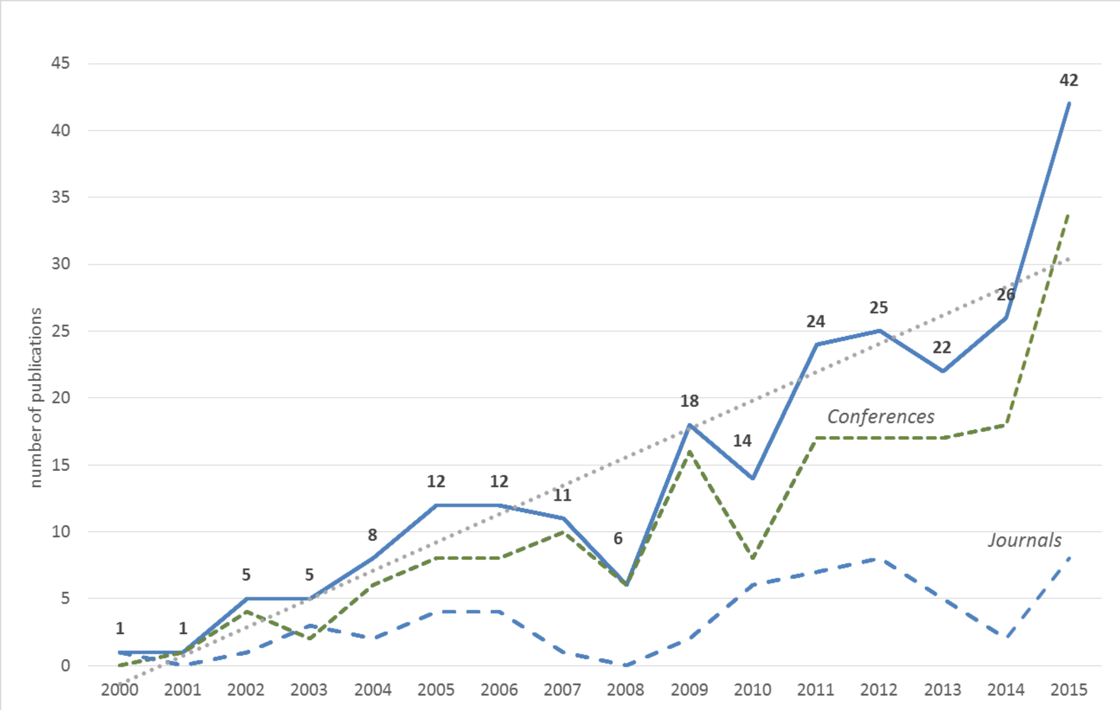

Figure 4.6 Trend and number or relevant publications per year.

In particular, the European, Chinese and Australian area published articles above average in 2015. For example 12 articles were solely written by authors from Germany, followed by Australia (8), China (7) - Spain, Sweden, Switzerland, Canada and the USA followed with 3 publications. In 13 out of 42 publications authors from different countries were involved. In European area, for example Grabis (Latvia), Stirna (Sweden), Sandkuhl, Koç (Germany) and Espana (Spain) are represented by several collaborations. Especially Kurt Sandkuhl from the University of Rostock, who collaborated with Hasan Koc and Matthias Wißotzki of the same institute, is responsible for more than half of all articles published in Germany. Moreover, for 2015, it cannot be excluded that the number of 42 publications could continue to rise, because not all analyzed conferences and journals already submitted their publications to the analyzed databases by the end of the year 2015. Furthermore, 25 articles, classified as relevant after reading the abstract, could not be accessed via the library network of the University of Rostock. Therefore, it is recommendable to request the literature sources (same procedure as in the first run) again, especially focused on 2015. Last but not least, the University of Rostock library network[5] provides access to LNBIP[6] publication series in the year 2015, which also increases the total amount of relevant publications since 2015.

Not the amount of published articles per year, but also the amount of articles published by each single journal or conference can be illustrated. To improve readability, Figure 4.7 just illustrates journals and conference with more than two relevant publications at all.

[5] Lecture Notes in Business Information Processing (LNBIP) reports state-of-the-art results in areas related to business information systems and industrial application software development (published: Proceedings, Post-proceedings, other edited monographs) – is indexed in DBLP, EI and Scopus.

[6] http://www.wirtschaftsinformatik-rostock.de/ | News: 26.01.2015, last access: 29.04.2016.

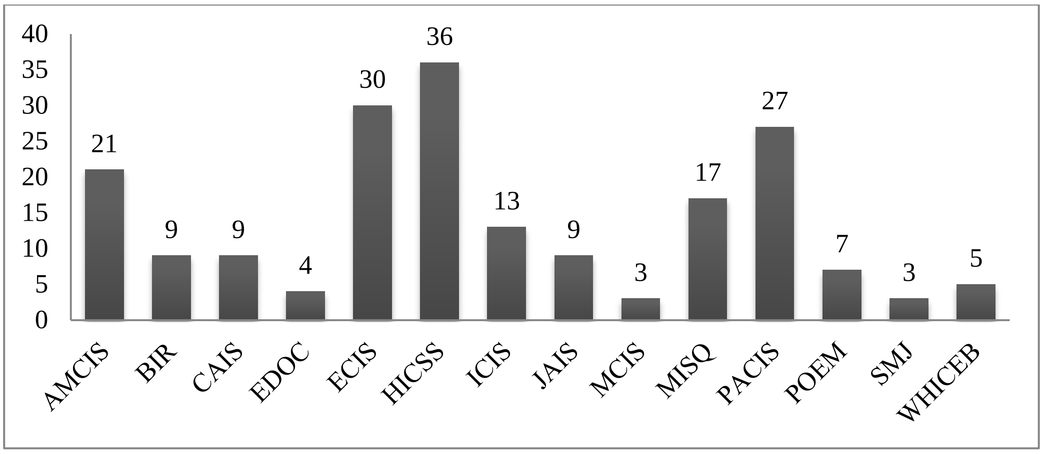

Figure 4.7 Articles per journal & conference per year >2.

The vast majority (36/232 articles) of article publications is attributable to the HICSS (16%), followed by ECIS (13%) and PACIS (12%). The MISQ (7%) tops the list of journal articles, followed by the JAIS (4%) and the CAIS (4%). Nevertheless, lifecycle information of journals and conferences should be considered in order to avoid premature decision regarding the thematic importance. For instance, BISE started publishing in English since 2009, but the German version started publishing in 1959 with changing names over the last decades and it already enjoyed a wide standing in IS research (e.g. 1990-2008: Wirtschaftsinformatik). Thus, the number of article per year, and lifecycle information of a literature source combined with its impact (e.g. H-Index, Ranking, Impact Factor) are important aspects for the argumentation in answering research questions.

AQ2: *What research subjects are being investigated?*

In the field of capabilities research the diversity of research investigations are increasingly widespread. In order to give an overview, we categorize all relevant articles and assign them to the following eight subjects, which were derived from the used concepts of the presented methods in strategy management, IT management and enterprise architecture management (Table 3.2, Table 3.3, Table 3.5):

Business Strategy Management: contains all articles regarding strategic issues of a company like process change management, enterprise transformation, organizational change, dynamic capabilities or the alignment of a company on E-business, with positive effect on the business outcomes.

Knowledge Management: includes articles in the topic of knowledge management (e.g. knowledge transfer, knowledge integration, data-warehouse).

Software Development: covers articles that explicitly handle software engineering and development or e.g. refer to the capability maturity model.

Project Management: contains articles with an explicit referral to the topic of project management.

Architecture Management: covers articles with a holistic view on enterprise organization and architecture. Also includes elements of business process management, corporate performance management and alliance performance.

IT-Management: includes articles within the field of information technology- and information system management. This category contains the development, implementation and measurement of IT systems as well as their impact on other categories. (this category does not contain papers applied to the software development category).

Supplier and Contract Management: covers articles regarding supply chain management, as well as contract management and sourcing strategies.

Development and Assessment processes: contains articles within the topic of business process management focused on development and assessment/measurement processes.

Several articles refer to more than one of the listed subjects or describe the impact of one subject to another. Therefore, these articles were assigned to more than one subject category. Figure 4.8 shows the number of articles assigned to their research subjects.

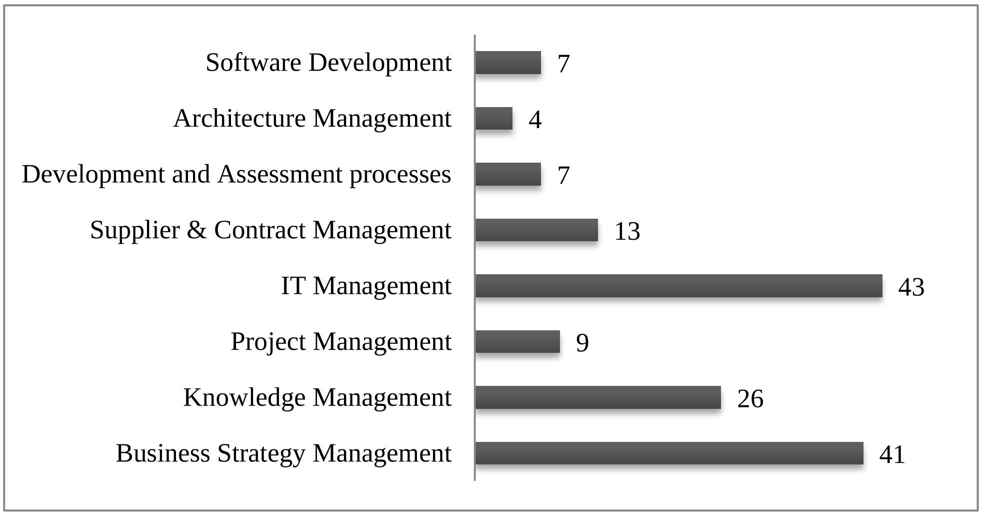

Figure 4.8 Number of articles assigned to research subject.

The reviewed scientific literature does not contain explicit articles about capability management, but we identified some articles regarding the nature of capabilities and capability modeling. Aside from software development and project management all subjects were discussed by more than one paper. Especially *IT-management* (43), *business strategy management* (41) and *knowledge management* (26) are focused on capability investigations. *Supplier & Contract Management* (13), *project management* (9), *software development/ development and assessment processes* (7) and *Architecture Management* (4) play a minor role. We recognized a fluent transition *between business strategy management* and *IT-management*, because former ones use more and more IT-management strategies and its capabilities for instance implementing business model, digitalize supply chains or communication. They represent more than 50 percent of the reviewed articles.

AQ3: Who is active in this research area?

In order to identify the authors and institutes, who are active in the respective research area, responsible authors and institutes have been linked to each article. The frequency of articles published in relation to the respective authors and institutes can offer a better idea of who is engaged with capability topics in the long-term. Figure 4.9 lists all these countries, where more than three articles have been published the last 16 years.

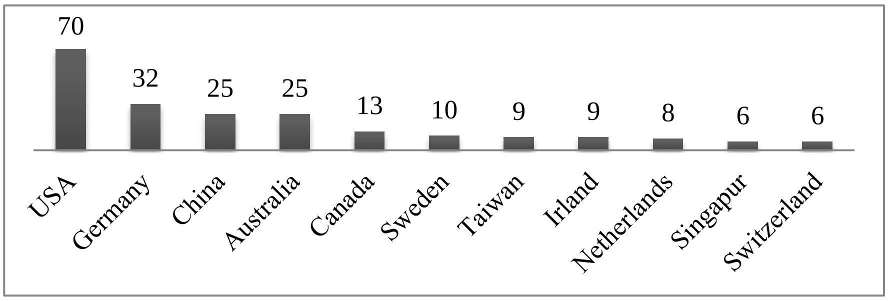

Figure 4.9 Publications per country >5.

We identified 36 different countries, whereas the USA dominates the list of publication with more than 70 published articles within conferences and journals (2/3 conference articles). Furthermore, it is apparent that German (35), Chinese and Australia (25) research institutes and scientists follow up investigations concerning capability topics. In addition to these very active countries, Canada (13) and Sweden (10) have to be mentioned, which seem to be also interested in capability research topics. It should be mentioned that nearly all involved research institutes are resident in the world's leading industrial nations.

Furthermore, the publication activities can be differentiated regarding the publishing institutions. For instance, a drill down of the USA basket (leading country in terms of publications) of published articles shows an evident tendency that especially in the South-East lots of institutions deal with capability topics. Figure 4.10 pictures an extract of institutions that have more than one article. Most of them are universities like University of Texas, Georgia State University or Emory University. Nevertheless, University of Münster and Rostock (Germany), City University of Hong Kong, RMIT University (Australia) or Queen's University (Canada) are additional examples that published at least two articles.

Only a small number of authors are employed by enterprises instead of a universities. For instance, we discovered companies like Sogeti Netherlands[7] (Dedicated to Technology and Testing Services), Centric[8] (offers software solutions, IT outsourcing, business process outsourcing and staffing services) or alfabet AG[9] (software AG company providing an EAM tool and consulting services).

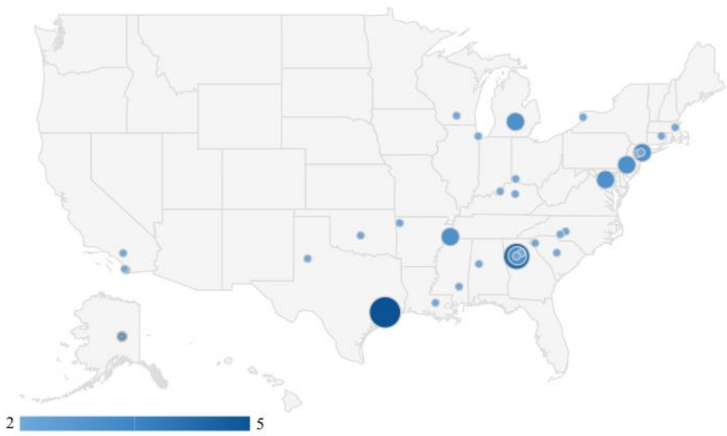

Figure 4.10 Publications per district in the USA.

Another interesting fact could be found by looking at the cited authors in articles. Bharadwaj [261], Helfat and Peteraf [263], Sambamurthy, Bharadwaj and Grover [264] and Arun, Patnayakuni, and Seth [265] are the most cited authors. Each of them has been cited more than thousand times (in sum: 8877, status: 29.02.16). It can be assumed that their work represents recognized scholars in the field. Nevertheless, within this work *AQ3* was answered focusing on publishing institutes and corresponding countries. Topics like co-authorship or citation analysis were not part of the review.

[7] http://www.sogeti.nl/, last visit 29.03.16.
[8] http://www.centric.eu/, last visit 29.03.16.
[9] http://www.softwareag.com/corporate/products/aris_alfabet/default.asp/, last visit 29.03.16.

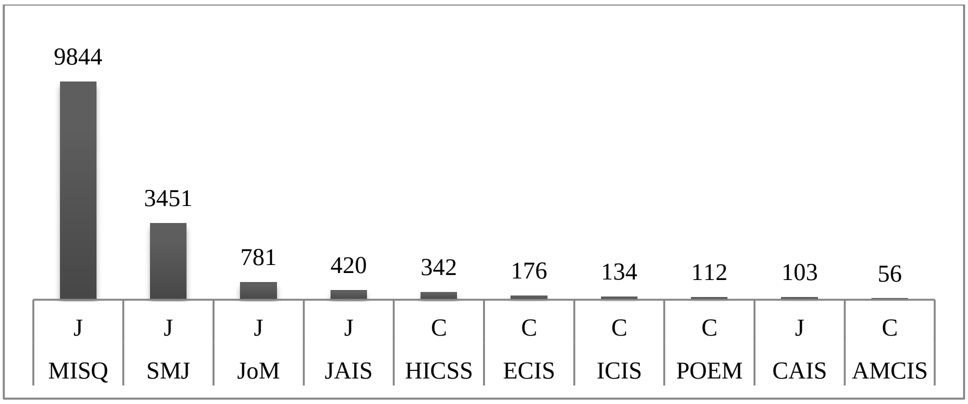

Figure 4.11 Top ten impact relevant Capability sources by citations >50.

The analyzed articles are citied over fifteen thousand times, whereas more than 94% of all citations are accomplished by 16 different journals representing just a quarter of all relevant articles. It is remarkable to note that the MISQ provides 63% of all citations, followed by the SMJ with just 22%. Therefore, the most cited article is published by the MISQ journal as well (Figure 4.11). "*A resource-based perspective on information technology capability and firm performance: an empirical investigation*" [261] leads the ranking with more than 3400 citations (captured 29.04.16) followed by SMJ article "The dynamic resource-based view: capability lifecycles" [263] with 2229 citations. On the conference side the articles "*Development and Validation of a Knowledge Management Capability Assessment Model* " by Kulkarni and Freeze [266], "*Developing eInteractions - A Framework for Business Capabilities and Exchanges*" by Goldkuhl and Lind [267] and "*Evaluating goal achievement in enterprise modeling–an interactive procedure and experiences*" by Horkoff and Yu [268] are the top three cited articles with 71, 49 and 41 citations which already represents 17% of all conference paper citations (929, captured 29.03.16).

AQ4: *What capability types are being used?*

With *AQ2* it has already been stated that relevant articles discuss different research subjects. This situation and the diverse capability interpretations lead to a variety of distinct views. Due to the large amount of different viewpoints regarding the term "capability", we tried to establish a structure based on found definitions. Organizational capability, (strategic) technological capability, (strategic) business capability, IT knowledge integration, customer orientation capability represent only a small set of identified viewpoints. Based on the found definitions, in order to differentiate capability types we looked for characteristics or elements that specify a certain type more detailed. To find these, existing similarities have been extracted, counted and classified. Within this process the results showed that the types could not be defined without intersections. Hence, our classification provides suiting results for our assumption that there is a lack of a consistent capability approach. Moreover, we updated and extended the classification scheme of Table 3.8 (Sect. 3.4.), which is presented in the following.

We started with a pre-categorization into internal and external capabilities that is based on Wade & Hulland [269] and Day [202] and its interpretation of how capabilities can be classified. [269] speak of inside-out, outside-in, and spanning capabilities while the inside-out capabilities deal with internal affairs, outside-in with external affairs and spanning capabilities involve both internal and external. Based on all analyzed articles we found five basic capability cluster (Figure 4.12). On one side "*Core Capability*", "*Business Capability*", "*EAM Capability*" and "*IT Capability*" that focus on internal operations, and on the other side "*Dynamic Capabilities*" that are mainly used within the enterprise's environment. In the following, all capability types are explained in more detail.

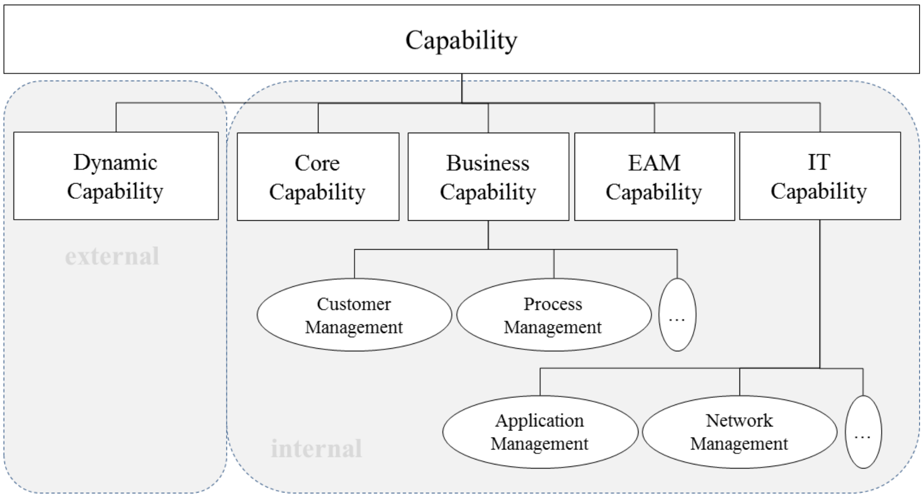

Figure 4.12 Identified capability types and possible sub-sets.

Dynamic Capabilities (89): The focus of dynamic capabilities is broader than all others since a dynamic capability deals directly with the business environment and its contemporary dynamic behavior. In case an enterprise acquired dynamic capabilities, it has the ability to be responsive to alterations of enterprise environment by e.g. recombining resources. Thus, enterprises are able to identify changes within the environment and to respond to it. Dynamic capabilities are steadily used in combination with other capabilities to maximize performance or goals [270]. The Innovative Capability subtype refers to the development and supply of both new products and services.

Core Capabilities (20): Core capabilities are described in general terms. They represent the execution of core competencies within a business process for the purpose of providing either products or services. In addition, core capabilities are supported by both enabling (these capabilities that are necessary but not sufficient) and supple-mental (even though they create an added value, they are replaceable) capabilities[271]. Here we identified several intersections with business capability definitions.

Business Capabilities (89): Referred to a corporate business goal the aim of business capabilities is to activate, use and maintain resources for specific business activities. These capabilities may belong to different business management sections as seen in Figure 8. For instance, customer management capabilities enable the detection and determination of requirements and preferences to an enterprise's customer or process management capabilities, which focus product delivery, non-product and non-service business growth processes, both are important in contemporary business environments as well [272,273]. More examples for synonyms or subcategories we found in literature are: Supply Chain Process Integration Capability [265], Customer Orientation Capability [274], Manufacturing Capability [275], Online Informational Capability [276], Marketing and Distribution Capability [277].

EAM Capabilities (19): Basically, these capabilities describe all abilities, which deal with the coordination processes between business and IT, the necessary planning and administrative capabilities. An EAM capability describes the specific combination of know-how in terms of organizational knowledge, procedures and roles able to externalize this knowledge in a specific process with appropriate and available resources to achieve a specific outcome for a defined EAM activity. Examples are current architecture analysis, target architecture planning, migration planning, impact analysis application architecture.

IT-Capabilities (139): By using their own IT-capabilities enterprises are able to mobilize IT-resources, "*to leverage their IT infrastructure to provide accurate, timely, and reliable data and information to users*" [272], and to manage their IT resources in order to be agile. The central goal of IT-capability represents the realization of business value and protection of competitive advantages provided by IT services and/ or IT products. Furthermore, IT-capabilities are used to develop, mediate and leverage other organizational capabilities - e.g. business and core capabilities – and are sometimes described as subtype or subcategory in the literature [265]. The IT Knowledge Integration Capability represents a subtype that concatenates knowledge management and IT resources [278]. Examples for synonyms or subcategories we found in literature are: IS-capability [279], IT infrastructure integration capability [265], IT infrastructure capability [273] or IT Knowledge Integration Capability [278].

AQ5*: What kind of descriptive elements are being used?*

Due to the wide spectrum of research subjects as well as the set of capability types presented above, it was hard to find a unified "*capability*" explanation providing a clear structure of its descriptive elements usable for the specification of different capability types. At a first assumption, we summarized found capability types and extracted its capability definitions in order to get a more general perspective on the concept. Questions like "*How (can capabilities be enabled)?", "What (can be done with these capabilities)?"* and "*Why (is the usage of these capabilities useful)?*" can be generally described by using this general description. Nevertheless, with this kind of capability definitions we have not made any progress in order to deliver detailed descriptions for different capability types and answer questions like: "*What does my organization need to be equipped with an EAM capability like Impact Analysis IS Architecture? What are the key elements of my business capability Customer Management?".* With the respective definition, we are not able to answer such questions. Thus, on a second attempt we analyzed relevant articles for potential descriptive capability elements.

For example, we started this investigation by analyzing the usage of most obvious descriptive elements of a capability. Amit and Schoemaker [218] already described capabilities as abilities that *"[...] refer to an organization's ability to assemble, integrate, and deploy valued resources, usually, in combination or compresences*" [218]. They figured out that capabilities are formed and build up on resources, which need to be used in order to do something. Nevertheless, they did not describe the cause why capabilities should be used and what kind of additional aspects like information or activities should be considered. Nineteen years later in another example, Ortbach et al. [219] describe that a capability refers to the ability of an enterprise to perform coordinated activities/tasks (which needs governance) to reach defined goals, which resembles with the definition of a process – maybe the next descriptive element of a capability. Furthermore, they assigned capabilities to resources and assets as well. We listed, counted and aggregated potential descriptive elements from the whole set of relevant articles which results in the following outcomes:

Resource (126): over hundred times a capability was related to tangible/material or non-tangible/immaterial goods that are required to define capabilities.

Goal/ Outcome (113): As an enterprise represents a goal-oriented system, every capability should be connected to a certain business goal from a logical perspective. Nevertheless, identified capability concepts are not always directly related to a business goal. In this case, business goals mostly referred to firm performance and competitiveness arguments in terms of outcomes (e.g. produce competitive advantages, satisfying customer wishes, provide services).

Processes (89): 89 times capability was associated to business processes that represent the sequence of activities to achieve a certain outcome.

Information (79): 79 times a capability was linked to an information concept that represents a requirement for owning this specific capability. If we identified information and its demand in a specific (enterprise) application area, we classified an information demand. Information was differentiated from resources as follows: If information has to be purchased (e.g. externally), it has to be classified as resource, in turn, if information is available in the enterprise, it has to be classified as a descriptive element from type information.

Role/Actor (56): 56 times capability was assigned to some roles or actors. In this case, these roles or actors could be organizational units like marketing, financial and accounting, etc. (i.e. specific domains within an organization).

Enterprise Context/ Focus Area (150): Capabilities are connected to an overarching subject (AQ2) such as an environment (macro/micro/internal or just external/ internal), application area or just field of interest that consider any relevant information which describes the specific surrounding in which an capability is required. We were able to identify 150 of these *focus areas* (in previous publications called context) in the analyzed articles and included these as element of capabilities, necessary for classification and identification.

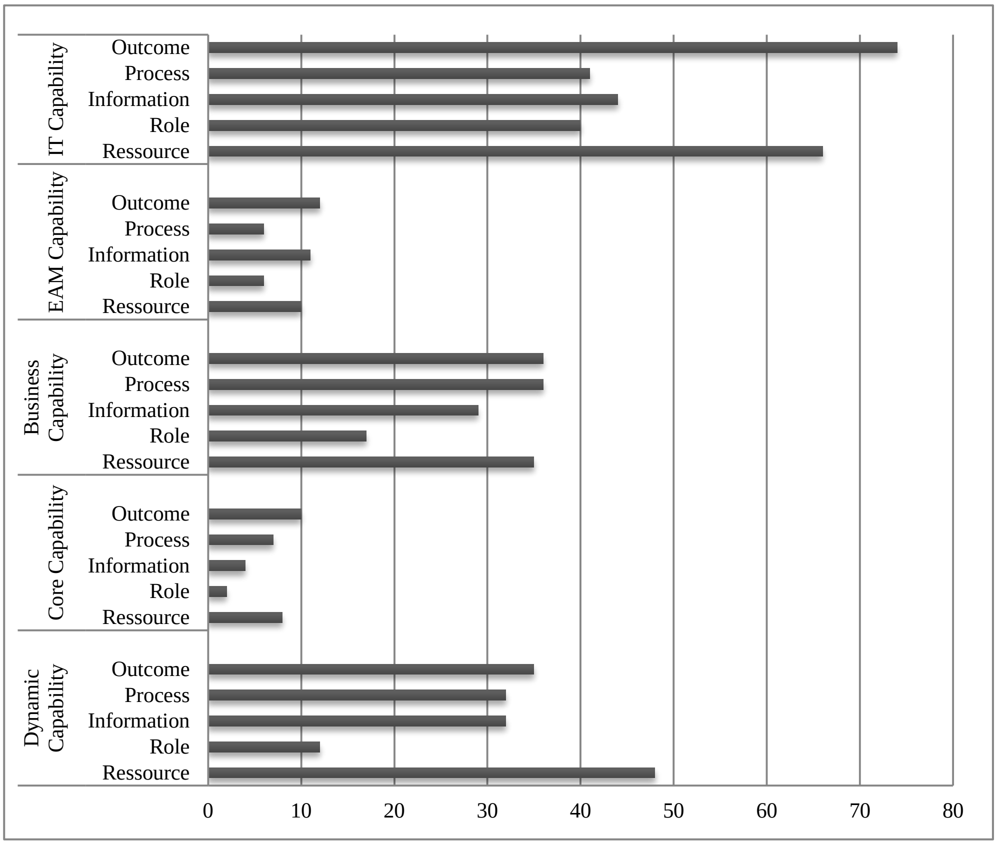

Figure 4.13 Distribution of descriptive elements by Capability type.

Figure 4.13 illustrates the distribution of descriptive elements by capability type. For instance, outcome and resource oriented element descriptions are most often been used to describe the content of IT capabilities. All in all the most important descriptive elements of analyzed capability concepts are represented by required resource (67%) and the desired outcome/goal (63%), followed by specification of required processe(s) (49%) and Information (45%). Last but not least roles are just considered by 29%.

Nevertheless, this analysis is limited by quantitative and qualitative factors. The range of selected literature sources and time frame could be extended in order to discover additional relevant paper. Furthermore, fee-based literature (e.g. Gartner Inc., Forrester Inc.) or additional library literature infrastructures could be analyzed to expand the set of recognized articles. Moreover, we could not exclude that some articles from 2015 were not available by the analyzed databases, because the current journal or conference edition was not indexed up until the SLA execution. From a qualitative point of view, the article analysis and classification was performed by a given process (e.g. SLR process, search string, threefold control) and given explanations for used concepts, but individuals perform and interpret information slightly different anyway. Most interpretations above provide information about the quantity of contribution not its quality within the scientific discourse.

4.4 INTERIM CONCLUSION

Enterprises reach their goals by implementing strategies. Therefore, organizations have to take appropriate actions, which are being summarized by these strategies. A successful strategy implementation is also accompanied by challenges that an enterprise has to face and to overcome. Enterprises require specific capabilities in order to be able to implement strategies efficiently and achieve a specific outcome.

In this context, the problem-selection *(P_L)* from the local practice has been described as well as whether and how *(P_L)* it can occur at other local practice partners *(μ1, μ2).* The various local practice situations were examined and documented for occurring problems in the identification and handling of the EAM capabilities *(μ3).* All studied cases showed a demand for a holistic capability concept and a method which can assist in the identification and management of EAM capabilities *(μ4).* In the next step *(P_L)* and its 11 sub-problems *(P_{Lnm})* were analyzed by *Root Causes (RC_n)*, which served as the basis for the relevance test against the knowledge base. Three central *(RC_n)* were identified *(μ6):*

RC_1: Lack of a consistent EAM capability understanding

RC_2: Standardized course of action is not available

RC_3: Missing stakeholder communication concept

In this context, we realized that capability related topics are widely treated in lots of different research areas and publications, which motivated us to get a comprehensive overview of the status quo in literature. In order to do so, this investigation merged six systematic literature reviews following the same structural pattern [38]. Therefore, we scanned five scientific databases and over 23 people analyzed more than 232 relevant articles. The results confirm our impression from Sect. 3.4, that the awareness of capability related topics increases and it will continue to increase in the next few years. The last few years have shown that quantitative-empirical analyses, literature reviews and case studies are suitable methods for capability research. Moreover, we could identify a trend of multi-methodological research approaches. The usage of different research approaches and methods in a single article seems to deliver more accurate research results and practice-oriented problem solving, which supports the utilization of respective approaches for our investigation as well *(μ7).*

Furthermore, the knowledge base analysis showed that there are a number of capability types (Figure 4.12), which can be distinguished by their focus areas and repeatedly appearing descriptive elements. Nevertheless, the found concepts could not solve *(P_L) (μ4, μ6).*

Under consideration of *(RC_1 – RC_3)* and results from knowledge base analyses, we abstract *(P_L)* → *(P_G)* and shift its relevance from local to global:

> *(P_G) A unified EAM capability approach is missing represented by a set of related architecture elements, identified, engineered and maintained by a procedure with structured actions, techniques, guidelines and illustrations in order to support various stakeholders.*

In order to find a solution for *(P_G)*, which is classified as wicked problem type 1 (Sect.2.2), as well as ensure that it is solvable we decomposed it into five key components, starting to find solutions for each module before putting it together (μ5):

(1) A unified EAM capability approach […]
(2) […] identified, […]
(3) […] engineered, […]
(4) […] and maintained […]
(5) […] by a procedure […].

Figure 4.14 illustrates the relationships between local practice partner, data collection activities and guiding principles of this research process step.

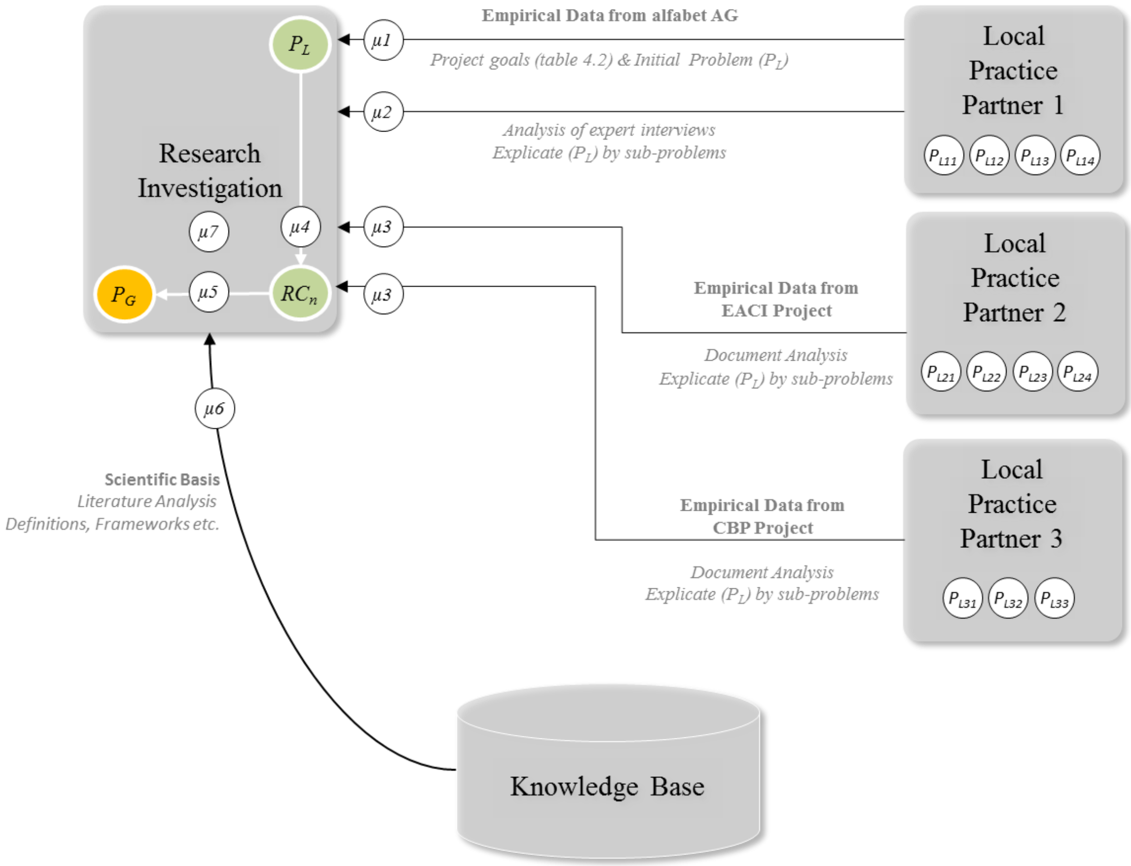

Figure 4.14 Problem Investigation Relationships and guiding principles.

5 DEFINE REQUIREMENTS

"What artefact can be a solution for the explicated problem and which requirements on this artefact are important for the stakeholders?"[21]

"Good design science research often begins by identifying and representing opportunities and problems in an actual application environment." [96, p.17]. Thus, the analysis of the local practices and its root cause analysis provide deeper insights on *(P_G)* and delivers indications for the artifact type and requirements on the artifact itself. We used results from the *problem investigation phase* as well as artifact type specific construction principles from scientific literature as resources. The controls include argumentative-deductive analysis based on the resource documents we used for qualitative content analysis.

The phase of *define requirements* starts in Section 5.1 with the classification of the artifact type to be developed and specification of its basic characteristics (*Outline Artifact*). Besides the artifact outline, Section 5.2 transforms the explicated problem into specific requirements on the artifact resulting from previous local practices, root cause analyses and artifact type selection (*Elicit Requirements*). The whole phase is illustrated in Figure 5.1.

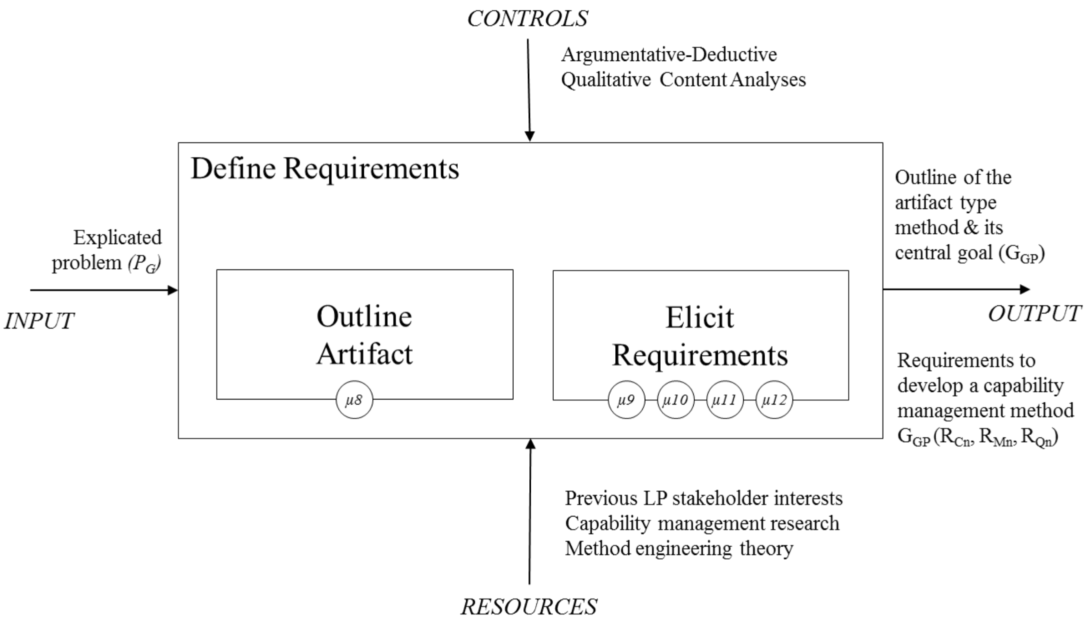

Figure 5.1 Research Process Step 2: Define Requirements.

For the requirement analysis, we followed a list of principles *($\mu 8$-$\mu 12$)* according to [21] in order to support the elicitation procedure:

μ8. *Specify the artifact:* Decision whenever the solution should be a construct, model, method, instantiation and describe corresponding to its general characteristics.

μ9. *Detailed formulation:* Precise, concise and understandable explanation of each requirement under consideration of *(P_G), (P_{Lnm}), (RC_n), (G_{PGn})* and type specific engineering principles of *($\mu 8$).*

µ10. Realistic and original: Implementation of the requirement should be realistic and original.

µ11. Sources of the requirements: Description of scientific literature and literature from practice as well as stakeholders that contribute to the requirements or corresponding (sub-) problems or root cause relation.

µ12. Description of the requirement definition process: How were the requirements defined – in terms of stakeholder involvement and reviewed literature.

5.1 OUTLINE THE ARTIFACT

We chose the *design research* paradigm because within this paradigm *"[…] a designer answers questions relevant to human problems via the creation of innovative artifacts, thereby contributing new knowledge to the body of scientific evidence."* [96,p.5]. In order to solve (P_G) and finding an answer to *RQ* this investigation argues that the constructed solution could be a procedure that supports the management of EAM capabilities involving a standardized and well defined capability approach. The produced artifact handles identification and structuring procedures for EAM capabilities and supports governance and maintenance functionalities.

Input for this part of the research process is the explicated problem *(P_G)* of the *problem investigation phase* (Figure 5.1), which suggests the development of a method. In order to verify this assumption within the DSR, the DSR framework analysis of [20] is used *(µ8),* which is illustrated in Table 5.1. With regard to the differentiation step (1) the main difference between design science and design research has been already discussed within the Section 2.2. Under consideration of outlining the artifact in its narrower sense (3) and of its main components (Sect. 4.4), the assumption that an artifact to be developed is a *method*, which is constructed and further developed by situational evaluations (4), can be confirmed.

Table 5.1 Analysis framework for IS design science research, according to [20].

<table>
<tr><th>According to [20]</th><th colspan="2">Design Science</th><th colspan="2">Design Research</th></tr>
<tr><td>Differentiation (1) separates IS design science</td><td colspan="2">reflection and guidance of artifact construction and evaluation processes</td><td colspan="2">construction and evaluation of specific artifacts</td></tr>
<tr><td>Differentiation (2) separates the reflection of IS artifact construction and IS artifact evaluation.</td><td>Reflection of artefact construction</td><td>Reflection of artefact evaluation</td><td colspan="2">---</td></tr>
<tr><td>Differentiation (3) separates IS design research in its narrower sense</td><td colspan="2">---</td><td>construction and evaluation of situational artifacts</td><td>problem-specific adaptation and utilization of situational IS artifacts</td></tr>
<tr><td rowspan="2">Differentiation (4) separates construction, evaluation, and adaptation processes with regard to their respective object.</td><td>Model</td><td>Construct</td><td>Model</td><td>Construct</td></tr>
<tr><td>Method</td><td>Instance</td><td>Method</td><td>Instance</td></tr>
</table>

There are different views on the characteristics and components of a *method* and therefore there are also different definitions available [379]. Furthermore, in the literature the terms *methodology* and *procedure model* are often used as synonyms or cannot be used without overlapping as method term [379,380]. To raise the substantive and conceptual demands on the artifact to be developed, the understanding of methods will be explained hereafter, which has been used in this work. In this context, the terms *methodology*, *procedure model* and *method* will be discussed in more detail.

A *methodology* describes a systematic approach for the design and development of a system (target state) and includes a number of phases, rules, activities, techniques, procedures, tools, documentation, guidance and training for its achievement. For that reason, a methodology supports and enhances the design and development process of the desired state by specifying the activities to be undertaken and standardized [381,382]. As a consequence, a methodology describes an ordered set of techniques and tools that will enable its users to solve a specific task (for example, mathematical problem, developing an IS) [383].

The term of *procedure model* is divided into two components: the *procedure* and the *model*. A *procedure* describes the way to do something. In combination with the already presented model definition (Sect. 3.2), it can be deduced that a procedure model represents a schematic, here pictorially illustrated and simplified description of how to proceed. The procedure may be defined in a specific sequence of successively processed phases, in which corresponding steps can be performed in turn. In this context, the substantive overlap / distortion begins with the concept of methodology, because these steps are described with regard to the rules to be observed, techniques or tools and therefore both terms cannot be clearly distinguished.

A *method* can be defined as a set of activities that is based on a set of concepts and is used as a sequence to attain [scientific] knowledge or practical results where a set of methods describes a *methodology* [216]. A method can therefore be understood to be a specific part of a methodology. In [380], it is noted that in the literature the term method is often mistakenly replaced by the term methodology. In view of the above and the resultant argumentative framework, the artifact type of this work is based on the method approach of Goldkuhl et al. [214] and will be presented in detail as part of the requirements specification. In this connection a method is understood as follows:

> *A method describes a collection of procedures, notations, and concepts forming the method component(s), which are structured in a framework, guided by a set values, principles and/or motivations under consideration of the required participants in order to achieve a specific goal [214,216].*

In order to summarize the central purposes of the artifact to be developed on basis of *(P_G), (RC_n)* and the specified type, we define the following set of goals *(G_{GPn})* for its development as follows:

> ***(G_{GP})*** *Development of a method that systematically supports identification, structuring and maintenance of EAM capabilities through a structured process gathered in an enterprise specific EAM capability catalog. The method has to operationalize the following global practice goals (G_{GPn}):*
>
> *$G_{GP1:}$ Introducing an integrated and standardized capability approach (RC_1)*
> *$G_{GP2:}$ Scoping and preconditions for capability management (RC_2)*
> *$G_{GP3:}$ Identification of involved stakeholders (RC_3)*
> *$G_{GP4:}$ Identification of EAM capabilities and its relations (RC_2)*
> *$G_{GP5:}$ Structuring of EAM capabilities in a catalog (RC_2)*
> *$G_{GP6:}$ Governance of the resulting EAM capability catalog (RC_2)*

5.2 ELICIT REQUIREMENTS

The EAM is restricted by different constraints occurring in its internal, micro- or macro environments (Sect. 3.1, Sect. 3.3.4). Developing an artifact which supports EAM, it has to meet a set of requirements arising from these environments. Consequently, the specification of requirements represents an important step regarding the design and development phase.

> *"A requirement is a property of an artifact that is a deemed as desirable by stakeholders in a practice and that is to be used for guiding the design and development of the artifact."[21,p.103].*

In order to elicit upcoming requirements we distinguish between *conceptual-, method-implied-, quality-* and requirements. *Conceptual requirements* relate to desired purposes of the artifact in terms of inputs, behaviors and outputs. *Method-implied requirements* refer to properties regarding the construction of the specific artifact type. *Quality requirements*, sometimes called non-functional requirements, are those that could be used to evaluate the other requirement types.

According to [213], we justify our requirement choices by a so called *contribution argument*, that represents a statement that an artifact satisfying requirements would contribute to a global practice goal *(G_{GPn})* under consideration of our local practice analysis (Sect. 4.2). Therefore, we design our upcoming requirement elicitation as follows:

$R_{C,M,Q}$: *(Root Cause) x (Local Practice Source) x (expected benefits) contribute to (G_{GPn})*

The resulting set of requirements is the basis for a first solution (S_{GP1}) approach of the design and development phase (Sect. 6), which in turn forms the foundation for upcoming DSR methodology based demonstration and adjustments cycles *(S_{GPn})* (Sect. 7).

5.2.1 CONCEPTUAL REQUIREMENTS

The upcoming method should be a general and flexible process that supports the creation of a capability catalog by identifying, structuring and evaluating capabilities in the context of the EAM discipline. Section 4.3 shows that the term capability is firmly established in practices even though there is no generally agreed definition or standard management approach for it (*RC_1- RC_3*). In this context, the following tables describe on one side the requirements for an Integrated Capability Approach (Table 5.2) and on the other side the requirements for a standardized management method (Table 5.3) with respect to the fundamental root causes and relations to the results of practical problem analysis.

Table 5.2 Conceptual Requirement Set 1: Integrated Capability Approach (µ11).

Requirement description (µ9 & µ10)	Source: Local Practice-/ Knowledge Base (µ12)	Contribution & Benefits
In particular, consistent definition of the corporate capability understanding represents one of the most important criteria for EAM capability identification, because a precise and common concept definition helps to find even the capability candidates, which are not obvious at first glance that in turn support the completeness of the final catalog and therefore the quality of the assessment of strategy options (strategic choice). Moreover, to ensure a precise capability definition its components need to be understood as well. Distinct component definitions improve the measurability of the capability as a whole, which represent an important requirement of the local practice also in light of the strategy assessment. A precise and standardized capability understanding, an integration into existing concepts and a specification of its characteristic descriptive elements is required. *R_{C11}: General and reusable term classification concept*	The problem has been exacerbated by alfabet's product focus and market orientation in terms of its special interest in EAM capability management. The way of using EAM capability approaches depends on the specific customer project. Different EAM capability approaches in combination with different customers leads to a wide range of not comparable results. And if results are not comparable it is hardly possible to extract overarching mistakes or similarities, which is a foundation for economic behaviors. Derived from: *RC_1* Analyzed LP: *P_{L11}, P_{L14}, P_{L21}, P_{L31}* Expected benefits:	Contribution to: *G_{GP1}* Expected benefits: *Increased efficiency in the introduction of a capability-based thinking approach, because concepts and definitions are distinct from the outset.* *Enable enterprise/industry benchmarks by relying on a standard EAM capability model*

R_{C12}: *Concept for capability type differentiation* R_{C13}: *Composition by EA elements* R_{C14}: *Possibility of mutual dependencies & hierarchies*		

Table 5.3 Conceptual Requirement Set 2: Standardized Management Method (µ11).

Requirement description (µ9 & µ10)	Source: Local Practice-/ Knowledge Base (µ12)	Contribution & Benefits
A method for identifying, structuring and maintenance of EAM capabilities as well as a definition of its elements in various use cases. R_{C21}: *Identification approach of involved parties* R_{C22}: *Definition procedure of terms and preconditions* R_{C23}: *Identification of capability types for operationalizing of strategic objectives* R_{C24}: *Systematic capability identification procedure* R_{C25}: *Structuring approach for gathered capabilities* R_{C26}: *Maintenance concept for the capability repository* R_{C27}: *Notation for EAM capability modelling* R_{C28}: *Structured capability content construction on an appropriate level of detail*	Moreover, its participants are using different methods that did not always lead to satisfactory result in terms of costs and benefits. Thus, it should be searched for a methodological standardization, which defines the terminology & management of capabilities as well as enables the reuse. Derived from: RC_1, RC_2, RC_3 Analyzed LP: P_{L11}, P_{L14}, P_{L21}, P_{L31}, P_{L22}, P_{L31}, P_{L32}, P_{L13}, P_{L22}, P_{L32}	Contribution to: G_{GP2} G_{GP3} G_{GP4} G_{GP5} G_{GP6} Expected benefits: *Strategic decisions are based on a structured method to produce EAM capabilities to improve the information quality.* *More time for analyzing and understanding the overall context since the methodology is already preset and no longer has to be developed.* *Support CIOs and IT management leaders with a method to implement fit-for-purpose EAM capabilities* *Reduction of project implementation risks by ax ante capability based decisions.*

5.2.2 METHOD IMPLIED REQUIREMENTS

We distinguish between two categories of method implied requirements. The first requirement set is predefined by the artifact type selection, because method engineering has to consider particular construction principles from the knowledge base to guarantee scientific rigor (Table 5.4). The aspects of second requirement set are derived from RC and additional local practice partners, which relate to flexibility, modularity and coherence desires (Table 5.5).

Methods and its construction are frequently used in many different disciplines for many different purposes which have been thoroughly researched during the last decades [215]. Nevertheless, there is no universal consensus within the academic discourse about which method engineering approach is better. Therefore, a suitable method engineering approach is up to the specific construction scenario and should be individually chosen for each case. For this investigation we used the method engineering approach of [214] in order to specify appropriate construction requirements for this investigation.

Table 5.4 Method Implied Requirements Set 1: Method Engineering (µ11).

Description (µ9 & µ10)	Source: Local Practice-/ Knowledge Base (µ12)	Contribution & Benefits
A method has to be a collection of procedures, notations, and concepts linked together in phases and arranged in a framework, guided by a set of principles in order to manage EAM capabilities. R_{M11}: *Procedure: describes how to perform a process step.* R_{M12}: *Notation: describes how to document a process step.* R_{M13}: *Concept: summarizes several circumstances that connect procedure and notation.* R_{M14}: *Framework: consists of different method components and constitute a structure.* R_{M15}: *Perspective: basis; implicitly or explicitly; summarizes goals, values, principles and motivations.* R_{M16}: *Co-operation Forms: define who cooperates with whom and in which form* R_{M17}: *Method Component: describes the close relation between procedure, notation and used concepts.*	A method is understood as a descriptive instruction sheet that aims to include all necessary rules and guidelines to achieve certain goals depending on a specific situation. These instructions are called *procedures*. Thus, a procedure describes the workflow and provides instructions regarding what kind of activities and information are relevant [83]. The *notation* closes the need of a representative documentation of conclusions and modeling of the outcomes of the procedure. *Concepts* describe the links between procedures and its notations by specifying what to talk about in terms of objects and reference points. The close relation between *procedure, notation* and *concept* forms the *method component*. Several method components can be merged to a concrete method, which is based by a related and specific perspective. This perspective can be implicit or explicit, describing values, principles and motivations, which have to be operationalized within the method component(s) [215,216]. Thus, the perspective represents the conceptual and valuable bases of a method. According to [215], the set of method components is called *framework*, if they align to a concrete structure and can be divided into specific phases. The *co-operation forms* define roles that describe how different stakeholder interact and co-operate when executing the method guided work [216]. It is important to distinguish between a procedure and co-operation form because method components can be used within a number of different forms of collaborations [216]. Additionally, *collections forms are* introduced to specify who performs single method activities and how single results are integrated together at the end [216]. The entire method engineering approach is illustrated in Figure 5.2 and stresses the indicative questions related to its elements.	*Supports scientific rigor, since the development of methods is based on a scientific based engineering approach.*

Table 5.5 Method Implied Requirements Set 2: Architecture (µ11).

Description (µ9 & µ10)	Source: Local Practice-/ Knowledge Base (µ12)	Contribution & Benefits
R_{M21}: *Recombination of single method components should be possible (modularity)* R_{M22}: *The method should be logically, orderly and consistently related (coherence)* R_{M23}: *Adequate granularity layer for a various set of stakeholders under consideration of its information demands.*	Different local practice partner require standardized method approach with a certain degree of flexibility. In order to be flexible the solution should suitable for adaptation and integration as well as stakeholder compliant granularity. Derived from: RC_2, RC_3 Analyzed LP: P_{L22}, P_{L31}, P_{L32}, P_{L13}, P_{L22}, P_{L32}	Contribution to: G_{GP3} G_{GP4} G_{GP5} G_{GP6} Expected benefits: *Modular design allows the use in various enterprises / application scenarios in various industries, sizes and can be used for SME as well.*

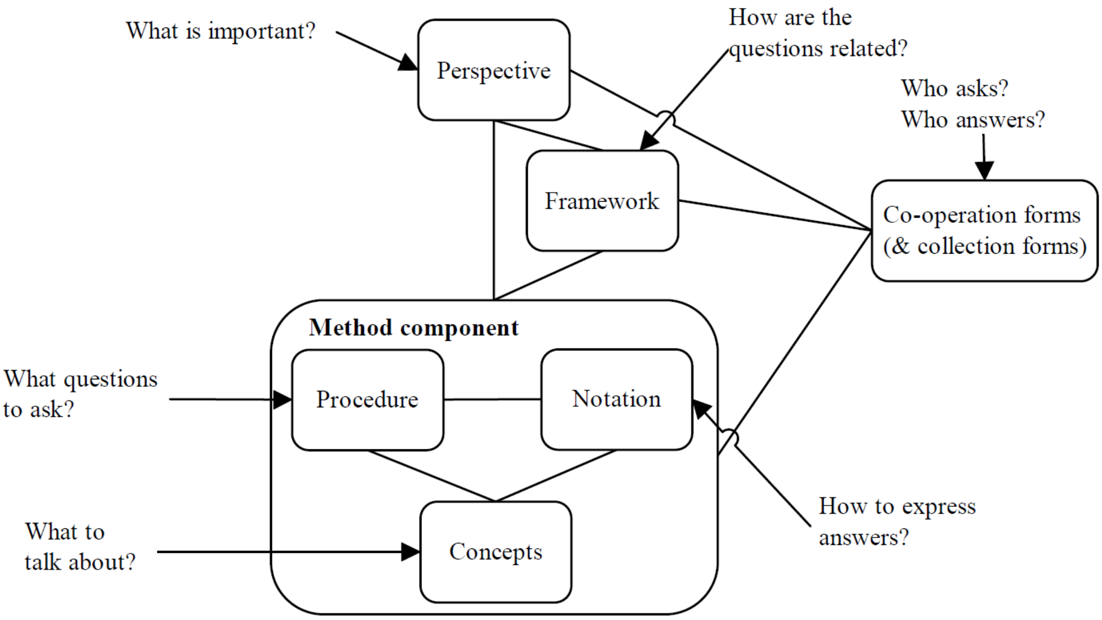

Figure 5.2 Conceptualization of the method engineering approach, according to [216,217].

5.2.3 QUALITY REQUIREMENTS

In contrast to the *conceptual requirements* that define a specific behaviors in terms of what the method should do, here we specify requirements to judge these behaviors in terms of how the method should behave and act as a kind of quality criteria. For this purpose, we derived three sets of quality requirements. The first set of requirements considers the measurability mechanisms of EAM capabilities in order to achieve transparency in the resulting value for the enterprise (Table 5.6). The second set of requirements refers to requirements relating to the handling and use of developed concepts (Table 5.7). The last set of requirements contains all requirements relating to the management and administration of the method (Table 5.8).

Table 5.6 Quality Requirements Set 1: Measurability & Value (µ11).

Description (µ9 & µ10)	Local Practice (µ12) and/ or RC Source (µ11)	Contribution & Benefits
R_{Q11}: *Decisions concerning identification and integration of necessary stakeholders, used capability concepts, required efforts and desired value have to be traceable.* R_{Q12}: *Defined capability components should be measureable in order to assess its status and benefits for a concrete strategic implementation* R_{Q13}: *The method should provide a high-level communication medium of current and desired EAM capabilities and its relations to other elements of the EA e.g. vision, strategy or goals.*	The method should describe how EAM capabilities form the bridge between the business leaders and the enterprise architecture practitioners under consideration of its relations to EA elements and economic aspects like value and its assessment. Derived from: RC_2, RC_3 Analyzed LP: P_{L22}, P_{L31}, P_{L32}, P_{L13}, P_{L22}, P_{L32}	Contribution to: G_{GP2} G_{GP3} Expected benefits: *Enables enterprises to make more informed decisions that improves its quality* *Enable enterprise/industry benchmarks by relying on a standard EAM capability model* *Support of capability-based investment decisions in terms of buy-in, build or outsource decisions*

Table 5.7 Quality Requirements Set 2: Usage (µ11).

Description (µ9 & µ10)	Local Practice (µ12) and/ or RC Source (µ11)	Contribution & Indicators
R_{Q21}: *Usability refers to the experienced user quality when interacting with the method. Particularly, simple in operation simultaneously combined with satisfied user expectations regarding target achievements receives a high usability.* R_{Q22}: *In order to enhance the understandability the method should include wordings, expressions, recommendations, guidelines and visualizations (Comprehensibility).* R_{Q23}: *Standardization of using a method by means of structured procedures and its documentation should guarantee its traceability and repeatable.*	Usage requirements involve aspects concerning the method should work and perceived in use situations. Derived from: RC_1, RC_2, RC_3 Analyzed LP: P_{L11}, P_{L14}, P_{L21}, P_{L31}, P_{L22}, P_{L31}, P_{L32}, P_{L13}, P_{L22}, P_{L32}	Contribution to: G_{GP1} G_{GP2} G_{GP3} G_{GP4} G_{GP5} G_{GP6} Expected benefits: *The quick understanding of the method content and an easy handling supports the acceptance and continuous use of the method in the enterprise.*

Table 5.8 Quality Requirements Set 3: Governance (µ11).

Description (µ9 & µ10)	Local Practice (µ12) and/ or RC Source (µ11)	Contribution & Indicators
R_{Q31}: *The method has to define mechanisms that support the recognition of faults, their causes and its correction as well as integrate new requirements occurring from enterprises' changing environments (maintainability).* R_{Q32}: *Method components should be suitable for adaption and integration of additional components (flexibility).* R_{Q33}: *The ease with which an actor can be made accountable for the workings within the CMG execution (accountability).* R_{Q34}: *The method has to include all aspects required for managing EAM capabilities (Completeness).*	Governance requirements describe how the artifact should be managed over time regarding maintenance, flexibility, accountability and completeness. Derived from: RC_2, RC_3 Analyzed LP: P_{L22}, P_{L31}, P_{L32}, P_{L13}, P_{L22}, P_{L32}	Contribution to: G_{GP3} G_{GP4} G_{GP5} G_{GP6} Expected benefits: *Even with flexible application of the method, decisions should be transparent and understandable by the clear allocation of responsibilities.* *Reducing the duplication of effort, because the method is subject to a continuous update process and will be adapted accordingly with the respective company.*

5.3 INTERIM CONCLUSION

Within the framework of this research process phase, the solution to be developed has been classified as an artifact of the type method and their general characteristics have been described accordingly *(µ8)*. All 32 requirements were derived from *(P_G)* under consideration of local practice sub-problems *(P_{Lnm})*, its root causes *(RC_n)*, *(G_{PGn})* and artifact type specific engineering principles *(µ9-µ12)*.

The requirements types and its properties were not evaluated regarding its suitability by LP stakeholder afterwards. This kind of feedback loop is integrated in next the phase where we performed questionnaires on specific requirement types (Sect. 6.2.4).

Finally, the general concept of the artifact can be summarized as follows: The method is developed for all interested parties, independent of the enterprise size, branch or market. It includes working steps and specific recommended tools to visualize and notate these ones. Hence, it is adoptable to different capability related circumstances. Due to this fact, the method is addressed to all organizational departments and parties interested in the capability topic itself, BITA issues or managing challenges of strategic transformations.

Due to the application of capabilities as communication and planning instrument (mediating role), the method is suitable for both parties. Problem definition and scoping, capability development as well as structuring and governance are significant topics in order to use the full potential of capability based approaches, especially for *newcomers*. Advanced capability users can apply the method in different ways, depending on the situation of use. Therefore, the method can be used as reference work for reading up on subjects of interest for the *advanced-capability-user*. Capability gathering approaches, structuring methods, type differentiation, helpful capability frameworks and maturity models are subjects covered in the modular structure of the method. Each module can be used independently of the other, provided that the background knowledge is sufficient.

6 DESIGN & DEVELOPMENT

"Create an artefact that addresses the explicated problem and fulfils the defined requirements!"[21]

In order to create a method specified in the previous activities this phase includes the design and development of the artifact under consideration of its conceptual-, method implied- and quality requirements. This comprises design and development decisions and its rationale in terms of LP and research community consultations as well as knowledge base investigations. Moreover, we used knowledge from research literature and other written sources (e.g. organizational records) as well as embedded knowledge from researcher and relevant practitioners. Furthermore, a software prototype was developed for CMG method support, which is used for modeling EAM capabilities. The controls of this research phase include literature reviews, questionnaires, prototyping, qualitative- and quantitative data analysis techniques.

This phase includes four sub-steps illustrated in Figure 6.1, beginning with gathering first ideas and assumptions and elaboration existing ones in order to provide a set of fundamental design directions in Section 6.1 (*Initial Assumptions*). In the Section 6.2 *(Method Structure)* and Section 6.3 *(Method Component)* steps we constructed the individual method components and define interrelationships. Finally, in Section 6.4 we summarize major design and development decisions (*Reflect and Justify*). The outputs of this research process phase are previously published in [52,84,85,87,133], which are referenced at the beginning of each section.

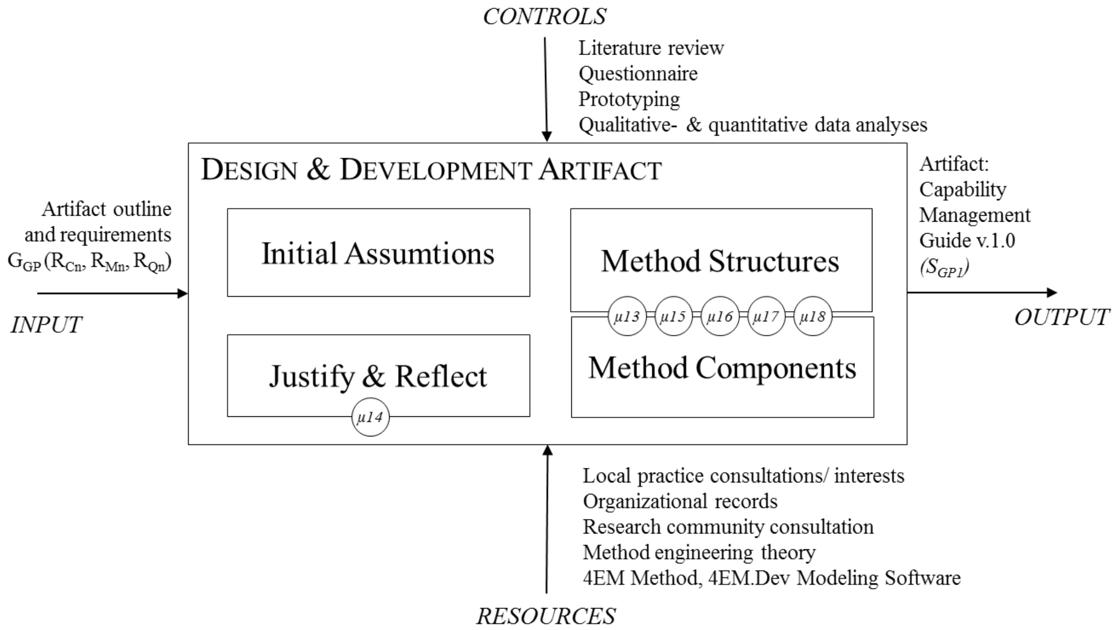

Figure 6.1 Research Process Step 3: Design and Development Artifact.

For proper design and development activities [21] proposed the following list of principles *(µ13-µ18):*

µ13. Clearly describe each component: Explanation of the structure and functionality of each artifact component.

µ14. Justify each component: Description of the purpose of each component as well as its contribution to a responding requirement. Understandable explanation how to use the artifact and single components in its intended practice.

µ15. Describe the use: Understandable explanation of how to use the artifact and its single components in its intended practice.

µ16. Clarify the originality: Show that the solution is different to existing ones in terms of its functionality and structure.

µ17. Specify the sources of the design: Description of literature sources and/or local practices that influences the design and development of single artifact components.

µ18. Describe the way how the artifact has been designed and developed: Explanation of the design and development process in terms of how single components are developed and local practices and research communities be involved as well as scientific literature has been reviewed.

6.1 INITIAL ASSUMPTIONS

This section provides first assumptions for a solution based on the problem definition and requirements from the previous section. Therefore, we imagined first assumptions for a solution and elaborated existing ones from our LP partners.

In order to find a solution for (P_G) we already decomposed it into its key components (Sect. 4.4) to find initial assumptions for its solution based on its conceptual- and method implied requirements:

(1)	A unified EAM capability approach […]	→ (R_{C11}- R_{C14})
(2)	[…] identified, […]	→(R_{C23}-R_{C25}, R_{C27})
(3)	[…] engineered, […]	→ (R_{C27}, R_{C28}, R_{M23})
(4)	[…] and maintained […]	→ (R_{C26})
(5)	[…] by a procedure […].	→ (R_{C21}, R_{C22}, R_{M11}- R_{M17}, R_{M21}-R_{M23})

(1) **CAPABILITY APPROACH:** Many different definitions of the term capability exist and different capability types have been presented in Section 4.3.3. Thus, we thought about a conceptualization of EAM capabilities and contemplated about its core elements and characteristics more deeply. Based on the capability types from the systematic literature review we began analyzing the documents to find type similarities i.e. descriptive elements of a capability and its relationships. On the basis of similarities in different definitions, capability elements and theoretical principles we tried to find a conceptual structure (R_{C13}). This structure should enable an *Integrated Enterprise Capability Approach* (Sect. 6.2.4) that could specify different capability types and hierarchies more unified and repeatable (R_{C11}, R_{C12}, R_{C14}). Furthermore, already available frameworks and assessment methods were examined, which are being used to identify and refine capabilities (Appendix C2). Besides the facts from literature, we performed two group discussions together with stakeholders of the EACN project [241].

(2) **IDENTIFICATION**: Based on Section 3.3 the management of something generally deals with activities like planning, organizing, staffing, directing, coordinating, reporting, decision making, budgeting and controlling [172]. In various stakeholder discussions about the management of EAs we recognized heterogeneous opinions about the contents of single EA management activities [241]. Thus, we started with a compromised management approach only containing planning, transforming and monitoring activities based on [12]. Building on this, we started sketching a concept that combines the integrated capability approach from (1) and the three management activities, because we assumed that each EAM capability is at least based on one of these general activities and the EA objects to be managed. Thus, we came to the conclusion that possible capability candidates could be found in a solution space, called *Capability Identi-*

fication Matrix (Sect. 6.3.2), comprising an appropriate capability concept and EA management activities. This assumption should provide the basis for structured and repeatable capability identification, structuring and documentation activities (R_{C23}-R_{C25}, R_{C27}).

(3) **ENGINEERING**: In addition to the identification of capability candidates the characteristics of its individual elements must be created on a sufficient level of detail. If capability candidates are identified, the method has to include activities for structuring and exploring relationships as well as guidelines how to enhance capability descriptive elements with appropriated content. In order to provide method stakeholders with a sufficient level of details we defined three content layers (R_{C28}, R_{M23}). The first layer is represented by the set of identified EAM capabilities, its names and short descriptions. The second layer specifies the capability content in terms of its descriptive elements. The third layer should be used to specify different kind of capability indicators to provide assessment criteria e.g. for current and to-be states evaluations. To document the found EAM capabilities using a standardized notation *(R_{C27})* and software, the development of a prototype was started, which provided an extension of 4EM-method [15] and the related modeling software 4EM.Dev[10] (Sect. 6.2.5).

(4) **MAINTENANCE**: Ensuring the desired quality of identified capabilities and content over time, a set of maintenance activities is required. Enterprises are continuously confronted with environmental challenges which results in a need of an up-to-date EAM capability catalog. Thus, we argued for an ongoing maintenance process that simplifies modifications and reorganizations by a defined set of measures (R_{C26}) (Sect. 6.3.4).

(5) **METHOD**: All these activities combined with the artifact outline (Sect. 5.1) bring us to the assumption that we need at least one method component for each key component (1-4) in order to meet modularity (R_{M21}). The framework (R_{M14}) constructor of the chosen method engineering approach ensures logically, orderly and consistently related method components (R_{M22}). Furthermore, we meet method implied requirements set 1 (R_{M11} – R_{M17}) by implementing its specified components (Sect. 6.2, Sect.6.3). The method to be developed is named: *Capability Management Guide (CMG).*

6.2 METHOD STRUCTURE

According to the method implied requirements set 1 (Sect. 5.2.2), we follow the method engineering approach of [216]. The design of the method to be created, also called guide from here, is aligned to proposed elements and concepts. Nevertheless, in accordance with the quality requirements set 1 (Measurability & Benefits), 2 (Usage) and 3(Governance) we renamed proposed vocabularies without changing its concepts and relations. The mapping of vocabularies [214,216] to the method ones as well as corresponding requirements is illustrated in Table 6.1.

Table 6.1 Overview – Method engineering components and its mapping on artifact structure.

Method engineering components according to [216]	Initial assumptions (Sect. 6.1)	Mapping method structure on CMG content structure	Reference in the thesis	Considered Requirements
Method Component	Three major actions: Identification, engineering, maintenance.	Building Blocks (BB) & Working Steps (WS) *(CMG chapters)*	Preparation (*Sect. 6.3.1*) Design Catalog (*6.3.2*) Detail Development (*6.3.3*) Catalog Governance (*6.3.4*)	R_{M17}, R_{M21}, R_{Q21}, R_{Q32}, R_{Q34}
Procedure	Solution space: EA management functions x EA	Objectives & Activities of each Working Step	Precondition and stakeholder analysis (Sect. 6.3.1), Integrated Capability Approach (Sect. 6.3.1), Ca-	R_{C21} – R_{C26}, R_{C28}, R_{M11},

[10] http://www.4em-method.com/de/projekte, last visit 29.04.16.

	elements; Content Layer Approach,	*(CMG sections)*	pability Identification Matrix (Sect. 6.3.2), Content Layer Approach (Sect. 6.3.3), Capability catalog Extensions pattern (Sect. 6.3.4)	R_{M23}, R_{Q11}- R_{Q13}, R_{Q21}, R_{Q31}
Notation	4EM Method Integration, 4EM.Dev Capability Extension	Documentation & Visualization for each Working Step *(CMG BB chapters → available as of CMG v2.0)*	4EM capability extension and 4EM.Dev Prototype (Sect. 6.2.5), Different visualization approaches (Sect. 6.3.3, Sect. 6.3.2)	R_{C27}, R_{M12}, R_{Q13}, R_{Q23}
Concept	Capability Approach	Terminology & Useful Approaches for each Working Step *(CMG WS sections)*	Integrated Enterprise Capability Approach (Sect. 6.2.4)	R_{C11}-R_{C14}, R_{M13}, R_{Q22}
Framework	n/a	Process Model *(Introduction chapter)*	A four phase based process model. (Sect. 6.2.2)	R_{M14}, R_{M21}, R_{M22}, R_{Q21}, R_{Q32}
Perspective	n/a	Motivation & Overview, Objectives *(Preface & Motivation chapter)*	Description of macro-, micro-, internal environmental challenges and why EAM capabilities are helpful. What aims can be support by applying the CMG. (Sect. 6.2.1)	R_{M15}, R_{Q34}
Co-operation Forms	n/a	Role model *(Introduction chapter → available as of CMG v2.0)*	Responsibility assignment matrix based on RASCI activities (Sect. 6.2.3)	R_{M16}, R_{Q33}

The following sections and explanations are based on the first version of the Capability Management Guide, published as peer-reviewed book chapter [87]:

> Wißotzki, M. "*The Capability Management Process - Finding Your Way into Capability Engineering*" In Simon, D.; Schmidt, C. (Eds.) (2015): Business Architecture Management - Architecting the Business for Consistency and Alignment, Management for Professionals, (Chapter 5), Springer, 2015, ISBN: 978-3319145709.

The CMG v1.0 (printed handbook) starts with a preface. In the second chapter the main objectives of capability management and guidelines for introducing a capability-based approach are motivated as well as the general guide structure. Furthermore, reading recommendations are presented - both *newcomers* and *advanced capability* users - are generally addressed. In particular, people with EAM backgrounds are specified as target group of the CMG. In the third chapter challenges and values are explained to introduce the importance of the topic (*perspective*). Moreover, important terms for a common understanding are defined as well as the introduction of the integrated capability approach (*concepts*). The fourth chapter provides an intensive overview of the underlying capability management process (*framework*). Moreover, the "*How to use*" of the guide is explained by describing the roles relevant for its execution (*co-operations forms*). The following chapters explain the building blocks of the CMG in detail. Every building block (preparation, catalog design, develop details and governance) is divided into working steps and their aligned objectives, stakeholders, possibilities for documentation and visualization, as well the used definitions. Examples stress the recommendations (*procedure, concept, notation, co-operation forms*). Those chapters are summarized by a conclusion. Named approaches and methods are shortly explained and further literature is recommended if more interest in details is present in a glossary (*concepts*). The used academic literature sources as well as practice-oriented papers are referenced in the last chapter.

Figure 6.2 shows the relationships between the CMG structure, the method engineering components from Table 5.4 and the requirement sets from Section 5.2.

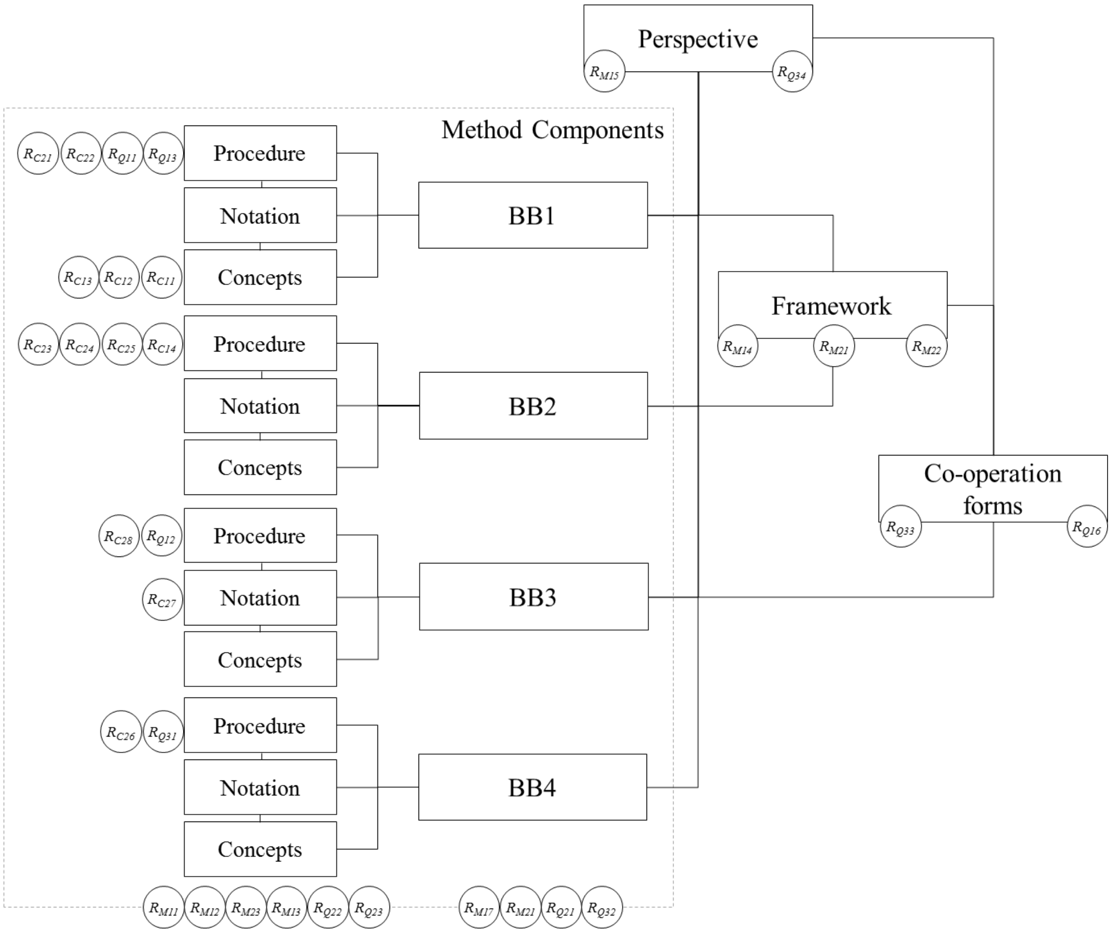

Figure 6.2 Conceptual structure of the CMG v1.0 development.

6.2.1 PERSPECTIVE

The method *perspective* can be implicit or explicit, describing goals, values, principles and categories, which have to be operationalized within the method component(s) [215,216]. Thus, the perspective represents the *conceptual* and *valuable bases* of our method and is part of the CMG v1.0 introduction chapter. In order to pick up newcomers of the topic, perspective explanations start with challenges caused by the *macro- and micro-environment*, followed by exemplary challenges relating to the *internal-environment* to pick up / motivate *advanced-capability-user* (Sect. 5.3). Therefore, the description of the perspective is based on content of the CMG v1.0 publication [87] and was as follows:

Triggered by the progressive change from an industrial to an information society, not only social but also economic conditions are modified. Moreover, the speed of changes in *macro-environment* and the society itself have increased considerably in recent years. The list below exemplary shows some *macro-environment* factors (Sect. 3.1):

- *Globalization:* Digital collaboration, distributed- and cloud computing and virtual organizations inter-operationality brings international markets closer together. Substantially lower structural, strategic, institutional and technical barriers support the global presence of companies [387,388].

- *Digitalization*: The dynamic of technological innovation requires adaptations in product policies and technology structures of entire industries and allows new class of products, markets and organizations [386,387].
- *Innovations cycles and trends:* Innovations occur at shorter intervals, thus shortening the period of adaptation of markets and businesses is a key success factor [304].

All of the *macro-environment* factors determine and affect corporate actions und shift enterprises from stable towards dynamic market conditions [384,385]. As a result enterprises are faced with new *micro-environmental* challenges to keep their market position, transparency and efficiency. Thus, we introduce a set of influencing *micro-environment* challenges.

[94,p.182] names the fundamental changes as: "*Environmental turbulence (dynamism) is the rate and instability of the environment, which is the result of changes in customer preference, development of new products, new technology, or the competition.*" Hence, enterprises have to be more sensitive towards the implementation of business strategies and their [affecting] consequences. Enterprises are complex, highly integrated systems comprised of processes, organizational units, information, and supporting technologies, with multifaceted interdependencies between each of these [227]. In fact, while enterprise structures are becoming increasingly complex, changes inside such structures have frequently presented enterprises with challenges over the last few years [52,60]. This issue is emphasized by the fact that "business-critical" projects fail in two out of three enterprises. A lot of decision makers experience failure in their "*business-critical*" projects because of conflicting interests, insufficient information quality, or decisions being taken elsewhere [62]. Above all, there are several micro- environment factors that trigger and/or influence enterprise-wide transformations:

- *Fast changing or new business models* might require more agile business operations and IT to provide completely new capabilities (e.g., car manufacturers that become mobility providers or telecommunication infrastructure enterprises that become full service providers) [67,304].
- *Customer empowerment:* Market transparency leads to smart customers, declining barriers lead to decreasing customer loyalty, reduced by homogenization of markets, transparency allows customers to identify product problems easier and provides the possibility to communicate this (e.g. social networks, recommendation systems) [387].

In addition to the *macro- and micro environment* challenges, we already mentioned a set of challenges in Section 1.1 and Section 3.3.4, which will be used as an example of *internal- environment* challenges.

- *Mergers & acquisitions* require consolidation and elimination of redundancies to form a "new" architecture that supports the whole business at a high-quality level at lowest possible costs [64,65].
- *Sourcing strategies* like outsourcing, insourcing, offshoring, or cloud computing create a distributed landscape with completely new requirements for the governance processes [66].
- *Budget restrictions* especially limit the resources used for transformations in the small-to-medium enterprise (SME) context [59, 65].
- *Unable to express information demands:* Enterprises are often unable to express its information demand, which makes it difficult if not impossible to design a fit-for-purpose solution.
- *Data quality and consolidation:* Information quality depends on the degree of data excellence which seems to be one of the biggest obstacles for enterprises [346]. **"**Information is outdated: 14 months old & 55% accurate" [63]. "Information is weak: On average 20% of applications are redundant" [61].
- *Missing common language:* Since the roles and responsibilities have to be defined clearly in an organization, a consensus on a common terminology has to be achieved [20].

Economic success is dependent on sound strategies that support the realization of defined goals. Therefore, aside from being aware of the existing challenges and problems, it is also essential to continuously gather and assess information about organizational knowledge, responsibilities, available resources, and processes required for strategy implementation. Thus, *strategy implementation* represents the value-based part of the overarching method perspective. In line with the description provided in Section 3.3.1, a strategy serves as a mediator between goals and its realization in terms of, e.g., action catalog packages, considering other motivational elements such as directives, values, constraints, and drivers. Goals of an enterprise and strategies used to achieve these goals may lead to the adjustment of, e.g., the business model or sourcing activities which characterize (among others) the overall value chain, involved stakeholders, core assets, or the operating model, which, in turn have effects on the EA [22]. The EAM discipline supports those adjustments by mediating between the strategy- and IT management view (Sect. 3.3.3). EAM represent the *conceptual perspective* of the CMG as a consequence.

We expect that enterprises are equipped with various EAM capabilities that are specific to its situations and settings (Figure 6.3), but many of them are not aware of those capabilities. For this reason, the CMG is focused on the identification and description of capabilities required for an effective operationalization of enterprise strategies. These capabilities should then be derived systematically through a structured process, gathered and managed in an enterprise-specific repository that we call “capability catalog.”

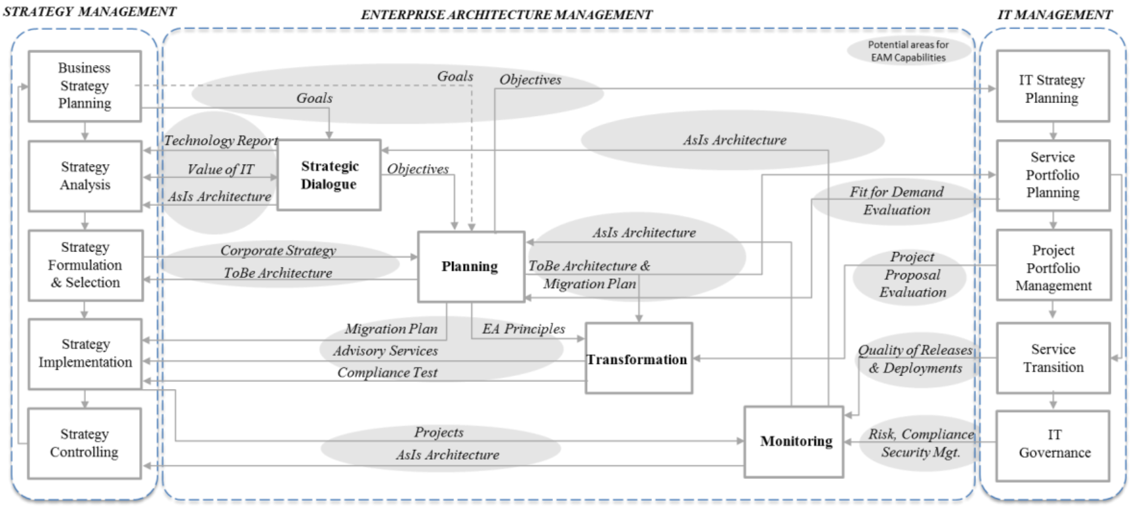

Figure 6.3 Potential Areas of EAM Capabilities, according to [13,52,142].

All in all, the capability management guide copes with several internal and external, market-depending and global, business and IT factors. Therefore, its objectives are focused on the following aspects:

- *Scoping and preconditions for capability management*
- *Identification of involved stakeholders*
- *Identification of capability types and their relations*
- *Structuring of capabilities and their models as a catalog*
- *Governance of the resulting capability catalog*

The guide shall help to systematically derive capabilities, gathered and maintained in a repository - called capability catalog.

6.2.2 METHOD FRAMEWORK

According to [215], the set of method components is called *framework*, if they align to a concrete structure and it can be divided into specific phases. Therefore, this section offers the description of combining the building blocks (BB) and work steps (WS) with a process-based structure using a pseudo notation. In the CMG v1.0, the following explanations are referred to process model approach description.

The CMG consists of four building blocks, each focusing on distinct content and having distinct outputs. The first building block (*BB1*) defines conditions for the EAM capability catalog to be created. Hence, the reason for the project/ initiative in terms of initiating strategy goals and clear scoping of the application area has to be defined (*BB1.WS1*). Therefore, developer and user groups of the future catalog are assigned. In order to enhance the communication of different user groups and developers, terms and perspectives are negotiated (*BB1.WS2*). Based on the outcomes of the first two working steps the EAM capability type and its elements are specified (*BB1.WS3*). The development strategy is specified within the last step of BB1 in terms of an agreed development plan and procedures (*BB1.WS4*). In order to ensure compatible outcomes of each WS it was recommended to handle *BB1.WS1 – BB1-WS4* once in sequence.

Subsequent to the determination of content within the first building block, the design of the capability catalog is initiated. Hence, capability candidates are determined (*BB2.WS1*) supported by a structured identification procedure. After collecting initial capability suggestions, the results need to be analyzed, discussed, and, if necessary, restructured (*BB2.WS2*). Since the collected improvement suggestions usually may not guarantee a sufficient, complete, or consistent capability catalog, it is necessary to conduct further analyses regarding the identification of dependencies and including the documentation of capabilities (*BB2.WS3*). In order to ensure compatible outcomes of each WS it was recommended to conduct *BB2.WS1 – BB2-WS3* in sequence once, whereas each WS could run through several iterations.

The third phase ensures that each capability is described sufficiently in detail for supporting the specified strategy goals (*BB1.WS1*). Therefore, the initial step of (*BB3.WS1*) addresses the definition of the content and associated depth in order to provide both a final structure and relations of the capability catalog details. Followed by performing a systematic analysis of identified capabilities (*BB2*) (*BB3.WS2*). Here, the capabilities and its descriptive elements are actually described in further detail and additional indicators are specified in order to e.g. capture financial status or architectural changes for auditing or EAM assessments. The third building block is completed by the “develop and test stakeholder views” step (*BB3.WS3*). When describing capabilities in detail, it is necessary to ensure that the outcomes are formulated in a way that they can be applied to different kinds of stakeholder groups defined in (*BB1.WS2*). In order to ensure compatible outcomes of each WS it was recommended to conduct / perform *BB2.WS1 – BB2-WS3* in sequence once, whereas each WS could run through several iterations.

The governance building block (*BB4*) is important for keeping the existing capabilities up-to-date and introducing new ones. In order to counteract deficient quality and promote the functionality of the developed catalog, the optional stages “*evaluation concept*” and “*catalog evaluation*” can be used (*BB4.WS1*, *BB4.WS2*). The way of integrating a catalog into an enterprise has a vital influence on the success of this catalog. Therefore, (*BB4.WS3*) addresses the roll-out of a catalog into organizational use. As enterprises have to face new challenges and capabilities need to be modified accordingly, there is an ongoing maintenance step proposed (*BB4.WS4*). This WS can trigger new activities in BB2.

The concrete structure and specific phases of the CMG v1.0 are visualized in Figure 6.4.

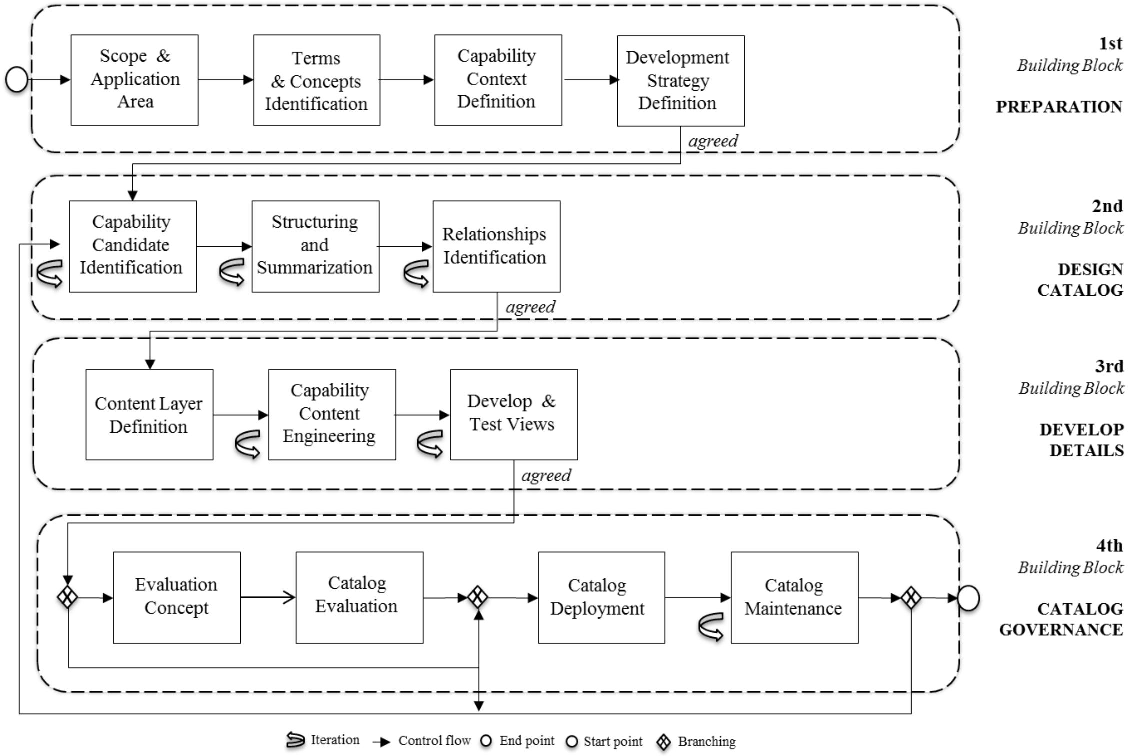

Figure 6.4 CMG v1.0 - Process Model.

6.2.3 CO-OPERATIONS FORMS

The *co-operation forms* define those roles that describe how different actors interact and co-operate, when executing the different WS of the CMG v1.0. Although the role concept was developed after the publication of the CMG v1.0, but the initial role concept was considered for succeeding CMG versions.

Based on the activities within each WS, we used for the assignment of responsibilities a so called responsibility assignment matrix that is based on following five RASCI activities [351]:

- *Responsible (R):* The corresponding role is responsible for the actual execution of the assigned WS.
- *Accountable (A):* The corresponding role deals with the responsibility for the budget (resources, money, time) of the assigned WS and is therefore responsible for its deliverables. Thus, it approves appropriate activities, delegates them to the respective *Responsible* role and provides the required budget.
- *Supportive (S*): This role can be a supportive role by actively providing information and / or available resources without execution responsibilities.
- *Consulted (C):* This role is not directly involved in the activities of a WS, but it possibly provides relevant information for the implementation and is therefore used for advisory purposes.
- *Informed (I):* This role receives information and updates on the progress or the result of a WS based on the respective permissions.

The following role descriptions are adapted for this investigation based on our related work [15].

Adapted from role descriptions of our related work [15], we defined seven roles required for the CMG v1.0 execution. RASCI activities are assigned to the respective roles (columns) of a WS (rows). Several activities can be carried out by one role. For example, the stakeholder of a project can be both the supportive, consulted and informed role in a project. The only exception relates to the *accountable* activity, which is only allowed to be assigned to one role per WS. Thus the responsibility should be clearly ensured in terms of results *(R_{Q33})*. Table 6.2 shows the RASCI matrix based on the first CMG version.

Problem owner: The administration and the creation of an EAM capability catalog require resources which must be provided by e.g. the executive- or senior management. The problem owner (also sponsors) are convinced of the positive impact of the CMG output in order e.g. to cope with the aforementioned challenges regarding the perspective. Thus, the role of the problem owner includes being the initiator and the budget manager, who finances the implementation of the CMG (if not as single role, the problem owner could be a member of the stakeholder group).

Project lead: The project lead, also in large projects, is often represented by one person (deputy possible) who is responsible for project planning at BB level, the operational project management (incl. control of schedules, results and resource consumption of each WS) and reporting to the *stakeholder group*. In this regard, the role is responsible for providing any required documentation (*minute taker*), the selection and exemption of *domain experts* and the integration of the *EAM capability management team*. Thus, the project lead has a key role in the CMG.

EAM capability management team is composed of a defined, fixed over the course of the project, group of EAM Experts who know the current structures and processes in the company and can be extended, depending on the application, to additional *domain experts*. The main task is the technical integration of the results of different WS activities to support at the relating project level. In addition to the conceptual support of BB1 activities, the role is focused on BB2, BB3 and the associated active participation of capability design and engineering activities.

Domain expert: Domain experts (e.g. business and IT leader) have the necessary knowledge of the enterprise in question or domain and application context for capability design and engineering purposes. These subject matter experts have embedded knowledge about the enterprise environments, organizational structures, business model and processes, responsibilities, regulations or problems of the enterprise. This means that any member of staff, from an ordinary worker to executives and enterprise stakeholders, may be a potential domain expert. The competence of the experts is one of the most important aspects in the CMG.

Stakeholder group: The stakeholder group (possibly steering committee) typically includes members from different areas of the enterprise that are involved or at least interested in achieving the project goal. This may include the person in charge of departments, budget officer or employee representatives. In larger projects, the stakeholder group/ steering committee is the project's top-most decision-making body, to which the project lead reports. The stakeholder group finally decides on project plan (problem owner participation), obtains official acceptance of milestones and deliverables, decides about changes in project plans in case of new requirements and delays in project work, supports the acquisition of resources, and decides about resource allocation

Moderator or facilitator moderates workshops or meetings and is responsible for target achievement and compliance of the methodological framework (e.g. WS goals). A workshop may have multiple moderators who take turns during the workshop and focus on different aspects. In particular larger projects could have several moderators in the same group of participants, but one of them must then be the assigned the leader to clarify who is accountable for results.

Minute taker capture meeting notes, decisions, results and tasks to be done during the moderated workshops or meetings. The documents are used afterwards to distribute decisions made or record the reasons for particular agreements between the participants.

The particular level of abstraction of the capability concept and its enterprise-wide perspective is associated with a range of *technical competencies* (Table 3.7) provided by *domain experts* and the *CM team*. Thus, the specialized knowledge of a particular subject that is required to develop a certain capability is very important. This expertise combined with a long-standing use in order to achieve the given objectives is another important skill. Furthermore, *domain experts* and the *CM team* should feature *leadership abilities* (Table 3.7) like the ability to motivate and to cooperate.

Requirements apply to the *project lead* and the *moderator* such as a good listening skill (Table 3.7), due to the fact that it is not only important to capture what was said, but also how it was meant. "Reading between the lines" and if necessary selective asking to avoid possible misinterpretations are also essential. Since this level of skills are on the one side important for a unified high-level communication medium *(R_{Q13})* and on the other side it can particularly have fatal impact on decisions due to the strategic influence. Furthermore, abilities like group management and pedagogy are necessary for conducting the workshops to arouse the interest of the participants and to motivate them for an appropriate meeting. The recognition of potential conflicts and the respective solutions are as well part of *leadership abilities* (Table 3.7). Furthermore, these roles have to create trust and provide a certain expertise to the participants by their *technical competencies* (*project lead*) and presentation techniques for workshops (*moderator*).

Basically, all required roles should be prepared and motivated to contribute to the knowledge and existing skills to achieve the defined objectives, although it does not always match with their own goals. This motivation can be achieved amongst other by using one of the mentioned challenges (merger, new business model integration) triggered *strategy planning activities* (Sect. 3.3.1) as initiation of an EAM capabilities analysis, because in this situation the decision-making and the related information demand is at the highest point.

Table 6.2 Roles and its co-operations based on the CMG v1.0 Working Steps (RASCI matrix).

CMG Structure	Problem Owner	Project Lead	EAM CM Team	Domain Expert (B/IT)	Stakeholder Group	Moderator	Minute Taker
BB1.WS1: *Scope & Application Area*	RA	I			I	R	S
BB1.WS2: *Identification of terms and concepts*	AC	R	R	R	C	R	S
BB1.WS3: *Capability Context Definition*	AI	R	R	I	I		S
BB1.WS4: *Definition of the development strategy*	ASI	R	R	I	R(A)	R	S
BB2.WS1: *Identification of Capability Candidates*		AS	R	S		R	S
BB2.WS2: *Structuring and Summarization*		AS	R	S		R	S
BB2.WS3: *Identification of Relationships*		AS	S	R		R	S
BB3.WS1: *Definition of Content Layer*	C	AS	R	R		R	S
BB3.WS2: *Capability Content Engineering*	C	AS	S	R			S
BB3.WS3: *Development of Stakeholder Views*	CI	AR	R	C	I		S
BB4.WS1: *Evaluation Concept*		AR	R				S
BB4.WS2: *Catalog Evaluation*	R	AR	S	R	C		S
BB4.WS3: *Catalog Deployment*	I	AR	S	I	I		S
BB4.WS4: *Maintenance*	I		AR		I		

6.2.4 CONCEPTS: THE INTEGRATED ENTERPRISE CAPABILITY APPROACH

From a method engineering perspective (Table 6.1) this section describes the development of the key concepts on which all CMG versions are based on, summarized as *Integrated Enterprise Capability Approach (IECA)*. Thus, the following conceptual descriptions are independent of the CMG versions, otherwise the particular version is explicitly stated. The content of this section is based on a number of previously published results [85,133].

Starting point for the investigation presented in this section is the *conceptual requirements set 1* (Sect. 5.2.1) and based on our findings of Section 4.3. Thus, we discovered the absence of a consistent conceptualization of "*EAM capability*" and a need for developing such a conceptualization as a basis for structured and systematic EAM capability management (R_{C11}- R_{C14}). *How could you manage and EAM capability if you do not know exactly what it consists of?* With this question, our local practice partners argued that a future capability concept should be considered as type-specific or at least adaptable to a required classification, i.e. there might be generic capabilities for comprehensive enterprise purposes as well as specific ones for a certain domain e.g. business, EAM, or IT purposes (Table 4.4).

Therefore, the goal of this section represents the development of a unified EAM capability approach by combining most significant characteristics and descriptive elements. Consequently, the investigations in this section answered *RQ1* (Sect.1.2):

RQ1: *What are the components of a unified capability structure?*

The proposed conceptualization of an EAM capability is evaluated in one local practice example and a questionnaire among scientists and practitioners. Thus, the main contributions of this section are:

(1) An analysis and discussion of the systematic literature review on capabilities from Section 4.3,
(2) a conceptualization of EAM capability identifying the core elements and characteristics, and
(3) the results of a scientist- and practitioners questionnaire for a first validation of the conceptualization.

The research approach underlying this work is an abductive approach, i.e. a combination of (a) deduction from the body of knowledge in the field of EAM what theoretical basis applies to EA capabilities and (b) development of a conceptualization of "*EAM capability*" and induction from work with experts in the field to what extent our conceptualization is sound and would work in practice.

The basic characteristics of the six descriptive capability elements are already presented in Section 4.3.3. However, we provide a short recourse to the six mentioned elements in order to prepare the description of the ICEA. Therefore, the concept of "*Knowledge*" is aggregated with the concept of "*Information*" to create a more universally valid statement. Furthermore, the "*Goal/Outcome*" was converted into "*Outcome*", which is linked through strategy to corporate goals, however it must be mapped to capabilities more granulated, since various strategies and different combinations of capabilities support a corporate goal. Moreover, we identified different capability types, but overlaps were present in these types [85]. Therefore, we added a descriptive element, which represents an additional perspective like focus, application area or subject that we derived from identified research fields. The concept of "Enterprise Context", from here called *Focus Area (*in our previous publications called as "Context element", but renamed as part of linguistic unification), characterized the environment of an enterprise or an overarching subject and is an inherent part of the definition for the purpose of seizing a relationship to a desired *capability type*. EAM challenges (Sect. 3.3.4) reveals that the allocation of functional and financial responsibilities is an inherent part of the organizational development/ alteration. Consequently, the respective element, whose influence is recognizable in the terms of join *individual*- and *organizational competencies* as well as *individual abilities* (Sect. 3.4), was integrated in the definition as well and is depicted in the element "*Role*". One essential part of the definition is the combination of "resources" and "information" as this progress is iterated on the execution of every capability. *Roles* need information for the implementation and governance of processes and thus need to be supported by *resources*. The *processes* generate the output, considering each of the *descriptive elements*, and thus are necessary for the strategy implementation and the ultimate achievement of objectives. *Processes* can also be regarded as physical operationalization and a more flexible version of the logical and stable capability construct (Sect. 3.4).

Nevertheless, a capability remains in a stable and steady condition. The classification of the five capability types and its elements formed the basis for our correlation analysis. Therefore, 961 interrelations were analyzed, which lead us to a weighted relationship model by calculating corresponding correlations [190,300]. We illustrate the relationships and elements of our findings in Figure 6.5. The gray rectangle illustrates the descriptive elements and its interrelations that bring a capability into existence. We accomplish that a capability has to take place under consideration of a specific focus area like business-, EAM- or IT. The specification of a capability *focus area* enhanced its accuracy considering capability management activities like identification, engineering or maintenance which positively affected its outcome as well.

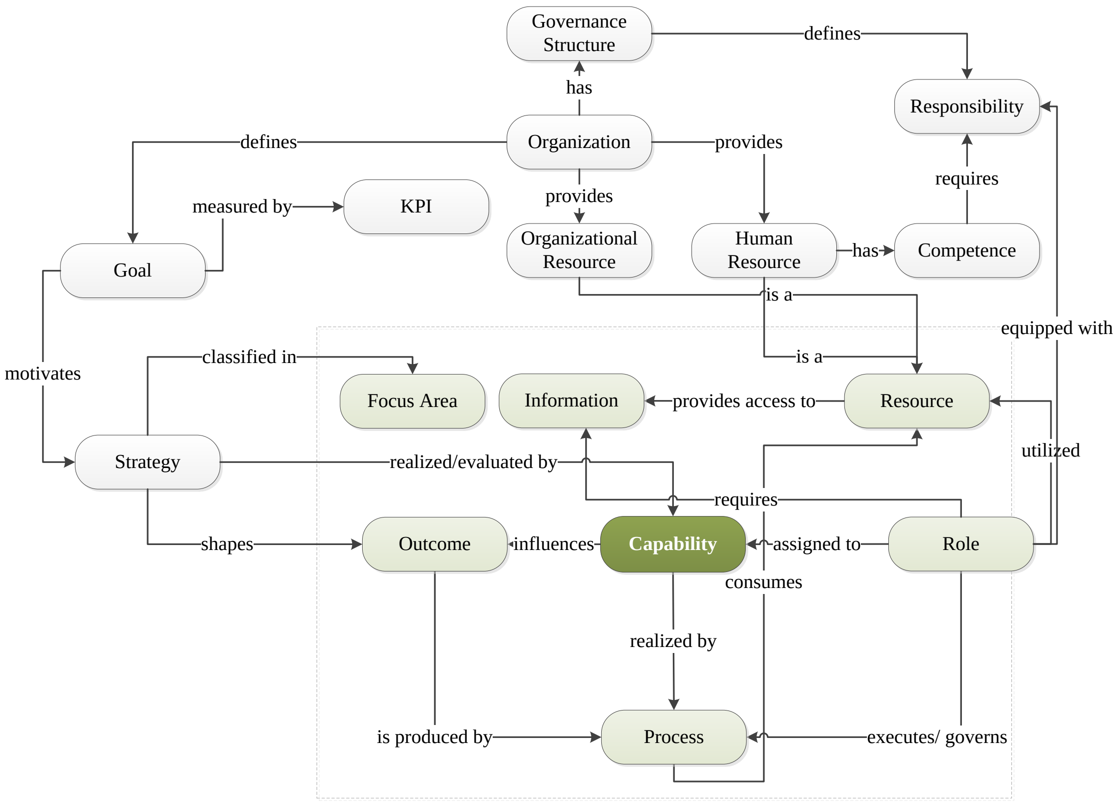

Figure 6.5 Conceptual model of the Integrated Enterprise Capability Approach [300].

The definition below is predicated upon the identified concepts. The aim is to provide a general definition coping with the *conceptual requirements set 1* (R_{C11}- R_{C14}) and *RQ1*:

> *An enterprise capability represents the ability of an organization to join information and roles able to execute a specific activity with available resources in order to support strategy goals under consideration of its focus area.*

According to the definition, a capability includes the definition of a specific focus area for type differentiation (R_{C12}) which could be *architecture objects* derived from strategy (R_{C13}) and *EA management functions* for an EAM capability (Figure 6.6). The focus area objects combined with a combination of information relate to e.g. information about architecture models or standards. In order to perform its tasks, the required roles should be occupied by an optimal set of resources (e.g. competencies, abilities and/or skills). Furthermore, resources (e.g. technologies, HR, Budget, and Personnel) are consumed by the EAM related processes executed and governed by appropriated roles. The processes generate the desired outcome of a specific capability and could be iterative or divided in sub-processes. Information required for process execution as well as for the corresponding roles could be blended of explicit, embodied/implicit or embedded information. The desired outcome of a capability enables the achievement or decisions about the implementation of strategic goals.

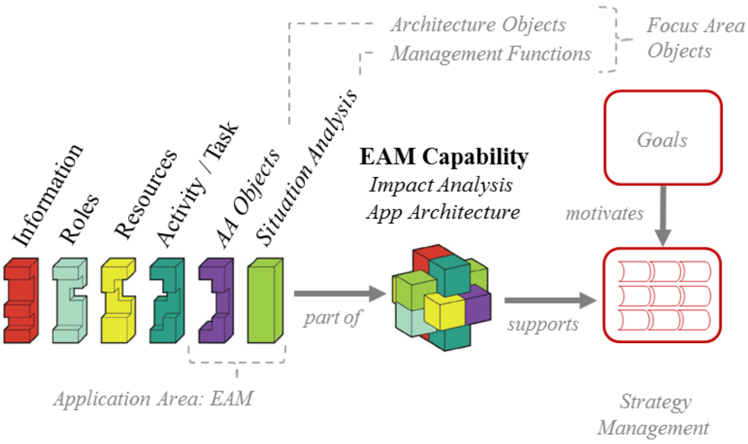

Figure 6.6 Elements of an EAM capability[11].

As the conceptualization presented in Figure 6.7 is based on scientific literature only, we decided to validate suitability for practical application and soundness of an EAM capability using a two-step procedure. In a first step (1) we applied the conceptualization within the EACN project; the second step (2) was a survey among EAM experts.

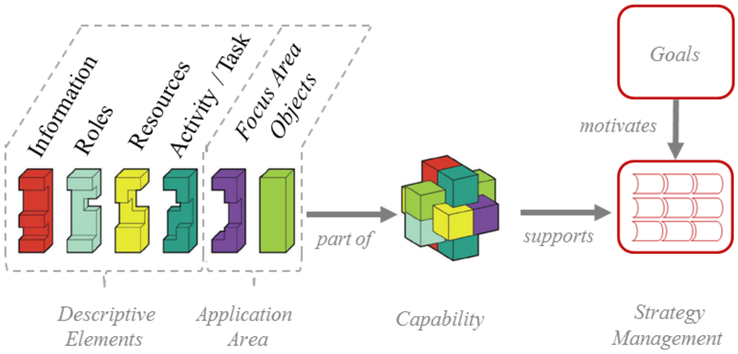

Figure 6.7 Concept of descriptive capability elements.

(1) As a first validation step, we put the conceptualization to feasibility test by describing a concrete capability from the EACN project with the descriptive elements of an EAM capability identified above. The EAM capability selected for this feasibility test is "*Impact Analysis IS Architecture*". Its elements are illustrated in Figure 6.8 and will be introduced in the following. The selected EAM capability assumes a formulated enterprise specific IS strategy that aims to ensure the I*mplementation of high-quality data management* processes in order to guarantee information supply within the IS department (layer: strategy). To implement this strategic objective, different initiatives have to be started within strategy implementation plan (layer: initiatives). From these initiatives, we select *Implement a central IS Architecture Inventory* for our example. Key goal of this initiative is the establishment of a practice to sustain a reliable documentation of the enterprise architecture by focusing on identifying the data and data quality require-

[11] Colored cube image is provided by Corso Ltd.

ments stored in a central inventory. Based on this goal and the fact that the required inventory did not exist, needed EAM capabilities were derived. One of these capabilities is reflected in our selected example: Impact Analysis IS Architecture (layer: capabilities). The Impact Analysis IS Architecture capability is characterized by the ability to analyze the impact of change needs/business requirements in comparison to the current state IS architecture. In order to satisfy the information demand of this capability, information like: set of IS architecture objects, dependencies between IS architecture objects, technology architecture objects, etc. should be provided by existing source (layer: descriptive elements, red element: information). The green and purple objects represent the two meta-object dimensions (management functions, EA objects) and show how the example EAM capability arises from. The management functions situation analysis represents a sub- function of the defined planning phase, the EA objects are components of alfabet's EA meta-model. The activity/ process (identification of data sources, information maintenance process) element combined with the turquoise role element including the roles enterprise architect, application owner and the yellow resource (e.g. EAM software planningIT) represent necessary components of our EAM capability example.

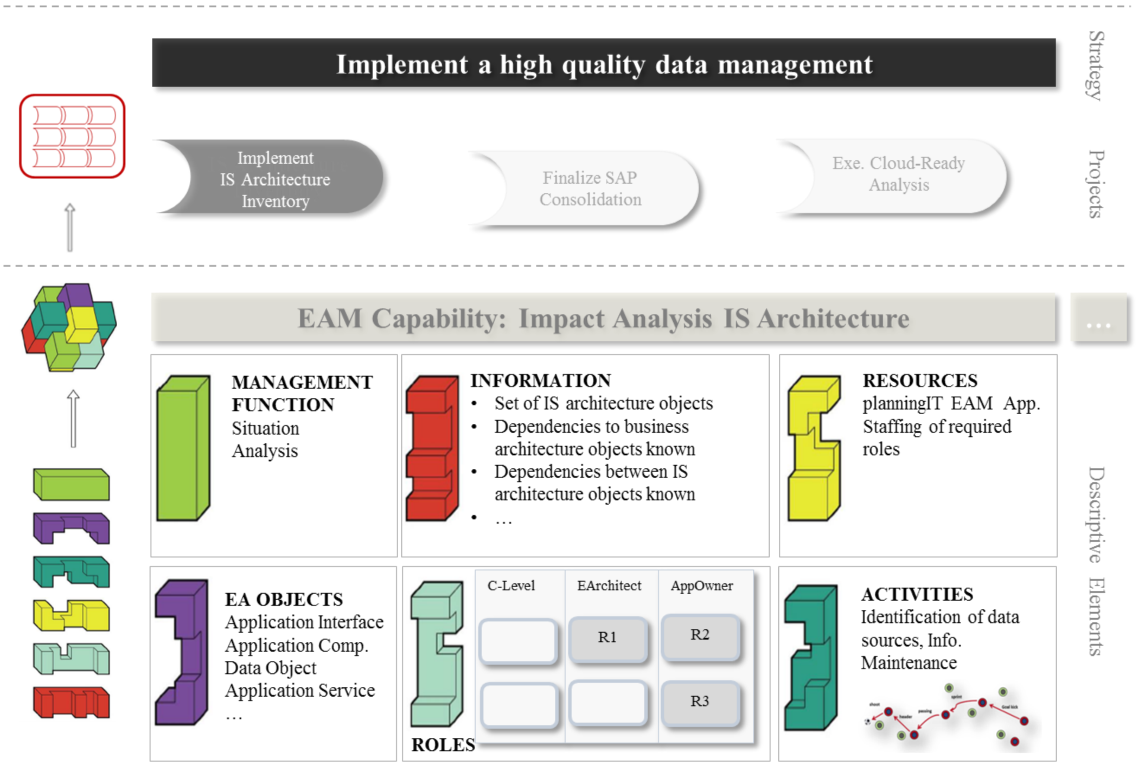

Figure 6.8 Example of an EAM capability: Impact Analysis IS Architecture.

(2) The second validation step aimed at evaluating soundness and completeness of the conceptualization from the perspective of experts in the field of EAM. For this purpose we performed a questionnaire survey among experts and practitioners from the field of EAM. We performed two separate questionnaires (Sect. 2.2.2) and analyzed the results using quantitative data analysis (Sect.2.2.3). The first survey was a *group-administrated questionnaire* and took place at the beginning of November 2013. In context of a master class[12] with academic practitioners at the 6th IFIP WG 8.1 Working conference on the Practices of Enterprise Modeling (PoEM2013) in Riga, Latvia, we evaluated the EAM capability conceptualization and parts of the EAM capability type. Before elaborating the result, the following design parame-

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[12] http://poem2013.rtu.lv/invited-talks, accessed 29.04.2016

ters of the first survey were given: Basic population (n=11), 7 participants answered, that they are well familiar with EAM (intermediary level of expertise) whereas 4 were just beginners in the field. The capabilities experience level of the audience can be described as follows; 1 expert, 3 intermediates and 7 beginners. Due to the fact that the basic population is relatively small, an interpretation relating to the correlation of the different groups (expert, intermediate, beginner) will not be presented. Table 6.3 shows the distribution of answers (in percentage of total) for all three groups concerning the question “In your opinion, which of the following aspects are needed to describe an EAM capability?”

Table 6.3 Research community group: POEM 11/2013 questionnaire.

Capability Elements	Answers	n	Frequency	
Information	9	11	81%	Descriptive Elements
Roles	8	11	72%	
Resources	8	11	72%	
Process	9	11	81%	
EA Object	8	11	72%	EAM Context Elements
Mgt. Function	7	11	63%	

The second survey was a *self-administrated electronic questionnaire* and executed in cooperation with alfabet AG in Boston, USA, at the end of November 2013. We evaluated EAM capability conceptualization as well usability and feasibility of the capability management process (CMP). Basic population n=15, 12 participants answered, that they are EAM experts as well as 3 are intermediate. The capabilities experience level of the audience can be described with 12 experts, 2 intermediates and 1 beginner. The fact that the basic population is relatively small, an interpretation relating to the correlation of the different groups (expert, intermediate, beginner) will not be presented. Table 6.4 shows the distribution of answers (in percentage of total) for all three groups concerning the question “In your opinion, which of the following aspects are needed to describe an EAM capability?”

Table 6.4 Local practice group: alfabet Boston 11/2013 questionnaire.

Capability Elements	Answers	n	Frequency	
Information	13	15	86%	Descriptive Elements
Roles	12	15	80%	
Resources	14	15	93%	
Process	10	15	66%	
EA Object	13	15	86%	EAM Context Elements
Mgt. Function	12	15	80%	

All in all, 84% of 26 respondents think that information and resources are needed to describe a capability. 76% and 73% answered that roles and a process should be included. For the specific EAM capability type, the context should be described by EA objects and management functions for 80% and 73% of the respondent.

(RQ1) is answered by a general capability concept, which formed the basis for a conceptualization of EAM capabilities. This conceptualization is validated by an empirical study in form of a questionnaire and a quantitative analysis with academic and local practice respondents, but under consideration of limitations. One limitation of the integrated capability approach is the *exploratory sample* in terms of the small number of participants in both quantitative questionnaires and feasibility test. To counter this limitation, we conducted two questionnaires with participants of the same research community and local practice partners, which were selected under a purposive sampling and on the basis of their privileged knowledge and advanced experiences related to the capability topic. Furthermore, we performed a feasibility test within the EACN project and examined the real depiction of an EAM capability compared to the provided approach. However, the selected subset of individuals is not representative for an entire population and requires further validation that are executed within the *demonstration-* and *evaluation phase* of the research process.

6.2.5 NOTATION & MODELING TOOL

Based on the IECA, this section introduces the notation extension of the *4EM-method (4EM)*[13] in order to model EAM capabilities and describe the development of a corresponding software prototype. Although the 4EM capability extension was developed after the publication of the CMG v1.0, however it was included in the CMG adjustments for successor versions two and three.

Since the management of capabilities is the core component of the CMG, the documentation in form of visualization and standardized notation has a special position. Furthermore, the requirements analysis *(R_{C27})* already determined that the importance of capability management (Sect.4.3) and the demand for a separate, easy-to-use modeling tool continuously and verifiably increase. For this reason we chose the *4EM-notation* and developed a corresponding capability extension.

4EM was developed at the University of Rostock in cooperation with the University of Stockholm (SE) and the University of Skövde (SE). The method is very flexible and pedagogically well suited to reproduce core content of enterprise modeling. It is used in both the Master's and Bachelor's degree of business computer science as well in business practice. Thus, the methodology is already an integral part of teaching as well as research and can support the modeling, analysis, design and adaptation of EAM.

The *4EM-method* uses six interrelated sub-models that capture different perspectives of an enterprise; necessary perspectives- and relation descriptions are taken from our published method description [15] and listed below:

- *Goals Model (GM)* focuses on describing the goals of the enterprise. It describes what the enterprise and its employees want to achieve, or to avoid, and when. Goals Models usually clarify questions, such as: where should the organization be moved, what are the goals of the organization what are the importance, criticality, and priorities of these goals, how are goals related to each other, which problems are obstacles for achievement of goals.
- *Business Rule Model (BRM)* is used to define and maintain explicitly formulated business rules, consistent with the Goals Model. Business Rules may be seen as operationalization or limits to goals. Thus, business Rule Model usually clarifies questions, such as: which rules affect the organization's goals, are there any policies stated, how is a business rule related a goal, how can goals be supported by rules.
- *Concepts Model (CM)* is used to strictly define the "things" and "phenomena", which are dealt with in other models. We represent enterprise concepts, attributes, and relationships. Concepts are used to define more strictly expressions in the Goals Model as well as the content of information sets in the Business Processes Model. A Concepts Model usually clarifies questions, such as: what concepts are recognized in the enterprise (including their relationships to goals, activities and processes, and actors), how are they defined, what business rules and constraints monitor these objects and concepts.
- *Business Processes Model (BPM)* is used to define enterprise processes, the way they interact and the way they handle information as well as material. A business process is assumed to consume input in terms of information and/or material and produce output of information and/or material. In general, the BRM is similar to what is used in traditional data-flow diagram models. A Business Process Model usually clarifies questions, such as: which business activities and processes are recognized in the organization, or should be there, to manage the organization in agreement with its goals? How should the business processes, tasks, etc. be performed (workflows, state transitions, or process models).
- *Actors and Resources Model (ARM)* is used to describe how different actors and resources are related to each other and how they are related to components of the Goals Model, and to

[13] http://www.4em-method.com/, last visit 29.04.16.

components of the Business Processes Model. For instance, an actor may be responsible for a particular process in the BPM or, the actor may pursue a particular goal in the GM. An Actors and Resources Model usually clarifies questions, such as: who is/should be performing which processes and tasks, how is the reporting and responsibility structure between actors defined?

- *Technical Components and Requirements Model (TCRM)* becomes relevant when the purpose of 4EM is to aid in defining requirements for the development of an information system. The focus is the technical system that is needed to support the goals, processes, and actors of the enterprise.
- *(Inter-) Relationships:* Each of these sub-models includes a number of components describing different aspects of the enterprise. For example, the Goals Model contains business goals, business problems, divided into threats and weaknesses, causes, business opportunities, and constraints. The modeling components of the sub-models are related between themselves within a sub-model (intra-model relationships), as well as with components of other sub-models (inter-model relationships). Figure 6.9 shows inter-model relationships. The ability to trace decisions, components and other aspects throughout the enterprise is dependent on the use and understanding of these relationships. When developing a full enterprise model, these relationships between components of the different sub-models are essential. For instance, statements in the Goals Model allow different concepts to be defined more clearly in the Concepts Model. A link is specified between the corresponding Goals Model component and the concepts in the Concepts Model. In the same way, goals in the Goals Model motivate particular processes in the Business Processes Model. The processes are needed to achieve the goals stated. A link therefore is defined between a goal and the process. Links between models make the model traceable. They show, for instance, why certain processes and information system requirements have been introduced. However, there are limitations in the way sub-models and their relationships may be populated. These are controlled by a number of static as well as dynamic consistency rules, which control their permissible state transitions. These are necessary because they allow for analysis and comparison. How each sub-model focuses on a specific view of the enterprise is described in detail in [15].

At this point, we are going to explain the integration of our capability approach as an additional 4EM sub-model. Based on the *Integrated Enterprise Capability Approach* (Sect 6.2.4), the capability sub-model and the addressing issues could be described as follows:

- The *Capability Model (CapM)* focuses on joining information and roles able to execute a specific activity with available resources in order to support strategy goals under consideration of EAM focus area objects, independent of the organizational structure. The EAM capability model generally clarifies the questions: “What do we do?” What information, roles, processes and recourses are required to achieve a certain goal? Based on the CapM contents, an EAM leaders decide on “How can it be done?”.

The Capability Model is developed for analyzing enterprises’ capability structure to support Business-IT-Alignment (Sect. 3.3.3) and strategic decisions (Sect. 3.3.1) to react quickly and flexibly on environmental challenges (Sect. 3.3.4). So far, EAM responsible uses several sub-models in combination or at different levels of abstraction based on its stakeholder information demand to support respective activities. The *CapM* combines different EA elements describing how an enterprise operates within a certain *focus area* on a layer of abstraction to describe what it does within the respective area. Capabilities can be decomposed into sub-capability hierarchies. The components of the *CapM* are primarily motivated by components of the Goals Model as well as enabled by goals to be achieved. Based on its long-term and stable characteristic (Table 3.7), the capability model provides strategical relevant information about what an enterprise is able to afford in a current situation. Moreover, it can be used to model desired capabilities of a future state without considering constraints of the current one.

Thus, the *CapM* can describe existing and future capabilities on different hierarchy levels and levels of detail. Figure 6.9 illustrates the EM sub-models and capability extension.

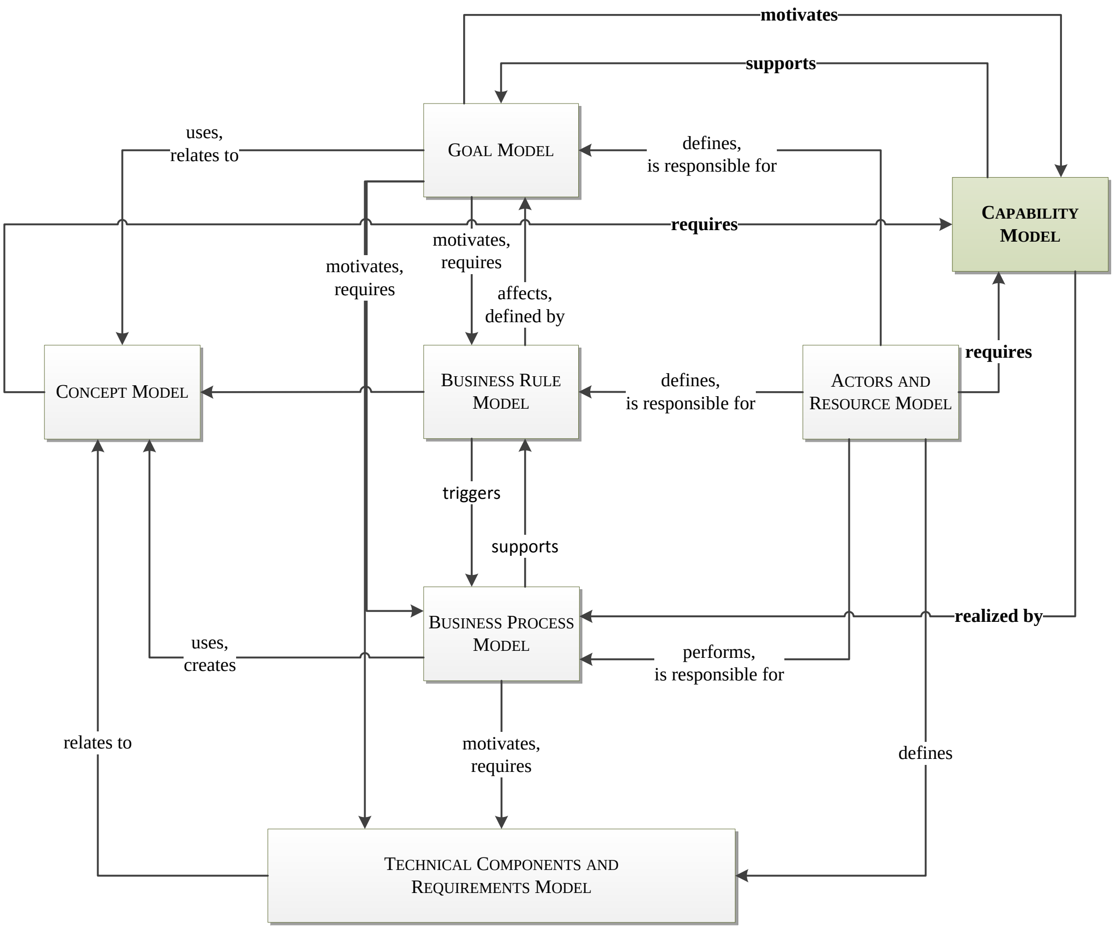

Figure 6.9 4EM sub-models and Capability Extension.

In the following the *components*, *notation* and *interrelations* of the *CapM* are described.

Components

In terms of classification purposes (Table 3.7) we recommend to name capabilities by nouns (Figure 6.10), whereas other architecture elements (e.g. processes, business functions, value streams) should use noun-verb declarations. A suitable type-independent declaration facilitates a fundamental objective of a capability management being an instrument of communication between different enterprise perspective (Business and IT) by enhancing the understanding and transparency of what these perspectives do (Figure 3.8). Nevertheless, even at this early stage suitable declarations should fulfill the following six aspects:

(1) As simple and short as possible,
(2) Conclusive and consistent,
(3) Focused and transparent,
(4) Describing and comprehensive,
(5) As significant as possible,
(6) Statement-like.

These six aspects are supported by the *Capability Identification Matrix* approach of BB2.WS1 (Sect. 6.3.2).

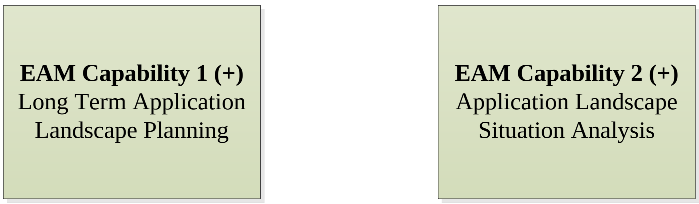

Figure 6.10 Example for EAM capability descriptions.

The *IECA* of the previous section describes a capability as the ability of an enterprise to join information and roles able to execute a specific activity with available resources to support strategy goals under consideration of its focus area. The single specifications are summarized within the *IECA* [300]. The model illustrates capabilities' relations to its descriptive elements within an exemplary EA (Figure 6.5). However, in order to transfer the *ICA* approach to 4EM, a capability is described as collection of 4EM interrelations (GM, BPM, ARM, CM) combined with a set of attributes under consideration of a certain context.

Thus, the *CapM* interrelations are characterized as follows:

- Supports the evaluation of goals and causes, the strategic choice of opportunities as well as the analysis of problems (*supports*).
- Is motivated by enterprises' goals (*motivates*).
- Is realized by a process or a set of processes of the BPM (*realized by*).
- Has a relation to the tangible- and intangible (including information) resources required to achieve a certain goal as well as the responsible roles of governed Actors of the ARM (*predefines*).
- The contents of a capability in terms of its attributes like generic and specific assessment criteria required for a capability content layer 3 descriptions (BB3.WS1) are described by referencing them to its concepts within the CM (*uses*, *creates*).

Next to the interrelations, the relationships between the components of the *CapM* are represented by unidirectional semantic links and are classified in:

- *supports* relationship that is used to show that one capability is a precondition fulfilling another. Support is essentially seen as "vertical" relationship, i.e. it is used to refine or decompose a capability.
- *conflicts* relationship that is used to show influences between components of the *CapM*, and can be considered as opposite to "supports" in terms of its negative influence.

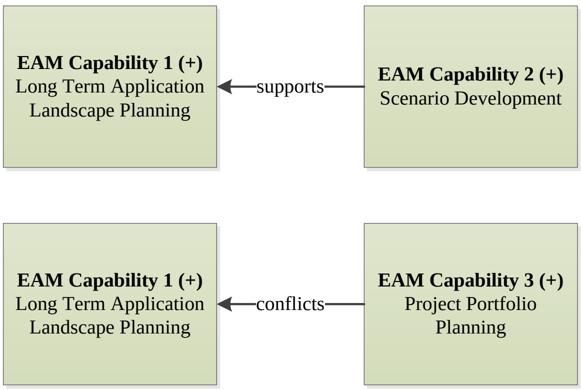

Figure 6.11 Example of EAM capability relationship types in the Capability Model.

Capability models could have a high level of abstraction, especially at the beginning of the capability catalogue. To provide more details it is necessary to refine them into sub-capabilities. Such decomposition is provided by AND, OR and AND/OR relationships.

The AND relationship is used to specify a set of unique sub- capabilities that are necessary to provide a capability (Figure 6.11). The OR relationship represents a set of alternative sub-capabilities. To support the original capability exclusively one capability of the sub-set is permitted. The AND/OR relationship is used to specify a set of alternative sub-capabilities. A combination of sub-capabilities from the set provides the higher-ranked capability. Capabilities that consist of hierarchically composed sub-capabilities, but are not fully presented in the current view, are labeled with a (+) after the numbering.

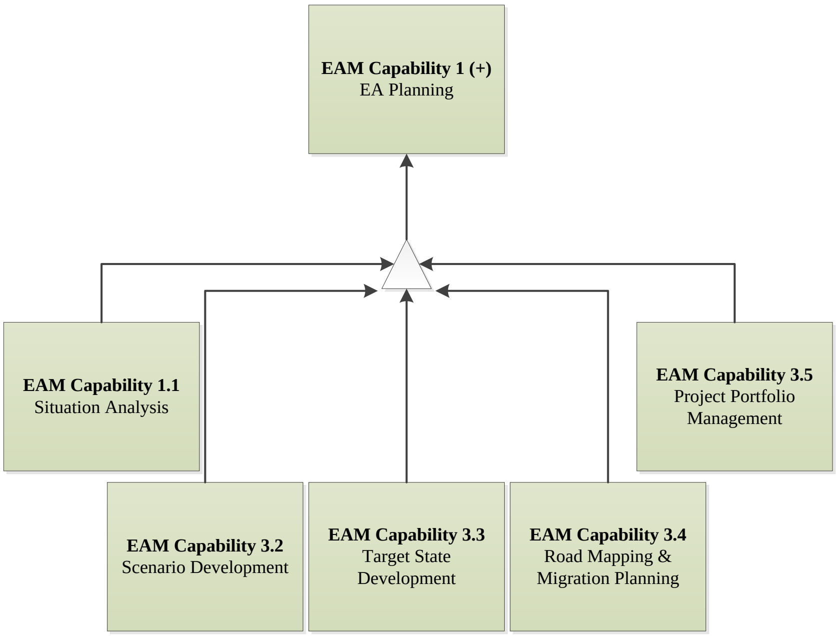

Figure 6.12 Example of EAM capability refinement with AND relationship.

Notation

The notation of the Capability Model is depicted in Figure 6.13.

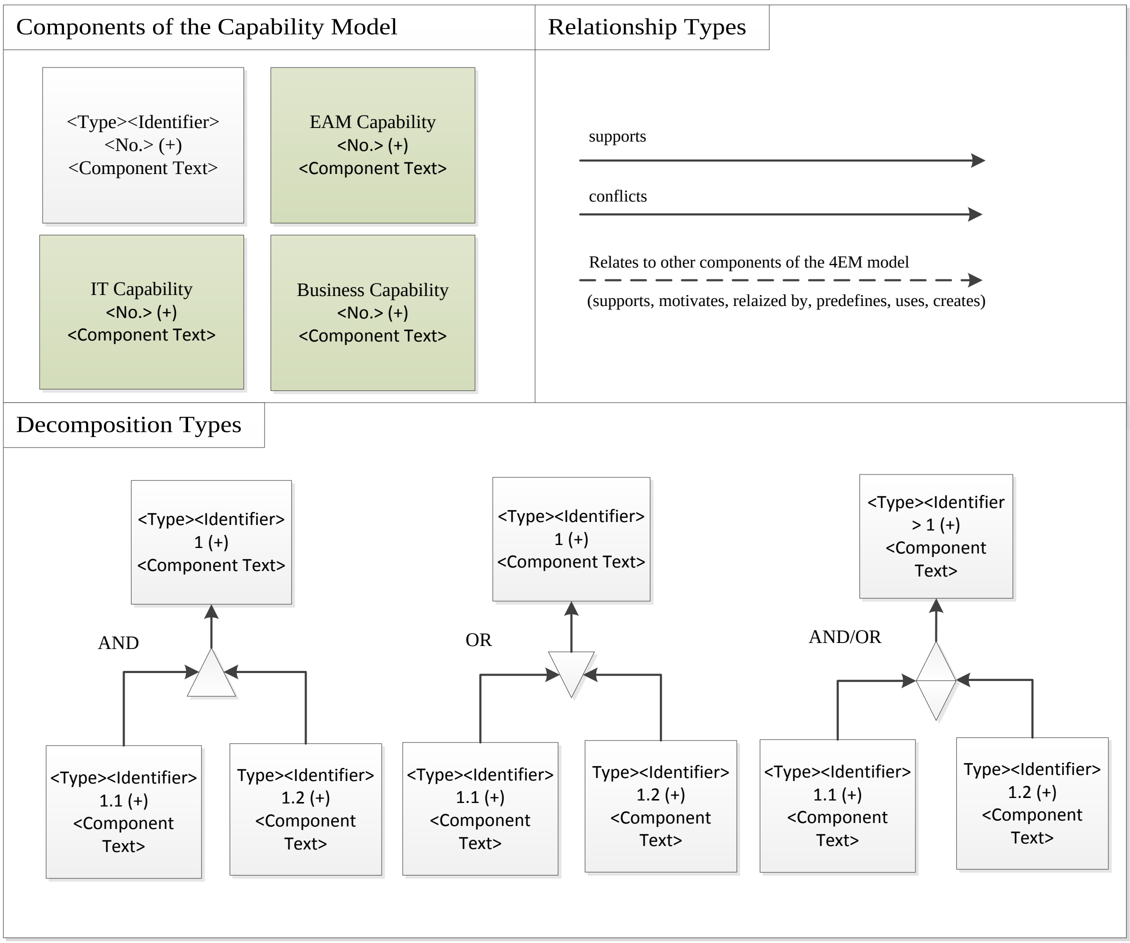

Figure 6.13 Notation for 4EM Capability Model.

Relationship between the CapM and 4EM sub-models

The previous sections focused on the CapM sub-model relations between its different sub-model components. The following paragraph explains the essential links of each sub-model has already been discussed previously. In developing a capability model, links between its descriptive elements and its corresponding sub-models are essential.

For instance, an EAM capability: EA planning allows a refinement into a unique set of sub- capabilities that are necessary to provide an EA planning capability. Statements in the EA planning capability allow different concepts to be defined more clearly such as the particular elements of an EA. This is done in the *Concepts Model*, and a link is specified between the corresponding Capability component and the concepts in the Concepts Model. The EA planning capability is realized by a set of particular processes of the *Business Processes Model*. A link is therefore defined between the capability and the process to be carried out to operationalize it. For the planning of EA the role of Enterprise Architect is required, because it describes the tasks of the head of EAM who ensures the completeness and quality of the architecture from a cross-departmental perspective as well as the responsibility of the all-do-some approach in terms of the corporate usage of the EAM Application. Thus, it requires profound technical competencies as well as leadership abilities (Table 3.6). Relations between sub-models are shown with dashed arrows and knowledge is therefore traceable. It is, for example, possible to see why certain capabilities are required to realize a specific goal. Figure 6.14 provides an overview of relations between the sub-models.

Consequently, when these relationships are present an enterprise has a specific EAM capability, whereby the relationships do not give evidence about the respective quality. In order to give evidence about the quality of a capability, the different relations as well as the individual capability with desired indicators must be provided, which in turn can be defined in *Concept Model* more accurately.

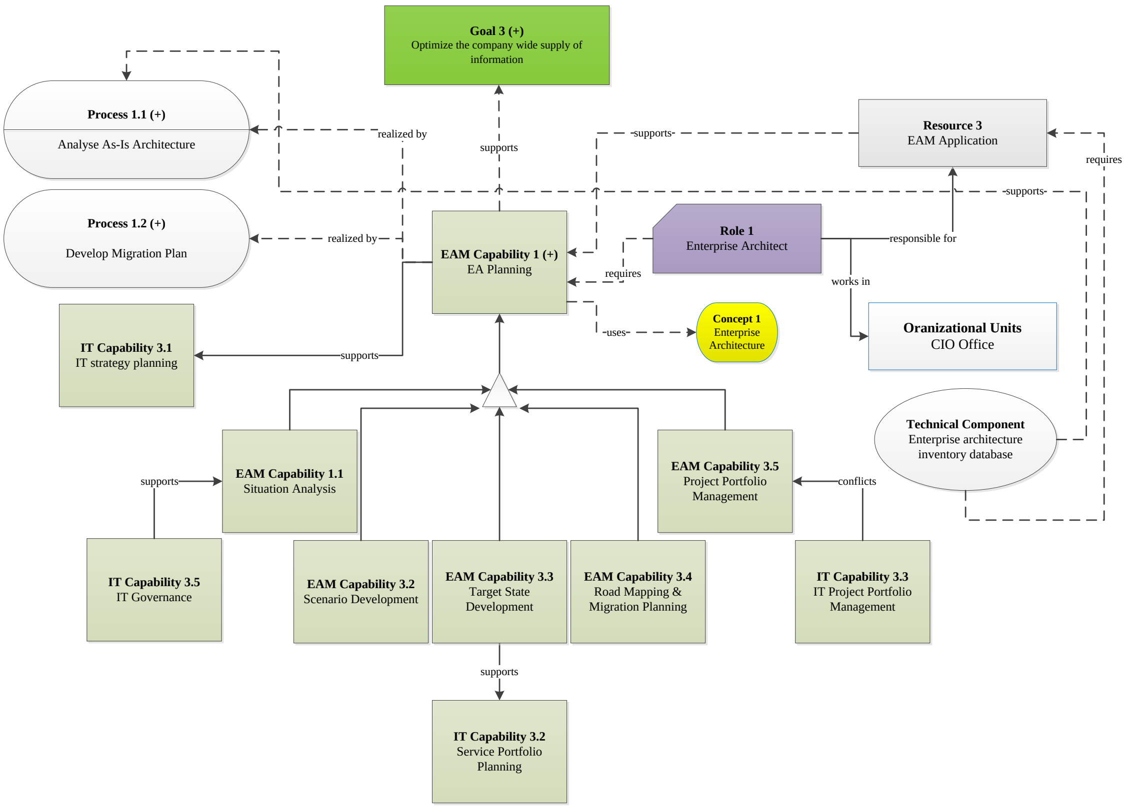

Figure 6.14 Example for inter sub-model links (dashed arrows) between the descriptive components of an EAM capability.

The previous explanations of 4EM capability extension were integrated as an extension in the 4EM.Desk and 4EM.Touch software of the 4EM.Dev project. Under the *4EM.DEV project*[14], a tool for modeling businesses was developed by using the *4EM-method*. The tool development has been implemented at the University of Rostock The project should contribute to the sustainability regarding the provision of a modeling software for all future Bachelor and Master students in enterprise modeling courses. Secondly, it promoted the development of innovative modeling techniques, because concepts of "*use collaborative and mobile modeling*" become increasingly common in industry and are part of the development work. As part of the project, the following modules have been developed, which are divided into different client modules and a server module:

Client-based modules:

- *4EM.Desk:* Development of a client prototype and its user interface and functionality.
- *4EM.Mobile*: Developing a mobile app prototype for use on the iPad IOS.
- *4EM.Touch:* Development of a prototype for a multi-touch-table (3M Multi-Touch Display C5567PW & MultiTaction MT550W7).
- *4EM.Motion:* Test with Gesture Control Devices (Leap Motion) for navigation analysis by business models.
- *4EM.VisualAnaltytics:* in planning, use of Visual Glasses for analyzing business models and architectures.

[14] http://www.4em-method.com/de/projekte, last visit 29.04.16.

Server-based module: Development of a server prototype for collaborative work installed on the infrastructure of the Department of Economics computer science. The module enables communication between client and server using a token management system.

Technologies used: jWebsocket[15], Java Architecture for XML Binding (JAXB)[16], PaperJS[17], JQuery[18] and HTML, CSS, JavaScript[19].

The results allow a networked, mobile and creative work environment with regard to the education of students and provide potential for further research in collaboration with the industry due to the timeliness of the application area.

Figure 6.15 shows a screenshot of 4EM.Desk solution. The software can be accessed via the network of the University of Rostock and can be requested at the author.

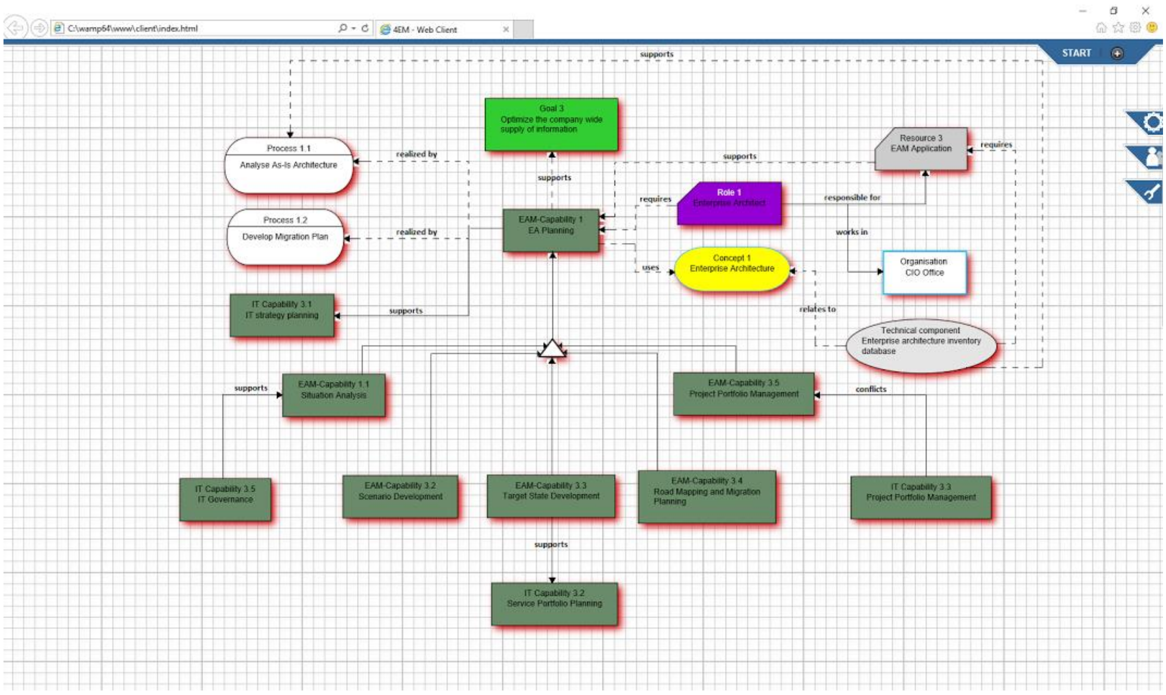

Figure 6.15 Example for inter sub-model links within 4EM.Desk 2.7a (Appendix D5).

Further notation concepts, which are based on existing approaches such as standardized protocols (Appendix D1), visualization concepts (Appendix D2) and corresponding software support, are explained in the respective method component (WS).

6.3 METHOD COMPONENTS - CMG V1.0

The first version of the CMG was developed in the middle of 2014 and published at the beginning of 2015. The relationships among each other and their procedural sequence are described in the context of the method frameworks (Sect. 6.2.2). The following section presents the content of the first version. In

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15 http://jwebsocket.org/, last visit 29.03.16.
16 https://jaxb.java.net/, last visit 29.03.16.
17 http://paperjs.org/, last visit 29.03.16.
18 https://jquery.com/, last visit 29.03.16.
19 https://wiki.selfhtml.org/, last visit 29.03.16.

order to support user from practice, CMP v1.0 is written in a more common business-style language to reach wide acceptance and understanding. The following Table 6.5 shows an overview of the Working Steps (WS) activities and its outputs.

Table 6.5 CMG v1.0 – Overview Working Steps.

	BB Scope	Working Steps	Output
BB1	**Preparation** *(Problem & Stakeholder Identification)*	WS1: Scope & application area WS2: Identification of terms & concepts WS3: Capability Context Definition WS4: Definition of the development strategy	Definition and scoping of: application area, definition of developer and user groups (e.g. stakeholder, CM team etc.), terms, concepts, perspectives, capability types and context (*focus area*) objects, definition of common development procedure and project plan integration
BB2	**Design Catalog** *(Design & Structure)*	WS1: Identification of Capability Candidates WS2: Structuring & Summarization WS3: Identification of Relationships	Definition of: • first capabilities • area of application and work coordination (cp. BB1) Planning of: • required identification activities, • involved experts, and • Planning of the estimated amount of effort. Structuring and summarizing of results
BB3	**Detail Development** *(Capability Content Engineering)*	WS1: Definition of Content Layer WS2: Capability Content Engineering WS3: Development of Stakeholder views	Definition of the catalog level of detail, specifying the different levels of detail (i.e. descriptive elements, KPI, additional attributes), capability content engineering, development and testing of visualization for stakeholder groups
BB4	**Catalog Governance** *(Administration)*	Evaluation, Maintenance	Catalog rollout and continuous improvement of the catalog regarding: • quality • usage period Different variants: Updates and upgrades

The following terms of CMG v1.0 were adjusted to keep the wording in the various versions, which are described in the work consistently (linguistic unification):

- Integrated capability approach → *Integrated Enterprise Capability Approach (IECA)*
- Context → Focus area
- Context objects → *Focus area objects*
- Enterprise context → *Enterprise environment (macro, micro, internal)*
- Capability solution matrix → *Capability identification matrix (CIM)*

6.3.1 BB1 – PREPARATION

The first building block defines conditions for the capability catalog to be created and should help meet the following requirements:

- Problem definition & clear scoping of the application area.
- Definition of developer and user groups of the capability catalog.
- Negotiating terms & perspectives.
- Definition of capability type & context (focus area) objects.
- Agreement on a common development procedure.
- Form the outer frame of the catalog.

Therefore, the first building block will be divided into the four steps:

WS1: Scope & Application Area
WS2: Terms & Concept Identification
WS3: Capability Context Definition
WS4: Development Strategy Definition

WS 1: SCOPE AND APPLICATION AREA

In the first WS, called "*scope & application area"* stakeholders and the focus of the required capability model are clarified. The involved parties have to agree on collaboration and communication principles, on the application area and on the goals of the capability catalog that is to be created. Accordingly, several questions are relevant, e.g.: What kind of support do stakeholders expect from the capability catalog? Does the catalog cover domain- or focus-area-specific questions or is it used for more general purposes? Who is involved in the development of the catalog (e.g., managers, domain experts, etc.)? So, all in all, the following questions have to be answered in this stage:

- For which purpose are capabilities defined?
- Which strategies need to be supported?
- Which area of application requires a capability catalog?
- Are there any industry-specific capabilities that need to be considered?
- Who is involved and provides input?

As indicated, different stakeholders need to be involved in the preparation of a capability catalog, including the upper management. According to human nature, there is a warily behavior towards change as long as change is not assessable. Consequently, a base of confidence needs to be established by providing information about the starting situation and interests (e.g. organizational- and/or personal advantages) and thus creating so-called "pick-up points" for involved parties. These pick-up points might strongly differ from each other, depending on the position and associated concerns of the participant. A stakeholder analysis supports the identification of parties that are or at least should be involved, their interests and their corresponding pick-up points. Therefore, the following questions need to be answered:

- Who will have which benefits?
- Who has an influence on the capability catalog development project?
- Who should be involved?
- What are the expectations of involved persons / groups / stakeholders?
- What is the general attitude towards the project (positive, negative or neutral)?
- How much influence do specific persons / groups have (small, medium, high, or crucial)?
- Who initiated the project for what reasons?
- Who is already or needs to be informed about project goals / addressed problems?
- Who is essential to initiate the project and who will be affected by project outcomes?
- Are answers to these questions documented in the form of a project description and also approved in some sort of project contract?

Table 6.6 illustrates an exemplary analysis of a capability catalog's application area with respect to a potential goal to improve the business-IT-alignment.

Table 6.6 Example for application area analysis.

Goal	Improve our business-IT-alignment	**Challenge**: "IT is not able to deliver to the business strategy say 75% of CFOs" (Gartner 2011).
Strategy	Development and maintenance of an architecture inventory	**Benefits**: Reliable architecture information, standardized communication, cross-company comparability of applications, reduced efforts for current landscape analysis and ad-hoc reporting, ability to identify redundancies and change impacts

Application area	Enterprise architecture management	**Focus Areas:** e.g., situation analysis, elaborate options, develop target state, roadmapping and migration planning, project portfolio planning, etc.

WS 2: IDENTIFICATION OF TERMS & CONCEPTS

This first step defines just the outer frame of the catalog but it does not yet determine the concept of capability in depth, its level of detail, the specific context, as well as the strategy and design of the catalog. The understanding of the capability concept may vary among the relevant stakeholders. Therefore, the step "*terms & concepts identification*" will identify terms and common perspectives to define a consistent capability concept. Starting with a general example of the capability approach may create a common understanding of the perspective at hand. Nevertheless, obtaining an overview of already existing definitions and concepts in the area of capabilities during preliminary stages is advisable in order to either use or extend present standards. The following questions might be helpful:

- Are there existing capability approaches, projects, catalogs, or maps in the enterprise?
- How is the concept of capabilities applied?
- What level of detail do these capability approaches have?
- In which application areas have these approaches been applied?
- How satisfied are stakeholders with preliminary results?

Results of this particular stage have to be documented and made available for the involved stakeholders. At this point, the global requirements of the capability catalog development are defined, and the existing concepts are compared and enhanced by missing components.

WS 3: CAPABILITY CONTEXT DEFINITION

In the next step, the "*capability context (focus area) definition*" activity is carried out. According to Abowd et al. [230], a *focus area objects* describes any information that can be used to characterize the situation of an entity. As already depicted, the *Integrated Enterprise Capability Approach* is premised not on an entity but on object-based concepts of the enterprise architecture, i.e., descriptive elements such as roles, information, or resources (Sect. 6.2.4). Therefore, the application area capabilities are divided into architectural levels as well – the corresponding architecture objects representing possible focus area objects (Figure 6.16) for capability type construction. Referring to Buckl et al. [231], capabilities have either a direct or indirect relationship to (other) architectural objects. The introduced descriptive elements are assigned to a capability within this step to determine the actual type (e.g. Figure 6.17, Figure 6.18).

Despite the analyses of scope and application area, attention should be paid to the definition of the focus area objects that are derived from the application area in order to specify the capability type in detail.

An EAM capability generally describes the ability to combine information relating to specific application area like architecture objects (focus area object) and management functions (focus area object) for e.g. an EAM Capability "Impact Analysis Application Architecture" is constructed of the focus area objects application architecture and its elements (Figure 3.4) and the EAM management function "Situation Analysis" (Figure 3.8). Furthermore, respective EAM capability is a combination of information relating to e.g. information about current architecture models or standards, roles with corresponding competences to create a specific outcome that are applicable in a process with appropriate available resources.

For instance, the focus area objects for business capabilities could depend on industry-specific aspects, since business capabilities are able to enhance both competitive advantages and core competences due to its uniqueness, inimitability, and contribution to the generation of better customer value [232]. In this context, certain architecture objects or functions such as business objects (e.g. Order) or management functions (e.g. Monitoring) are defined as focus area objects, since an interaction of these creates a customer value (Figure 6.18). Time horizon (e.g., current, future), activity-based or management aspects (e.g., planning, implementation, audit, maintenance), impacts (e.g., core, support) might be other candidates for focus area objects as well.

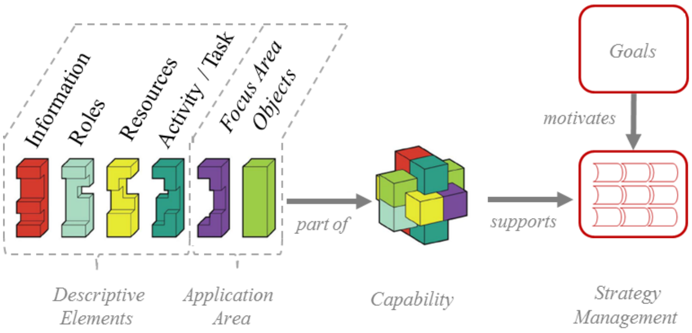

Figure 6.16 Integrated Enterprise Capability Approach.

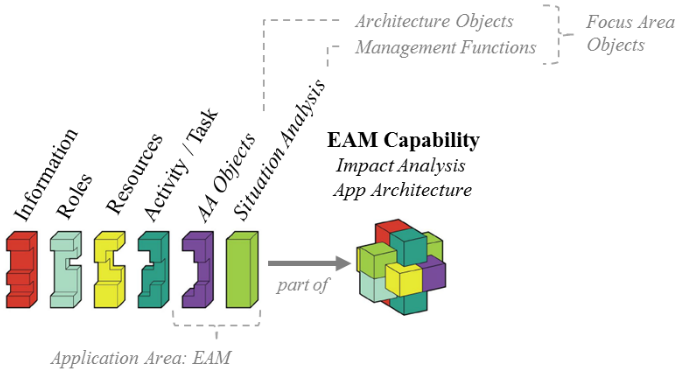

Figure 6.17 EAM Capability Example.

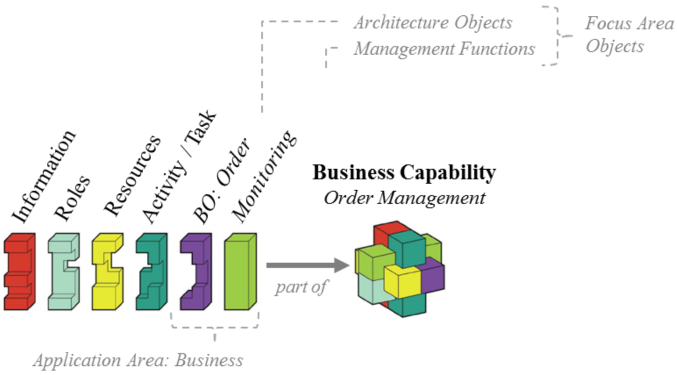

Figure 6.18 Business Capability Example.

Table 6.7 illustrates a couple of examples of typical industry-related business capabilities that provide guidance for the identification process.

Table 6.7 Typical industry-related business capabilities industry.

Industry	Examples
Utility	*e.g., Contract Management, Policy Management, Claims Management, Customer Management, Network Capacity Management*
Automotive	*e.g., Production Facilities Planning, Production Equipment Manufacturing, Customer Management , Supply Chain Management, Incoming Goods Processing Factory*
Banking	*e.g., Safety Management, Credit management, Compliance Management, Trade Manage-*

	ment, Risk management, Order Management, Real Estate Management
Software	*e.g., Product Life-Cycle Management, Pre- and After Sales, Test & Validation Management, License Management*
Mining	*e.g., Production Planning, Ore Extraction, Waste Management, Logistics Management, Plant Management, Smelting, Materials Management*

WS 4: DEFINITION OF THE DEVELOPMENT STRATEGY

Now, that content-related elements of required capabilities have been explained, the question of how the catalog is constructed and how appropriate capabilities are found need to be answered. Hence, this leads us to the *"development strategy definition"* stage. At this point two different approaches can be distinguished:

- a new catalog is developed
- an already existing catalog is extended

During the development of strategies, obtaining management approval and support is necessary. In addition, all relevant organizational units and employees have to get access to required information and documents. In fact, informing relevant stakeholders about, e.g., the upcoming activities and the corresponding timeframe is essential in order to obtain the required support.

The relevance of the overall project to the enterprise, the purpose of the capability catalog, a time schedule, planned activities, the involved parties, a common understanding of how capabilities will be applied – all of these aspects need to be clear and / or available right at the beginning. The main objective here is to create openness among the involved parties or stakeholders to upcoming analyses in order to have a positive influence on both quality and correctness of the identified capabilities.

The need for personnel and financial resources required in the context of a capability development project may have to be justified during the first building block as well. The following aspects may generally support the value justification:

- Added value of the capability catalog in accordance with the overall performance of an enterprise, e.g., cost savings or quality enhancements
- Development of competitive advantages with the aid of capability-based planning and investment
- Improvement of the documentation and auditability of organizational requirements used to achieve goals

The following aspects summarize the most important points of the preparation phase:

1. Define and agree on goals and the application area
2. Ensure to have consent and support of the upper management
    - Integrate all relevant organizational units
    - Arrange an adequate period of time and sufficient resources
    - Admit access to already existing documents
3. Consider affected individuals at an early stage
    - Inform about the purpose of the capability catalog that is to be created
    - Create/ produce the schedule and planned activities available
    - Communicate who currently is or will be involved for what specific purpose

The quality of a developed capability catalog depends on precise scoping and whether compliance with guidelines for quality management is achieved. These guidelines represent another important component of this phase, as they contribute to quality improvement of the development process and allow an evaluation of the achievement of objectives.

6.3.2 BB2 – CATALOG DESIGN

Subsequent to the determination of content within the preparation stage, the design of the capability catalog is initiated. Hence, capability candidates are identified, collected, structured, and their dependencies are defined:

WS1: *Capability Candidate Identification*
WS2: *Structuring and Combining*
WS3: *Relationships Identification*

WORKING STEP 1: IDENTIFICATION OF CAPABILITY CANDIDATES

The phase starts off with the "*capability candidate identification*." The focus of this activity is the definition of the first capabilities. Prior to any analyses, it is important to accurately define the area of application and coordinate the required work (*BB1*). The area of application determines the content and concepts being significant for the identification process.

Therefore, the output of (*BB1)* provides the basis for the planning of required identification activities, involved experts, and the effort estimation. For the actual identification process, there are several possibilities that have been successfully used in other fields such as enterprise modeling. Table 6.8 summarizes different methods of analysis with respect to their field of application within the capability candidate identification stage.

Table 6.8 Overview of methods of analysis for capability identification, according to [15].

Analysis Method	Field of Application within Capability Identification
CapStorming	The utilization of creativity techniques such as brainstorming in the course of the initialization process of a capability catalog is helpful for the purpose of quickly seizing ideas and combining these with existing concepts. The goal is to gather several ideas in a minimum of time with the aid of problem-oriented associations and combinations. As the point of origin, there might be, e.g., goals, packages of measures, processes, or a context matrix.
Survey	Represents the main technique for gathering information in the context of descriptive capability elements. In particular, these elements are used to either describe the context or improve the comprehensibility of a subject by creating a uniform language.
Document Analysis	Is used for either preparation purposes or as an initial step within the identification process (e.g., existing strategy maps, process models, domain architectures).
Written Cases	Are used in addition to surveys to identify the time and material input necessary to carry out a certain task.
Moderated/ Participative/ Design Thinking Workshop	Characterizes identification activities and/ or solution development steps that are applied in order to achieve consent among the involved parties. A joint analysis of current as well as prospective capabilities has an influence on quality, feasibility, and acceptance.

The initial activities for identifying capabilities should be kept as short as possible. In general, these initial activities result in a roughly structured collection of individual capabilities or at least capability ideas.

The origin of the identification process is a so-called "*capability identification matrix*" At the X-axis and Y-axis of the matrix, you find the context objects. For a business capability "market analysis," for example, the X-axis contains a context object called "market" (business object). At the Y-axis, there are simplified management processes like "planning," "execution," and "controlling." Consequently, the matrix cell at the intersection of the "market" object and an analysis step of the "planning" phase would then represent the "market analysis" capability. Figure 6.19 illustrates this at the example of the EAM capability "Impact Analysis Application Architecture".

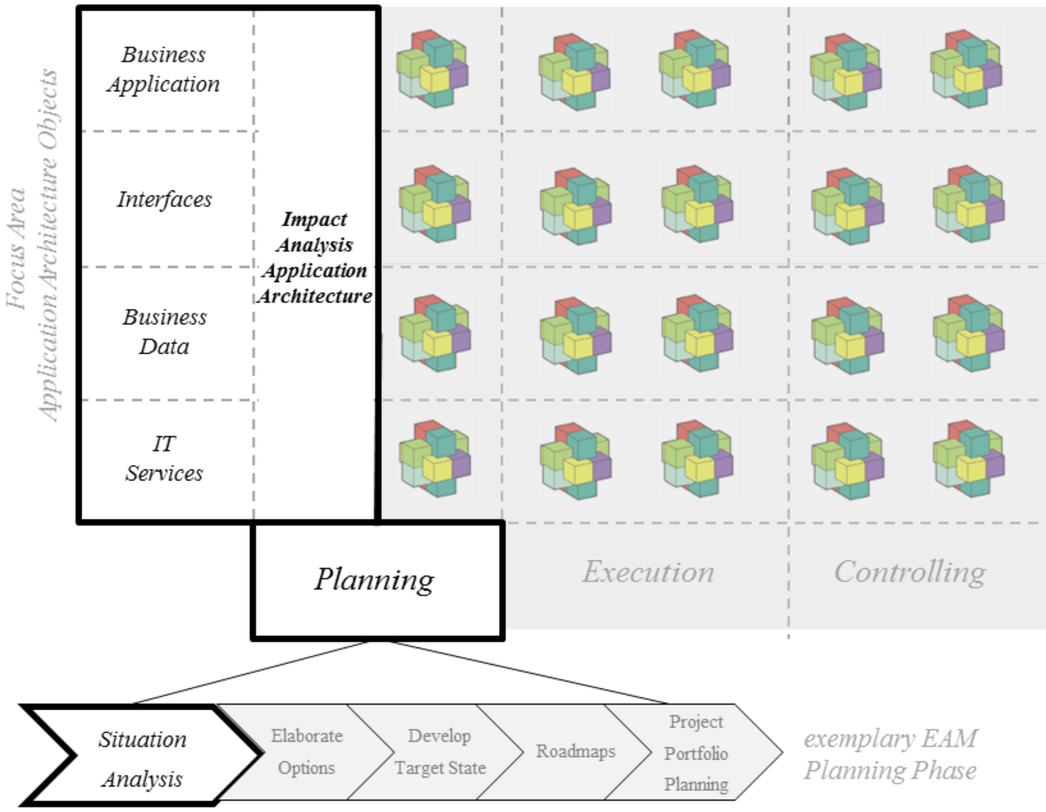

Figure 6.19 Concept of the Capability Identification Matrix (CIM).

WORKING STEP 2: STRUCTURING AND SUMMARIZATION

After collecting initial capability suggestions, the results need to be analyzed (with regard to the respective focus area), discussed, and, if necessary, restructured. Within the step "*structuring and combining*," redundant elements are removed and capabilities that have a strong coherence to content are aggregated or further specified. Within this stage, content-related aspects are combined to create a catalog that is both easy and clear to understand. A capability catalog does not serve its purpose if users are not able to gain a certain understanding of the catalog after an initial training. In case there is a large amount of capabilities, these could be aggregated or categorized. Accordingly, similar capabilities are either pooled or integrated using appropriate decomposition levels. It is of course necessary to have this agreed by the involved stakeholders and document questions and critical comments that may occur. Subsequent to first refinements of the capability catalog, participants work on additional iterations with the aid of the collected questions and critical comments in order to suggest further changes and enhancements.

In the course of several iterations, it is necessary to create a suitable document or description of the capability catalog in order to achieve a better understanding and to support involved stakeholders. The documentation should be digitized during initial activities, using, for example, a document such as the one depicted in Figure 6.20. The capability solution matrix could provide a structuring concept for this stage. Still, any other type of structuring is possible (note that this mainly depends on the area of application as well as the applied context (*BB1*). Additional criteria that might be subjects of further refinements (e.g., the level of content and detail) are explained in (*BB3*).

Architecture Layer	*Focus Area Objects*	Planning					Transfor-mation	Monitoring
		Situation Analysis	*Elaborate options*	*Develop target state*	*Road-mapping*	*Project portfolio planning*	…	…
Application Architecture	Business Application	**Impact Analysis Application Architecture**		Application Landscape Planning	Application Roadmap Definition			
	Interfaces		Technology check					
	Business Data							
	IT Services							
Business Architecture	Contract	Contract Analysis	Contract Development					
	Market	Market Analysis	Priories Channels	Concept Development				
	Product	Product Analysis	Product Development		Product Packaging	Product Portfolio Mgmt.		
⋮	…							

Figure 6.20 Structural example of a CIM with MS Excel.

The objective of this step is to classify identified capabilities, create a consistent structure, and fix capability names and prepare stable descriptions. The capability catalog can be characterized as follows at the state of this building block:

- Represents the first substantial results of the brainstorming activities
- Redundant elements that state similar points are pooled
- The catalog is may still be incomplete
- Relationships between capabilities are either fragmentary or missing

WORKING STEP 3: IDENTIFICATION OF RELATIONSHIPS

Since the collected improvement suggestions usually may not guarantee a sufficient, complete, or consistent capability catalog, it is necessary to conduct further analyses and reorganizations. In addition to an improved level of detail that is achieved in (*BB3*), dependencies among capabilities need to be identified and documented. During the step "relationships identification," different relationships are documented and analyzed. As a result of identifying missing relationships, removing inconsistencies and discovering gaps, there is an enhancement of both the knowledge represented by the catalog and the understanding of capabilities being available within an enterprise. Implicit, undesired, or overlapping relationships between capabilities have to be detected and adjusted (Figure 6.21).

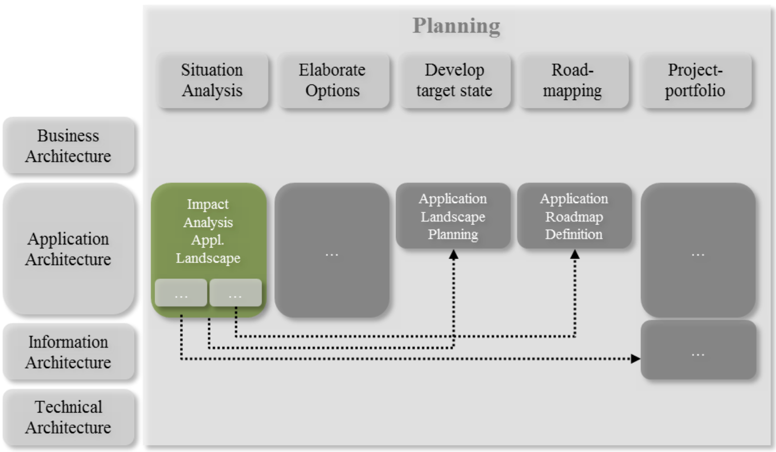

Figure 6.21 Example for the visualization of relationships in the CIM.

The different relationships between capabilities can be classified as follows:

- *Informative Relationship:* Which capability depends on information provided by another?
- *Supportive Relationship:* Which capability is a prerequisite for another?

6.3.3 BB3 – DETAIL DEVELOPMENT

Creating a capability catalog is typically an iterative process that is completed once every capability is described at a sufficient level of detail for supporting the strategy implementation of an enterprise. Thus, the third building block is responsible for the refinement of already achieved results by applying the following steps:

WS1: *Catalog Content Layer Definition*
WS2: *Capability Content Engineering*
WS3: *Develop & Test Views*

WORKING STEP 1: DEFINITION OF CONTENT LAYER

The initial step of the third building block, "catalog content layer definition," addresses the definition of the content and associated depth in order to provide both a final structure and order of the capability catalog. This step is important in case the catalog needs to achieve a high level of detail in the terms of content (e.g., by specifying descriptive elements and defining evaluation criteria). Figure 6.22 illustrates a three-level approach for the content layer definition. The capability solution matrix represents the first level and is used to identify contextual capabilities. The second level specifies the capability content and descriptive elements. Last but not least, different kinds of evaluation criteria are developed at the third level.

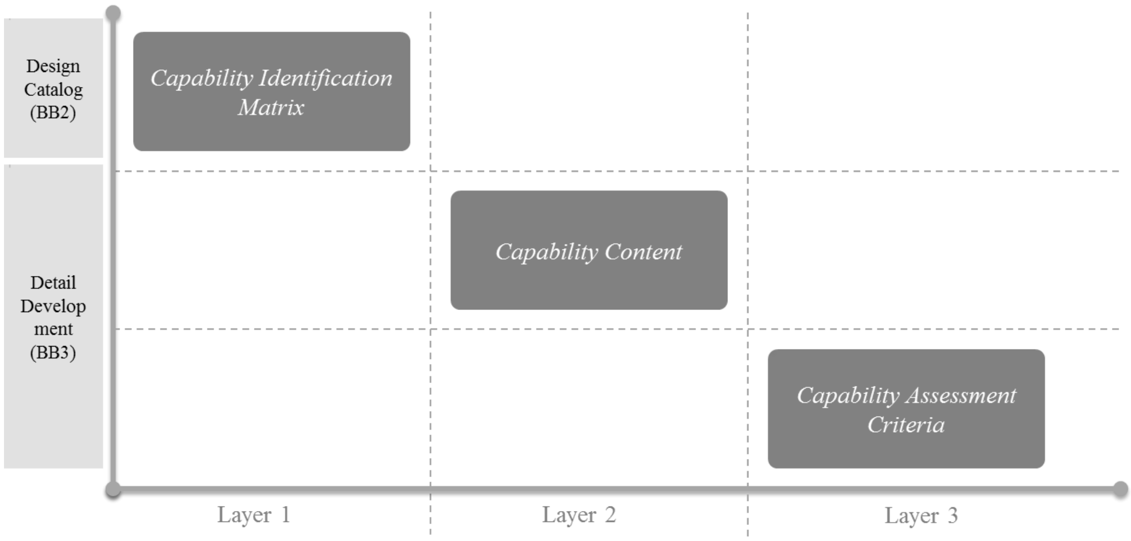

Figure 6.22 Capability Catalog Content Layer Structure.

WORKING STEP 2: CAPABILITY CONTENT ENGINEERING

After specifying the number of content layers covered by the catalog, a systematic analysis of the identified capabilities as part of the "*capability content engineering*" step is advisable. At this stage capabilities are actually described in further detail.

According to Ulrich and Rosen [80], the following list presents a number of basic principles for the capability content engineering process:

- Capabilities define what is done, not how to do something.
- Capabilities are nouns
- Capabilities are defined in terms of their application area (i.e., there should be no technical terms for describing business capabilities).
- A capability should be enduring and stable, not volatile.
- Capabilities are not redundant.
- There is one capability map for an application area.
- Capabilities can have relationships to other capability types.

During the engineering process, the entire capability catalog appearance may still be subject to substantial changes. The catalog’s structures are depicted with the help of models that support a clear and consistent conception of the catalog.

Prior to any adjustment, a review of previous work is required. Afterwards, an elaboration or refinement of the descriptive elements can be carried out. An elaboration of the “market analysis” capability would be performed with respect to the following questions for example:

- What information is required to conduct a market situation analysis?
- Which roles are able to provide information and make decisions with respect to this object?
- What resources are required to perform a market situation analysis?
- How is a market situation analysis performed and what kind of output is produced?
- Are there already predefined activities or a standard process for market analysis?
- Are there any references of already defined capabilities to logical objects of the enterprise?

WORKING STEP 3: DEVELOPMENT OF STAKEHOLDER VIEWS

The third building block is completed by the “*develop & test views*” step. When describing capabilities in detail, it is necessary to ensure that every capability is formulated in a general manner, i.e., there should not be any connections to objects such as particular applications or markets. However, capabilities may well be linked to logical elements. For instance, the connection between strategy, goal, and corresponding capabilities for its realization could be captured in a view. Figure 6.23 illustrates this example.

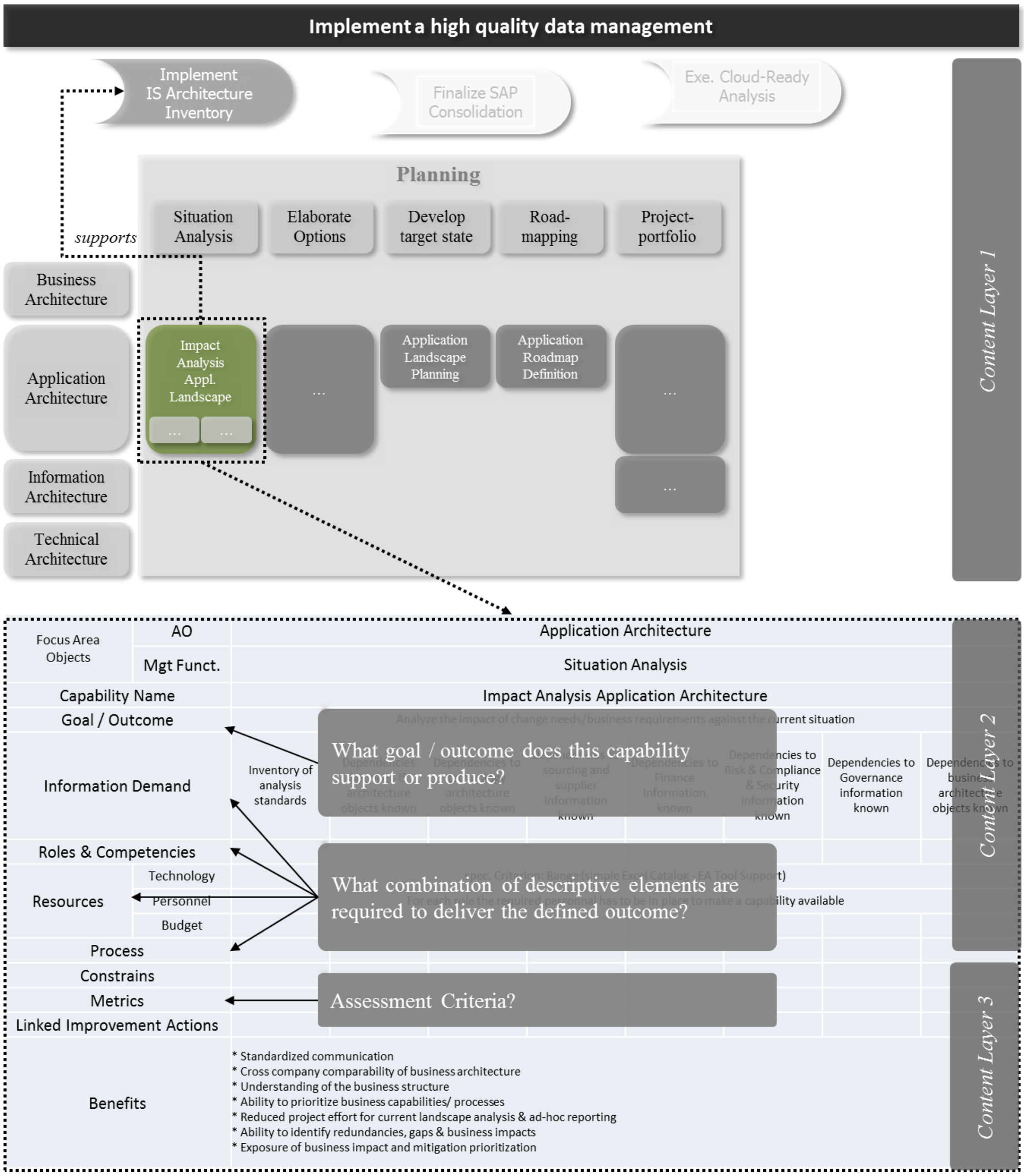

Figure 6.23 EAM Capability on all three content layer**.**

In general, views might be applied to present specific sets of capabilities to different kinds of stakeholder groups. In particular, one of the following sample views might be created: required maturity level vs. current maturity level of a capability used for strategy implementation, costs of creating a capability, dependencies between capabilities, financial aspects (revenue, profit), or just a EAM capability overview (Figure 6.24).

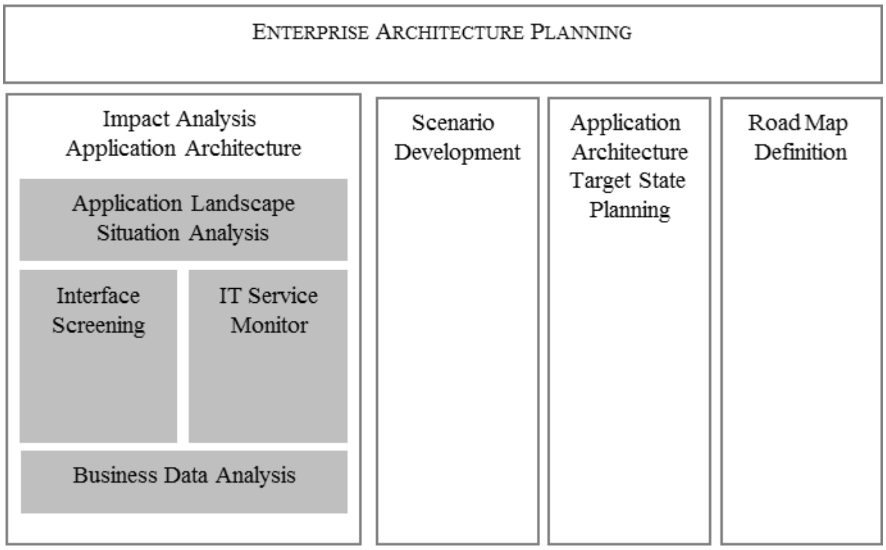

Figure 6.24 Overview - EA Planning Capability.

For presentation purposes, different tools and technical measures (multiple video projectors or monitor screens, special software tools) may be used. The following are only mentioned as a few examples: data and tree maps, radar charts, parallel coordinates, cone trees, or layer charts [234].

6.3.4 BB4 – CATALOG GOVERNANCE

The last building block describes an important, remaining stage in the context of creating and introducing a capability catalog. In fact, the governance process addresses the quality management of a created capability catalog. Therefore, it includes activities referring to the evaluation, deployment, and maintenance of a catalog. The paragraphs below describe these activities in detail:

WS1: Evaluation Concept
WS2: Catalog Evaluation
WS3: Catalog Deployment
WS4: Catalog Maintenance

Even though there are a lot of approaches dealing with quality criteria and evaluation methods in the context of, for example, business processes [15], there is still little progress in the application area of evaluating capabilities, in which approaches are most often build on ordinary methods for quality control or are impractical for the designated purpose. This might have originated from an omitted preparation phase, which is normally used to describe the quality criteria a catalog has to satisfy.

WORKING STEP 1: EVALUATION CONCEPT

In order to both counteract deficient quality and promote the functionality of a catalog, the optional stages "evaluation concept" and "catalog evaluation" can be used. The subject of the "*evaluation concept*" step can be the development process (the way the catalog is constructed), the designed result (the catalog itself), or both, i.e., a differentiation between "model verification" and "model validation" can be necessary [235]. In line with Duhan et al. [236], the catalog verification determines if the artifact represents the developer´s concept accurately and it tests the model against a set of theoretic evaluation criteria. The catalog validation examines from the perspective of the intended catalog usage if the artifact corresponds to the real world. This can be achieved by applying case studies, assessments, and expert interviews. An example of a verification method is described by [57]. Due to practice-oriented reasons, this section exclusively covers the validation of capability catalogs. Accordingly, the quality level and quality criteria have to be elaborated during this stage (unless it has been done *BB 1*) to make a measuring possible. Appropriate criteria can normally be derived from the goals predefined in the scoping of the capability catalog (*BB1.WS1*). In addition to conducting an overall review of general quality standards such as completeness, accuracy, flexibility, linkage, simplicity, intelligibility, and usability, it is recommended to apply comprehensive evaluation tools, e.g., capability maturity models, in case of large capability catalogs.

WORKING STEP 2: CATALOG EVALUATION

Maturity models are specific management instruments, which define various degrees of maturities in order to evaluate to what extent a particular competency fulfills the qualitative requirements that are defined for a set of competency objects [237] and / or development processes in an organization [375]. Beginning with very early stages of these entities, maturity models define anticipated, logical, and consecutive development paths until observed objects reach an absolute maturity [238]. Having their origins in the software industry, maturity models are designed to measure the current state - the achieved level of competence - by means of assessment methods [235,239]. Maturity models may be applied in the "catalog evaluation" step. After such an evaluation, the second building block can be revisited and the feedback can be used as an input for further iterations of catalog development.

WORKING STEP 3: CATALOG DEPLOYMENT

The way of integrating a catalog into an enterprise has a vital influence on the success of this catalog. To this end, the "*catalog deployment*" step addresses the implementation / roll-out of a catalog in the organization. As specified earlier, creating a capability catalog is only reasonable in case the management approves and supports the process. Accordingly, both upper and middle management need to be convinced. Corresponding to the aforementioned facts, the success of integrating a capability catalog depends on three aspects:

1. The capability catalog has a high-quality level
2. Stakeholders (e.g., board level, business developers, line managers) are satisfied with both the approaches and achieved results.
3. Right communication and representation

Thus, the completed capability catalog needs to be formally presented to the steering committee and contracting authority, respectively. This should be delivered either in the form of an intermediate presentation or as part of the project completion. It has to be ensured that the needs of the stakeholders are satisfied. To achieve this, accurate planning and preparation is required. The project team needs to be able to enhance the results of the capability catalog creation process, i.e., converting the final catalog version, descriptions, and illustrations into an appropriate form of presentation. Relevant stakeholders might, for example, obtain a copy of the document to prepare themselves for approval. The subsequent aspects have to be considered in the context of catalog deployment:

- Obtain feedback from users and the steering committee
- Obtain decisions about the maintenance of the catalog and the allocation of resources
- Integrate the catalog into existing processes

All in all, the catalog deployment needs to pursue the goal of achieving an acceptance of the results and creating an activity plan in terms of additional elaborations or unresolved issues. Even though an initial evaluation of the achieved state should have been conducted in the preceding building blocks, it is unlikely that a single iteration is sufficient. The second goal is to receive user feedback provided by individuals or working groups in order to improve the catalog utilization. In this regard, it is recommended to perform internal surveys or workshops after a certain period of time. Such feedback can result in a change in the structure and / or in the function of the capability catalog.

WORKING STEP 4: CATALOG MAINTENANCE

Besides, changes in the domain knowledge and management approaches can create the need for improvements in the catalog [240]. For these reasons, the maintenance step will be passed through, which is necessarily an iterative process. Ensuring the catalog relevance over the years, this step addresses the evolution of the model. As an enterprise may have to meet new challenges and capabilities need to be modified accordingly, there is an ongoing "catalog maintenance" process in addition to evaluation methods applied to create a high-quality capability catalog. These are the following advantages of the introduced process step:

- Structure and comprehensibility
- Precise descriptions
- Simplified modifications and reorganizations of the created catalog
- Contributes to the organizational learning and securing of organizational knowledge

Consequently, an improvement of both quality and usage period of the catalog is addressed within the last step of this building block. Modifications in the catalog structure as well as slight adjustments may occur in this step. From [240], we adopted three of four extension patterns for the purpose of catalog maintenance, illustrated in Figure 6.25.

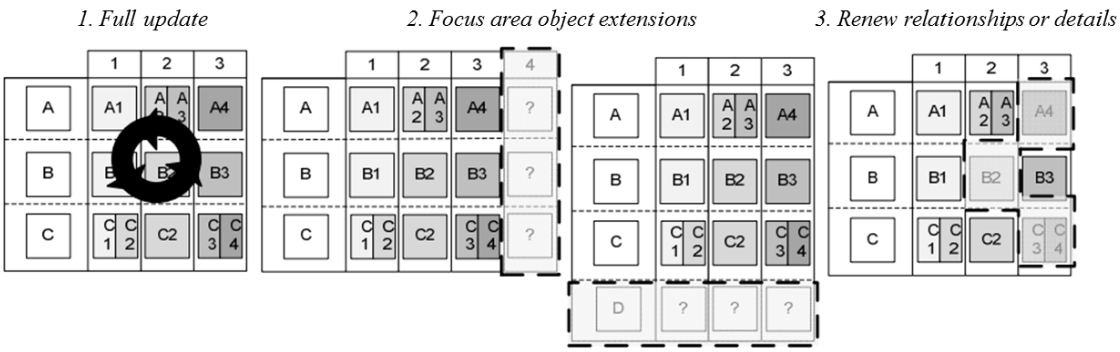

Figure 6.25 The Capability Catalog Extension Patterns, according to [240].

A general update of capability catalog elements such as by adding new descriptive elements or updating the evaluation mechanism (e.g., maturity assessment procedure) may be examples of the first pattern. It is also possible to add new context objects or reorder their configurations, e.g., by changing attributes that might influence the identification process (*BB2*,*BB3*) or at least reconfigure the relationships between different capabilities. Although these extension patterns challenge the meta-structure of the capability catalog to some extent, it is not required to pass the first building block and begin the development process again by redefining the scope, as this would go beyond the scope of maintenance.

6.4 JUSTIFY AND REFLECT

In the following section major design and development decisions are explained in more detail, which were made in the development of the CMGs. The section is mainly focused on design-related decisions and constraints and excludes possible limitations relating to the used research methods (discussed in Sect. 9.1). Furthermore, the compliance with the aforementioned principles *(μ8-μ13)* is also addressed.

Figure 6.26 summarizes an overview about the developed method aligned to Goldkuhl's Method Integration [216] as well as the assigned corresponding requirements (Sect. 5.2).

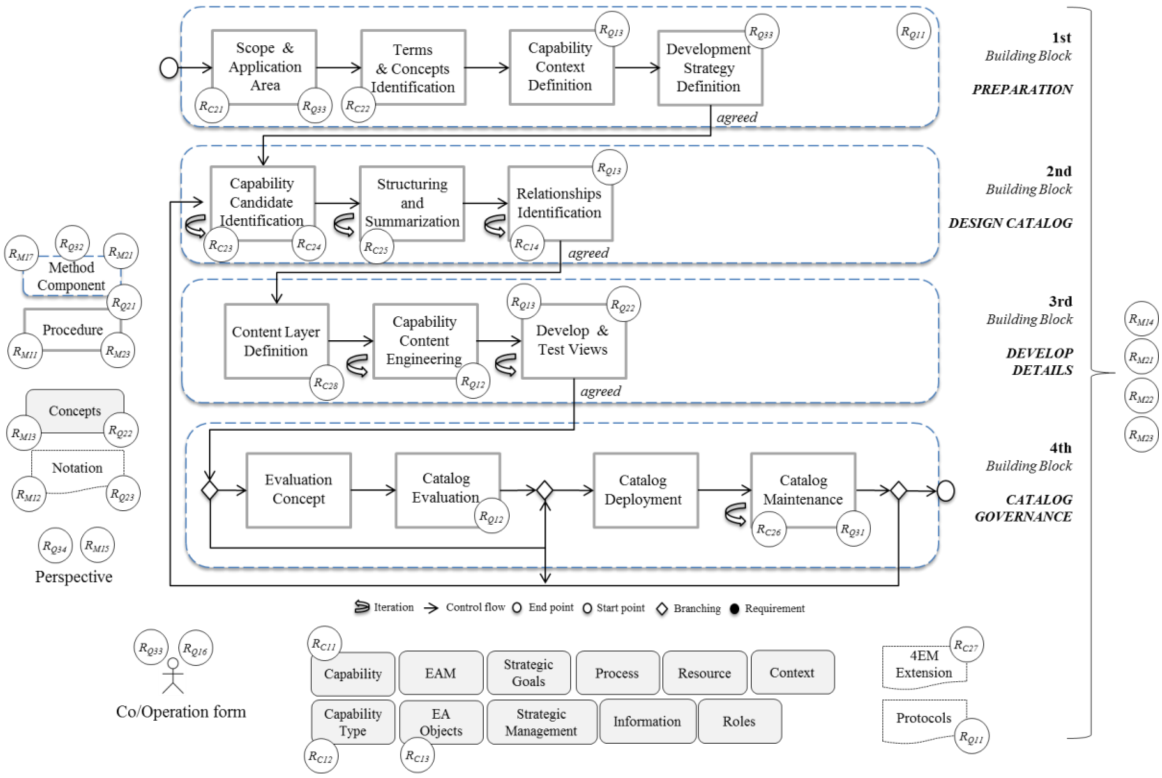

Figure 6.26 CMG v1.0 – Requirements Overview.

For the description how each requirement is solved by CMG v1.0, Table 6.9 a list with all 32 requirements including the respective solution and design decisions as well as literature of major concepts (the solutions of blank cells were developed from scratch).

Table 6.9 CMG v1.0 – Design decisions and developed solutions.

Conceptual Requirement	Design decisions and developed solutions	CMG v1.0 reference:	Solution based on
R_{C11}: General and reusable term classification concept	For the development of a general and reusable capability approach a total of 232 research papers were read and analyzed. Since no capability approach could be found which satisfies R_{C11}-R_{C14}, a proprietary development has been conducted. For this reason all capability approaches, which were specified in the relevant articles, were aggregated. Interim results were tested with both the ReC and the LP. The aggregated results are the basis for the Integrated Enterprise Capability Approach (IECA). The ICEA is a fundamental concept of CMGs and is used in various WSs.	Capability Concept for all method components *BB1.WS1-BB4.WS4*	Literature review results [85,190]
R_{C12}: Concept for capability type differentiation	This requirement is another reason for the decision to develop an own capability approach. The distinction between different types of capabilities should be made based on the same capability structure considering environmental conditions. Thus dependencies of capability elements, which can be similar for different capability types, can easily be assigned and derived. For example, certain roles can be assigned for both business as well as for EAM capabilities as a central role and their interactions should be reviewed within the EA. The type distinction is a component of IECA and also a concept for all WS.	Capability Concept for all method components *BB1.WS1-BB4.WS4*	Literature review results [85,190] Capability type classification [349,357]
R_{C13}: Composition by EA elements	In order to describe IECA on a general and reusable basis, the corresponding capability elements have to be reusable as well. In this context we decided to construct capabilities from EA objects, since these	Capability Concept for all method components	Literature review results [85,190]

	reusable components are available in any enterprise. Thus, the proposed capability types within the ICEA consist of descriptive basic elements of EA as well as a number of freely selectable focus area elements (former context elements), which characterize the type differences and are derived from the application area. The Capability composition of EA objects is part of IECA and therefore a corresponding EA object approach is required for all WSs.	*BB1.WS1-BB4.WS4*	EA Layer & Elements of the CIM [22,117,121] EAM functions of the CIM [9,12] Context and context-awareness [230]
R_{C14}: Possibility of mutual dependencies & hierarchies	Depicting capabilities in hierarchies with corresponding dependencies is common practice and has been taken over from literature.	BB2.WS3	Literature Reviews [85,190] Capability Dependency [171]
Conceptual Requirement	**Design decisions and developed solutions**	**CMG v1.0 reference:**	**Solution based on:**
R_{C21}: Identification approach of involved parties	The identification of involved stakeholder groups is a standard method of Strategy- and Project management and was adopted from literature.	BB1.WS1	Stakeholder Analysis [69]
R_{C22}: Definition procedure of terms and preconditions	To find a common understanding between different stakeholders with differing languages is found by analyzing current perspectives and already existing definitions in order to either use or extend present concepts. For capability definition we recommend a deductive procedure: starting with a general example of the capability approach for a common understanding, specific constellations and elements can be derived afterwards. Here the concept of the ICEA already influences the outcomes.	BB1.WS2	Capability relations within an enterprise [225]
R_{C23}: Identification of capability types for operationalizing of strategic objectives	For the capability identification we suggest several possibilities that have been successfully used in other fields such as enterprise modeling, such as brainstorming, surveys, document analysis, written cases, moderated workshops focused on the chosen application area (e.g. EAM, IT, business).	BB2.WS1	4EM-method [15] Development of an EAM Capability Catalog [52]
R_{C24}: Systematic capability identification procedure	We introduced an own developed multidimensional capability identification process, which is based on the ICEA. At the axes of the Capability Identification Matrix (CIM) the set of focus area objects are assigned to the two different axes – for EAM capabilities these are: EA objects and EAM functions. In case that more than two focus area objects classes are defined, the CIM has to be stretched to multidimensional spaces.	BB2.WS1	Development of an EAM Capability Catalog [52]
R_{C25}: Structuring approach for gathered capabilities	After collecting initial capability suggestions, the results need to be analyzed, discussed, and, if necessary, restructured. Moreover, in the course of several iterations, it is necessary to create a suitable documentation of gathered capabilities to achieve a better understanding and to support involved stakeholders. Therefore, we suggest a set of principles which should be applied on the CIM.	BB2.WS2	
R_{C26}: Maintenance concept for the capability repository	Due to environmental changes and/or feedback from capability catalog utilization, it can result in a change in the structure and/or capability elements. For these reasons, and given that an enterprise may have to face new challenges over time and capabilities need to be modified accordingly, a "maintenance" WS is introduced. From [240], we adopted three extension	BB4.WS4	Maturity model extension patterns [240]

	patterns for maturity model extension to the purpose of catalog maintenance.		
R_{C27}: Notation concept for EAM capability modelling	The documentation in form of visualization and standardized more formal notation is imperative for the capability management, which works on different levels of detail. Thus, we interpreted this demand in terms of an easy-to-use modeling notation that did not come into conflict with quality-related requirements. Moreover, the selected notation should be supported by a modeling software. For this reason we chose the 4EM-method [15] and a corresponding capability extension in the context of notation choice. The notation extension should be prototypically integrated into the *4EM.Desk* and *4EM.Touch* application and can be used for modeling EAM capabilities. However, the implemented prototype for CMG v1.0 and its demonstration status was unavailable, because it was still too unstable.	BB2.WS3	4EM-method [15] 4EM.DEV project (Sect. 6.2.5) Capability Modeling Concepts [56,72,91,200, 203,206,221]
R_{C28}: Structured capability content construction on an appropriate level of detail	In order to provide capability content on a desired level of depth without affecting the flexibility of catalog construction we introduced a three content layer approach (e.g., by specifying descriptive elements and defining evaluation criteria). The individual layers are logical extensions to the initially adopted CIM capabilities (Layer 1) and refer to specifying descriptive elements (Layer 2) and defining evaluation criteria (Layer 3).	BB3.WS1	
Method implied Requirements	**Design decisions and developed solutions**	**CMG v1.0 reference:**	**Solution based on:**
R_{M11}: Procedure: describes how to perform a process step.	Different WS describe the workflow and provide instructions regarding what kind of activities and information are relevant. This applies to all activities within the WS and the transitions between the individual BB.	*BB1.WS1-BB4.WS4 (Activities)*	
R_{M12}: Notation: describes how to document a process step.	Within each WS it is described how to conduct a representative documentation of conclusions and outcomes. For this purpose, inter alia, standardized protocols 4EM.Desk & Touch, Document- or KM systems are proposed. The actual selection is subject to the policies of each enterprise. The notation concept applies to all techniques for the documentation of results within the WS and the transitions between the BB.	*BB1.WS1-BB4.WS4 (Techniques for result documentation)*	
R_{M13}: Concept: summarizes several circumstances that connect procedure and notation.	All necessary concepts for the implementation of the respective WS are explained at this point. We also inserted a glossary containing all concepts of CMG and other reference points. Introduced concepts apply from the date of introduction for all further WS. Concepts apply to all WS and BB transitions from the introduction.	*BB1.WS1-BB4.WS4 (Glossary)*	
R_{M14}: Framework: consists of different method components and constitute a structure.	The CMG v1.0 framework is based on three different approaches, which originated in the EACN project and the maturity model development. Based on the Enhanced Maturity Model Development for EAM Capability approach (MMDP) [90] the CMG framework was developed. The BB structure and some names of WS were adapted from the approach. Besides the MMDP and under consideration of the task of CMGs, the individual WS are coarsely based on the following phase concepts of: [81] (Problem definition, comparison of existing maturity models, determination of development strategy, iterative maturity model development, conception of transfer and evaluation, implementation of transfer media, evaluation, rejection of maturity model),	BB1-BB4	Procedure model for developing maturity models [81] Maturity Model Development Method [90] Method for developing focus area maturity models [327] Assessing organizational capa-

	[327] (Scoping, Design Model, Instrument Development, Implementation & exploitation), and [328] (Planning, Development, Evaluation, Maintenance)		bilities: reviewing and guiding the development of maturity grids [328] EACN project (Sect. 4.2.1)
R_{M15}: Perspective: basis; implicitly or explicitly; summarizes goals, values, principles and motivations.	In order to motivate newcomers to the topic, perspective explanations start with challenges caused by the macro- and micro-environment, followed by exemplary challenges relating to the internal-environment to motivate advanced-capability-user. The motivation is based on conducted literature reviews, root cause analysis results and practical experiences from the EACN-, EACI- and CBP- project. Moreover, we describe the advantages of EAM capabilities and potential areas to find these within the EAM cycles (Figure 6.3). The goals of the CMG are summarized as follows: Scoping and preconditions for capability management, identification of involved stakeholders, identification of capability types and their relations, structuring of capabilities and their models as a catalog, governance of the resulting capability catalog.	*BB1.WS1-BB4.WS4*	Literature Reviews & Surveys [59,64,65, 66,134,135] EACN-, EACI- and CBP- project (Sect. 4.2)
R_{M16}: Co-operation Forms: define who cooperates with whom and in which form	We defined seven roles (*problem owner, project lead, EAM CM team, domain expert, stakeholder group, moderator, minute taker*), which are required for the implementation of the CMG. Here, we orientated on the role concepts from enterprise modeling. Its co-operation forms were determined on the basis of the responsibility assignment matrix using RASCI activities. The various roles have been integrated as a role model for all WS in the CMG.	*Role Model for BB1.WS1-BB4.WS4*	EM Role Concept [15] Responsibility Assignment Matrix (RASCI) [351]
R_{M17}: Method Component: describes the close relation between procedure, notation and used concepts.	The Method Components are represented by the WS of the CMG. It was decided to waive any clear separation between notation, concepts and procedure within each WS, as this might have created a conflict with the usability *(R_{Q21})* of CMG. Thus, the notation and concepts were integrated and referenced in the procedure description of the WS. This type of description of the relationship is valid for all WS and the transitions between the BB.	*BB1.WS1-BB4.WS4*	
R_{M21}: Recombination of single method components should be possible (modularity)	Modularity is represented by the CMG BB design in order to provide flexibility by its recombination. However, we recommend that the WS-sequence within the BB is not changed, as these sequences are harmonized to one another with regard to the output. In addition to this, it must be ensured that a BB recombination is provided with appropriate information, which is also necessary for the implementation of the WS.	BB1-BB4	
R_{M22}: The method should be logically, orderly and consistently related (coherence)	The BB and WS are logically ordered and consistent structure – see *R_{M14}*.	BB1WS1-BB4WS4	Procedure model for developing maturity models [81] Maturity Model Development Method [90] Method for developing focus area maturity models [327]

			Assessing organizational capabilities: reviewing and guiding the development of maturity grids [328]
R_{M23}: Adequate granularity layer for a various set of stakeholders under consideration of its information demands.	Adequate granularity layer of the method is provided by the written CMG manual and process diagram that can be used for communication purposes. Within the CMG we suggest different methods for stakeholder analysis (including desired information) and an information demand analysis approach. Both methods are mentioned in BB.WS1 and BB1.WS4 and referenced in the Glossary.	BB1.WS1, BB1.WS4	Stakeholder Analysis Map [69] Information Demand Analysis [53]
Quality Requirements	**Design decisions and developed solutions**	**CMG v1.0 reference:**	**Solution based on:**
R_{Q11}: Decisions concerning identification and integration of necessary stakeholders, used capability concepts, required efforts and desired value have to be traceable	All decisions during the CMG process have to be documented by the proposed protocols and systems (*Notation*). Within the project management, the *project lead* determines and communicates the level of detail, how and where these protocols will be stored / filed. With regard to *(R_{Q11})* in particular, all decisions of BB1 have to be covered and be provided for other BB.	BB1.WS1-BB1.WS4 Notation, Protocols	PM meeting protocol [393]
R_{Q12}: Defined capability components should be measureable in order to assess its status and benefits for a concrete strategic implementation	Under the Content Engineering (BB3.WS2) performance indicators (derived from outputs of BB1) can be determined in Content Layer 3 to measure the quality and current status of descriptive elements or the overall state of the capability. The actual review of the catalog is performed in BB4.WS2. In this context, attention is drawn to maturity models as a possible assessment approaches, but a specific model is not proposed at this point.	BB3.WS2, BB4.WS2	
R_{Q13}: The method should provide a high-level communication medium of current and desired EAM capabilities and its relations to other elements of the EA e.g. vision, strategy or goals.	The IECA and its content layer structure are designed to facilitate communication of capabilities in different granularity and for different customer groups, without losing the total content depth. For example, evaluations on top capability levels can be performed to assess / display the current financial needs respectively to raise the necessary financial needs of a capability in order to obtain the required level of quality for the optimal support of a specific goal.		
R_{Q21}: Usability refers to the experienced user quality when interacting with the method. Particularly, simple in operation simultaneously combined with satisfied user expectations regarding target achievements receives a high usability.	In order to optimize the ease with which a user can use the CMG we tried to describe all issues as simple as possible and to eliminate all redundant aspects. Simplicity is the key for usability, because users do not want complicated formulations, explanations and/or actions. Moreover, we focused our work on universal design principles and website usability guidelines such as making WS easy and intuitive to follow, minimize steps and removing roadblocks, making the CMG meaningful and valuable.		Universal Principles of Design [391] Website Usability Guidelines [392]
R_{Q22}: In order to enhance the understandability the method should include wordings, expressions, recommendations, guidelines and	Therefore, we tried to assure that everything is explained clearly, even complex issues, by using business language. For this reason we used the *(R_{M13})* in terms of the CMG Glossary, which at least contains all relevant descriptions of concepts, approaches and references to further literature. Furthermore, we used different visualization techniques to represent complex issues understandable.		Visualization techniques for complexity reduction [60,350] Periodic table of visualizations

visualizations (Comprehensibility).			[234]
R_{Q23}: Standardization of using a method by means of structured procedures and its documentation should guarantee its traceability and repeatable.	This requirement is commonly in conflict with the requirement of the flexibility *(R_{Q32})* of the CMG. Thus, it was decided to only make the BB recombining and it is highly recommended to use the proposed course of the WSs. Furthermore, the documentation of results and decisions for each WS was standardized in context of the notation suggestions *(R_{M12})*. In addition to this, systems to use for the standardization of the document- and model management are proposed as well.	BB1.WS1-BB4.WS4	
R_{Q31}: The method has to define mechanisms that support the recognition of faults, their causes and its correction as well as integrate new requirements occurring from enterprises' changing environments (maintainability).	The CMG has an own WS that provides mechanisms and activities that support the recognition of faults, their causes and its correction as well as integrate new requirements occurring from enterprises' changing environments. *(R_{C26})* describes how to deal with different demands (Catalog Extension Patterns), BB4.WS4 describes the necessary activities.	BB4.WS4	Maturity model extension patterns [240]
R_{Q32}: Method components should be suitable for adaption and integration of additional components (flexibility).	This requirement is commonly conflicting with the standardization *(R_{Q23})*. However, in order to provide a certain degree of flexibility the WS are suitable for adaption and integration of additional enterprise-related aspects.	BB1.WS1-BB4.WS4	
R_{Q33}: The ease with which an actor can be made accountable for the workings within the CMG execution (accountability).	The ease with which an actor can be made accountable for the workings within the CMG execution. In order to provide accountability of CMG actors we used the responsibility assignment matrix concept including the RASCI activities. As part of the assignments of activities to the individual roles within a WS, it was ensured that accountability was always assigned only once per WS. Thus, the responsibility concerning the budget decisions (resources, money, time) is always assigned uniquely. The accountable roles are defined in BB1.WS1 and BB1.WS4 and are applied in the entire CMG.	Co-operations forms, BB1.WS1, BB1.WS4	EM Role Concept [15] Responsibility Assignment Matrix (RASCI) [351]
R_{Q34}: The method has to include all aspects required for managing EAM capabilities (Completeness).	Based on the LPL projects and prepare-, design-, development- and governance- activities, the BB of CMGs for managing EAM capabilities in different situations has been developed in practice.	BB1-BB4	EACN-, EACI- and CBP- project (Sect. 4.2) Mgt. Approaches [142, 184]

We presented a generic approach that can be used to derive EAM capabilities through a structured process and gather them in an enterprise-specific catalog for an effective support of enterprise strategies. For this we provided in this chapter explanations of the design and development process in terms of how single components are developed and local practices and research communities are involved as well as scientific literature has been reviewed *(μ18)*. In this connection, the solutions for the 32 defined requirements are assigned to the respective CMG components (Sect. 6.2, Table 6.1) *(μ13)* and its application within the CMG is also described (Section 6.3) *(μ15)*. In Table 6.9 design and development decisions and underlying concepts are summarized *(μ14, μ17)*. The originality *(μ16)* of individual solutions is argued to the effect that concepts such as IECA, CIM and visualization concepts for complex issues have been published several times and were also partly tested with ReC and LPs (Sect. 6.2.4). This first version of the CMG represents the input for the demonstration phase *(S_{GP1})*.

7 DEMONSTRATION

"How can the developed artefact be used to address the explicated problem in one case?"[21]

Within the demonstration activity of the method framework the artifact's first feasibility check is performed by representing it to partners from local practices or using a theoretical illustration. The demonstration should show that even the initial version of the artifact can already solve some requirements. According to [21], a demonstration can be considered as a weak form of an evaluation due to the fact that if an artifact has already been used successfully in one situation, it could also be applied in different situations.

Since we had the opportunity to perform the CMG v1.0 not only in one but in two real-environment situations, we have chosen a *capability newcomer* and an *advance-capability-user* for the artifact demonstration. Therefore, we used two expert interviews for documenting the outcome of the CMG v.1.0 application and a qualitative content analysis for extracting suggestions for improvement. The demonstration activity is structured in two sub- activities (Figure 7.1).

The first sub- activity "*Use Case Outline*" describes the chosen situation in depth (Sect. 7.1). "*Apply artifact*" describes how the artifact is applied to the selected situations, how the demonstration is performed and what its outcomes are (Sect. 7.2). The findings of this research process phase are previously published in [15,243,300], which are referenced at the beginning of each section.

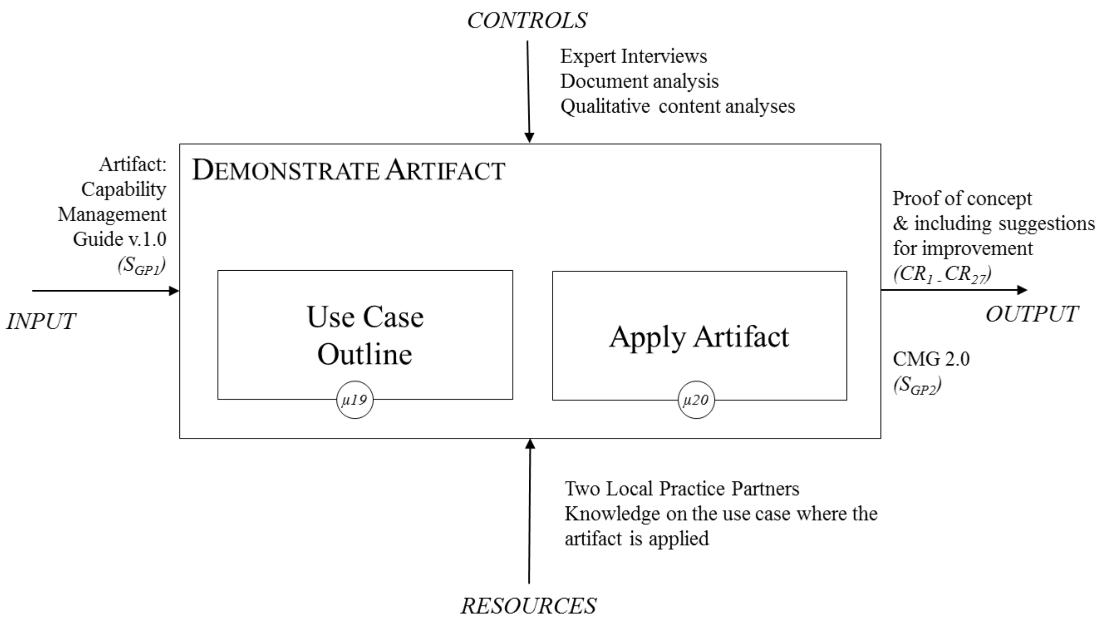

Figure 7.1 Research Process Step 4: Demonstrate Artifact.

In order to support scientific accuracy in the demonstration phase, we followed two principles *(µ19, µ20)* recommended by [21]:

µ19. *Justification of the practical use case selection:* Explanation of why the use case is chosen in terms of being representative and challenging enough for a demonstration activity.

µ20. *Clarify how much the artifact is tested:* Description of the components that are tested within the demonstrations.

7.1 USE CASE OUTLINE

The following section describes the two demonstrations, in which we used a handbook version of the CMG v1.0 [87]. The demonstration was executed by two master theses [241,242] written in 2015 at the University of Rostock. We selected two experts form different enterprises, with diverse responsibilities and various capabilities backgrounds. Both experts have long-standing experiences in EAM. One of them was already equipped with EAM capability experience, the other one came into contact with the topic for the first time. Thus, we could demonstrate the CMG v1.0 to the two defined user groups with EAM backgrounds, *newcomer* and *advanced-capability-user*. A description of the local practice partners and interviewed experts is summarized in Table 7.1.

Table 7.1 Demonstration descriptions for artifact demonstration.

LP Information	**Demo 1 - Stadtwerke Rostock AG**	**Demo 2 – Bombardier Transportation GmbH**
Master theses	Validation of an EAM capability management process in order to support strategy implementation [241].	Building and validation of an EAM capability catalog based on the requirements of new technology trends [242].
Company Name	**Stadtwerke Rostock AG** Schmarler Damm 5 18069 Rostock Germany	**Bombardier Transportation GmbH** Schönberger Ufer 1 10785 Berlin Germany
Description µ19	Stadtwerke Rostock AG was founded in the year 1990. The main business is in the public supply of electricity, gas, heat as well as the maintenance of traffic lights and street lamps in the area of Rostock. With over 550 employees and a turnover of 255 million Euro (as of 2013), Stadtwerke Rostock AG represents one of the largest companies in Rostock [294].	As the world's leading manufacturer of aircrafts and trains, Bombardier has established a comprehensive and diverse range of mobility solutions. These include railway vehicles and related drive and control systems, commercial and special aircrafts. With over 74,000 employees working in more than 26 countries, Bombardier is one of the world's leading railway engineering and aircraft manufacturer. At the end of 2014 Bombardier, which is headquartered in Montréal , Canada, achieved a turnover of 20.1 billion US dollars [295].
Interviewed Expert	An employee of Stadtwerke Rostock AG was questioned as an expert from the business development department, whose main task is in IT strategy and organization. Since 2011 the employee works for the company and has experience in EAM from previous companies and projects.	An employee of Bombardier Transportation, based in Berlin, from the Department of IT Strategy & Governance was questioned, whose main task is in IS / IT Strategy & Investment Portfolio Management. Since 2014 the employee works for the company and has extensive experience in EAM and capability - based on his current and previous areas of responsibility.

µ19: Corresponding to the primary research goal (G_{GP}), the basic objective of both interviews was to introduce CMG v1.0 to an enterprise to validate the process and content of each WS. Additionally, existing company processes should be determined, which ideally deal with capabilities itself and/or related EAM issues. These findings are compared with the CMG approach. Occurring differences and/or content-related gaps are discussed with the experts and are taken and evaluated as suggestion for improvement. These objectives justify the implementation of semi-structured expert interviews, because its qualitative character provides insights about CMG v1.0 handling, expert opinions and used capability management concepts.

7.2 APPLY ARTIFACT

To gain an overview of the subject in the expert interviews, both master theses have initially developed the methodological foundations i.e. *expert interview procedures* and *qualitative content analysis*, described in Section 2.2.2.1 and Section 2.2.3.2 in advance. Considering the abovementioned objectives (Sect. 7.1), a first version of the interview guidelines was created. The preparation was done in cooperation with both master theses to produce comparable results. This section is based on previously published content of our research results and contains passages of the following publications [15,243,300].

7.2.1 PREPARATION

Two individual guidelines were created initially for the interview preparation, which were merged into one in the next step. Therefore, redundant content was removed and questions grouped together into sets of questions. In the next step the guideline was tested and revised by two research assistants from the University of Rostock. Thus, for pretesting purposes the research assistants were appointed as experts, who answered the questions from experts' point of view. The pretest helped apart from examining the quality of questions and the process of questioning, also as training for the interviewer. Furthermore, an initial overview of the expected time required has been obtained. Based on the gained experience the interview schedule had to be adjusted only minimally, mainly formulations of questions had to be altered.

(1) *Introduction* (interview opening and includes the welcome and introductory questions, for example, the background of the experts or topic / purpose of the interview
(2) *Main part* (Content & feasibility questions about hypotheses)
(3) *Conclusion* (Summary, feedback / questions of the interviewee, gratitude)

[280] define four requirements for semi-structured interview guide:

- The range of the interview must be wide enough to ensure the exclusion of a pure query of preceding considered factors by the creator of the interview (uncertainty of results);
- Specific questions, in which the research interest has to be translated into the context of the background experience of the interviewee (accuracy of results);
- "profoundness": the interviewee should be supported with regard to the affective, cognitive and value-based classification of certain situations (effectiveness);
- Personal context of the interviewee must be re-constructible (context accuracy).

In general, the criteria described in the *expert interview survey* Section 2.2.2.1 were considered in the process of question construction. The main focus was on clear wording, avoidance of leading questions, the necessity of questions as well as the freedom from redundancies. Due to the guidelines the interview is semi-structured and gives the interviewer sufficient scope to be able to deviate, if required, without missing the set of questions at the end. The final version of the interview guideline is provided in the appendix of [241,242].

A self-study presentation for introduction and preparation had been sent to the interviewees. The presentation includes a short motivation that leads to the problem and presents the intentions of the interview. Due to the fact that experts should not be influenced by CMG in the first interview part, it was excluded from the presentation. On this basis, the detailed execution of both interviews is described in the next section.

7.2.2 EXECUTION

(1) The *interview introduction* includes the presentation of subject and purpose of the interview. The introductory presentation, which was sent to the experts in advance, has been summarized briefly. As suggested, questions about the background of the experts and the associated enterprise are asked in order to stimulate the willingness to talk.

(2) The *main part* of the interview is divided into two sections. To validate the capability management process, it is necessary to understand how the experts' enterprise runs or would run capability management. This takes place before the experts are introduced to CMG to prevent influence on their answers. In order to assign the results of the first interview part to the single CMG concept later on, the questions are based on the CMG structure. In the second interview part CMG concept is discussed in detail and if possible linked to already given answers of the first interview part. The individual BB and WS were presented consecutively. Each step was described to the experts and then they were asked how certain aspects could be implemented by the respective company (specific behavior) and how they personally see the particular WS, BB and the entire management process. However, there were two content restrictions, first the 4EM capability notation (Sect. 6.2.4) was not interrogated during the interviews as well as the associated software prototype 4EM.Desk, because these did not work reliably at the time of the interviews.

Furthermore, the co-operation forms described in the CMG v1.0 were implemented in the text, but were not indicated as part of a RASCI role model. After the demonstration, the RASCI illustration was integrated for better structuring and a consistent naming scheme was established, but Table 6.2 illustrates the initial situation and was considered in the demonstration. By linking the experts' experiences with CMG we identified weaknesses and improvement potentials in addition to general experts' opinion about CMG v1.0.

(3) The *conclusion* of the interview summarizes the results to provide experts the opportunity to add missing aspects and to provide additional feedback. Finally, the gratitude for the cooperation is pronounced to the interviewee and the access to the results of the interview is being granted.

The interviews went according to plan and the experts were very cooperative. Furthermore, they were able to answer all questions and gave a lot of additional subject related information and insights. With regard to the discussions around CMG, the experts were able to provide competent answers and represented their views plausible. Care has been taken to ensure that experts could always speak freely and finish speaking. There was no need to break mental blocks by the interviewer and it was not necessary to interrupt the interviewee due to providing too much irrelevant information.

Influencing factors, which were described in *expert interview survey* section, are shortly explained in the following paragraph. The experts appeared, despite differences in age and experience, not to be influenced in their responses. Furthermore, no refusal of self-disclosure or the effort to please the interviewer could be identified in both interviews. The terminology and presumed knowledge of experts was not exaggerated and could be fully understood by the interviewer. The iceberg, feedback- and catharsis effect could not be observed. There is no presumption of the occurrence of paternalism effect (the expert decides which information are important), but it cannot be excluded by the interviewer. The occurrence of the Hawthorne effect cannot be objectively verified as well. The procedures of the guideline were followed accordingly without restricting the experts in action. The experts answered most of the questions directly and without asking the interviewer further subject-related questions. The amount of questions with regard to clarification by the interviewer was minimal. The entire interview guideline, transcribed audio recordings and results can be looked up at [241,242].

7.2.3 RESULTS & IMPLICATIONS

[241] is focused on the validation of a CMG in the research area of EAM to support the strategy implementation of enterprises. [242] evaluates the validation of an EAM-focused CMG based on the requirements due to new technology trends. Both interviews provide 79 pages of interview material and over 70 categories after performing the content analysis (Table 7.2). Basically, both experts have confirmed that even the initial version of the artifact is feasible and could already solve some requirements from its local practice. Nevertheless, both investigations identified a number of smaller suggestions for improvement.

Within this section we summarized identified suggestions that we used for following adjustments (Sect. 7.2.4). Therefore, we assigned the recommendations of the authors to the BB structure and a general section including all statements focused on the whole CMG v1.0.

Table 7.2 Summary of demonstration activities.

Interview aspects	Stadtwerke AG	Bombardier Transportation
Interview duration	2:34 hours	3:15 hours
Results of the qualitative content analysis	56 Categories (inductive, deductive)	17 Categories (inductive, deductive)
Chapter & category references	[241], Chapter 6.5, Category System: K: category, Bn: Building Block, Sn: Step, *M*: opinion, *W*: theoretical solution assumption, *P*: practical activity, *V*: further suggestions and comments *K-BnSm-M, K-BnSm-W, K-BnSm-P, K-BnSm-V*	[242], Chapter 6.3, Category System: *V:* Preparation, *KD:* catalog design, *DE:* detail development, *KS:* catalog governance, *WSn:* Working Step *V – WSn, KD- WSn, D-WSn, KS-WSn*

The demonstration results in 28 content-related changes, which had no concept relevant impact on the CMG v1.0. These changes are referred to as Change Requests *(CR_n)*, which represent small content-related adjustments of the CMG v1.0. Larger changes have to be classified as new requirement *(R_n)*, which would include further iterations in the *design and development* phase (Chapt. 6), which was actually not the case. The following explanations (Table 7.3- Table 7.6) summarize the results of the demonstration and corresponding change requests *(CR_n)* based on master theses results of [241, 242] and our publication [243].

Table 7.3 Change requests of the CMG v1.0 – BB1 demonstrations.

Demonstration results for: **BB1: Preparation**	**Category references**
WS1: Both experts stressed the importance of scoping regarding BB1.WS1. The size of a capability catalog is determined by the application area (e.g. new business model integration for an entire organization or just for a business unit). Hence, this scaling effect must be stressed in the explanation and usability of CMG, because it offers the range of effectiveness of the process *(CR_1)*. However, it was recommended to identify, if possible, all EAM capabilities to comprehensively support strategy goals *(CR_2)*. The CMG addresses the middle and upper management due to the value and interest of them to deal with enterprise wide strategic decisions and implementation. This management group represents the one that define and limit the scope and budget of the capability development project. Therefore, a continuous introducing of involved parties by pick-up points must be clearly defined and underpinned with examples *(CR_3)*.	*K-B1S1-M, K-B1S1-W, V-WS1*
WS2: The identification of terms and concepts represents one of the most important steps of the first BB, because it provides the fundamental communication instrument for all forthcoming coordination and development activities. Thus, it is expected that the duration of this WS could be taken longer as assumed which should be communicated within the WS description *(CR_4)*. A central repository like a glossary, a MS SharePoint or a professional knowledge management system (KMS) was identified as possible solutions for central and accessible result documentation by using an overarching modeling concept *(CR_5)*. Difficulties about the understanding of *BB1.WS2* have not been observed in practice.	*K-B1S2-M, K-B1S2-P, K-B1S2-V, V-WS2*
WS3: The wording "context" produces wrong connotations in practice *(CR_6)*. It does not mean framework conditions that are responsible for the capability, but rather the itemization of pur-	*K-B1S3-M, K-*

pose, scope and application area from *BB1.WS1*. These are classified as IT, business or architecture in CMP 1.0. This kind of differentiation could be too strict or impractical for some enterprises. Therefore, the categorization should be flexible and thus is strongly linked to the Integrated Enterprise Capability Approach (Sect. 6.2.4). The most difficult challenges are seen in the identification of concrete elements to describe the capabilities. It was mentioned that the approach should better explain that this *BB1.WS3* prepares the foundations for the identification of capabilities within *BB2.WS1* *(CR_7)*.	*B1S3-V, V-WS3*
WS4: The interviewed LP partners agreed to the planning issues of this WS. The definition of a development strategy, both communication planning and appropriated planning purposes like periodic project status reports including cost benefit analyzes, fundamental engineering approach as well as storage systems like network drives or knowledge management systems were finally named and agreed for capability documentation (considering BB2.*WS2*) *(CR_8)*.	*K-B1S4-M, K-B1S4-W, K-B1S4-P, V-WS1*

Table 7.4 Change requests of the CMG v1.0 – BB2 demonstration.

Demonstration results for: **BB2: Catalog Design**	**Category references**
WS1: Both practice partners assessed the moderated/ participative workshop as most supportive creative technique for identifying capability candidates, even if its structure and composition has to be flexible and adaptable to individual organizations. Furthermore, it should be ensured that the participants are not overwhelmed with too ambitious workshop goals *(CR_9)*. For this purposes, moderators provide methodical expertise for adjusting workshop goals and design in an appropriated extend under consideration of the workshop subject. The presentation of an example at the beginning of this WS might be helpful to introduce the audience and issues. Protocols are recommended to document objectives, decisions, action items (e.g. open questions, tasks to be done & responsibilities) and inform (absent-) participants *(CR_{10})*. The capability identification matrix was assessed as well organized and supportive, but probably frightening due to its possible complexity. In order to reduce complexity and related efforts, pragmatic decisions should be possible without a significant influence on the original intention of the matrix *(CR_{11})*.	*K-B2S1-M, K-B2S1-W, KD-WS1*
WS2: The restructuring of identified capabilities has to avoid unnecessary duplications and redundancies. Grouping of smaller teams in comparison to the participant of the previous step might be useful in order to reduce coordination efforts and accelerate the process without significant influence on quality of achieved results. Just for controlling and agreements the involvement of larger group of stakeholder should be considered *(CR_{12})*. Identification and structuring activities are closely linked and should be coordinated iteratively *(CR_{13})*.	*K-B2S2-P, KD-WS2*
WS3: The demand for capturing causal relationships of EAM capabilities has been confirmed by the experts, because of its focus on the different EA layers, states and management functions (Sect. 3.3, Sect. 6.2.4). The different kinds of mentioned relationships in CMG v1.0 should be extended to a relationship describing several capabilities focusing on a common strategic goal *(CR_{14})*. The recommended visualization was rated as too complex and should be reconsidered *(CR_{15})*. However, a more formal way of documenting relationships was appealed like an Entity Relationship Models or another appropriated modeling notation in terms of usability, easy to learn and transparency *(CR_{16})*. It was recommended to use a suitable modeling tool that preferably supports central accessible database- or another kind of data- structure *(CR_{17})*.	*K-B2S3-M, K-B2S3-V, KD-WS3*

Table 7.5 Change requests of the CMG v1.0 – BB3 demonstration.

Demonstration results for: **BB3: Detail Development**	**Category references**
WS1: The definition of content-layers is understandable for practitioners, but has to be detailed in its progress, because especially newcomers could be lost without explanations and examples e.g. a list of selectable levels and its implications additional regarding content development *(CR_{18})*.	*K-B3S1-M, DE-WS1*
WS2: The preparation of the single content layer should be detailed regarding its organization *(CR_{19})*. Therefore, the same stakeholder should be involved already addressed in the previous BB2. In order to parallelize the activities within this step, small workshops of one or two actors responsible for the specification of a set of previously identified capabilities is recommended. Presenting the specific results at the end of a content engineering cycle to all other stakeholders brings single results together and provides the possibility to modify them as group decision *(CR_{20})*. Regarding the documentation, it was mentioned to use a consistent and easy to use modeling tool, but no example was stated *(CR_{21})*.	*K-B3S2-W, DE-WS2*

WS3: The last step is rated as very important by the local practice partners, because the supply of useful and needed information to the catalog stakeholder represents the major benefits of the whole catalog development project. Therefore, it was so important to involve these stakeholders in the development project right from the beginning. Nevertheless, no standard information supply procedure *(CR_{22})* in terms of adequate documents and visualizations *(CR_{23})* could be identified with respect to most documentation and visualization questions in the course of the CMG v1.0 demonstration.	*K-B3S3-M* *K-B3S3-P* *K-B3S3-V,* *DE-WS3*

Table 7.6 Change requests of the CMG v1.0 – BB4 demonstration.

Demonstration results for: **BB4: Catalog Governance**	**Category references**
WS1: Both experts consider quality assurance as reasonable part of the whole procedure, but they are not sure about this has to be done in a separate working step. In order to keep the whole process simple and short, it is recommended to combine this step with BB4.WS2 *(CR_{24})*.	*K-B4S1-M,* *KS-WS1*
WS2: The definition of the desired quality level and evaluation of the developed capability catalog should be reviewed by stakeholders of the BBs before *(CR_{25})*. New parties, whether internal or external, should not be taken into account just here, because if they are important for evaluation purposes, they should have been involved right from the beginning. The recommended quality criteria of the CMG v1.0 were confirmed. General criteria such as the completeness and flexibility of the catalog are just as important to consider criteria arisen in the course of performing the individual working steps. Thus, general and specific criteria are equally crucial for a comprehensive assessment.	*K-B4S2-M* *K-B4S2-P, KS-WS2*
WS3: If the catalog reaches the desired quality level, the catalog deployment step follows by just communicating results the stakeholders by using the views of *BB3.WS3*. The catalog deployment should be extended by necessary workshop and training activities in order to win new user and educate existing ones *(CR_{26})*. The communication of results as well as transition to the catalog maintenance represents one advantage of the CMG, because it is also focused on a continuous integration and utilization concept not just development and roll-out.	*K-B4S3-W* *K-B4S3-P* *KS-WS3*
WS4: The catalog maintenance step should be refined regarding its responsible roles *(CR_{27})*, because one expert explained that especially in large enterprises probably more than one person is responsible to keep the quality of the catalog. It was recommended that at least one person is required to rate the quality and actuality of a specific set of EAM capabilities. Therefore, this person should be selected under consideration of its expertise. Moreover, following an all-do-some approach *(CR_{28})*, responsibilities of different capability sets could be spread on the lower management of different departments. Both users and the organization provide feedback to evaluate needs for updates. Written documents in case of smaller changes, new training and workshops in case of bigger ones.	*K-B4S4-M* *K-B4S4-W* *K-B4S4-V* *KS-WS4*

7.2.4 ADJUSTMENTS

Due to the successful feasibility demonstration and the small amount of only content relevant changes (not concept relevant) it was not necessary to pass the stages "*Design & Development*" and "*Demonstration*" within a second iteration. Nevertheless, we implemented the implications mentioned above straight forward. In order to support implementation of change requests suggested by the experts we consulted literature of the field. Therefore, the first part of this section, used document sources supporting the implementation are described. The second part of this section summarized relevant CMG content, followed by the list of changes (Table 7.7) for the second version.

The selected documents are especially focused on experienced-based mistakes and best practices of how to transfer theoretical capability concepts to practice. Therefore we analyzed three documents published by *Gartner Inc*. [232,244,245], two by *The Open Group* [246,247], one paper by *Architecture & Governance Magazine* [225] and one paper provided by the *CEB CIO Leader Council* [224].

- *Gartner Inc.* represents one of the leading information technology research and advisory companies worldwide. Gartner supports business decisions based on appropriate market research of IT related topics. It especially addresses executive positions like CIOs and managers [248].

- *The Open Group* represents a global operating consortium developing vendor-neutral IT standards and certifications collaborating with more than 500 member organizations [211].
- The *Architecture & Governance Magazine* denotes an online community addressing Enterprise Architects, Portfolio Managers, Strategic Planners, Governance practitioners and IT Executives. The magazine provides industry case studies, analyst reports, and best practices related to EAM- and ITM topics [250].
- *CEB CIO Leadership Council* supports IT leaders based on practical recommendations and experiences, new ideas are communicated and tested by other council members. Especially, CIO positions are assisted by proven techniques in order to overcome enterprise challenges [249].

The documents are selected due to its capability-related findings based on practical experiences of large practitioner communities. Thus, [244] is based on experiences resulting from workshops with more than 150 clients and over 260 client inquiries. The work is focused on best practices and challenges for improving communication and collaboration among EA, business- and IT people by modeling capabilities [244]. The report [232] is focused on capability modeling as initiative to support the strategy and planning activities of a single US health system company. Within the case study the development process, utilization and benefits are described. [245] describes a best practice of how capabilities could be used to highlights gaps between strategy and execution planning priorities by focusing the management on required adjustments. The report is based on the experiences of two case studies (39 clients) leveraging capabilities for communication, Business-IT insights and decision support.

The whitepaper [246] suggests a capability-based planning method to enhance the alignment between business strategy and enterprise architecture management. [247] provides assistance of how to establish an EA capability that meets a set of enterprise-specific requirements. Thus, it provides context, content and rationale behind choices in order to comprehensively consult enterprise architects. Both documents are developed by members and invited experts of the Open Group, especially participants of the architecture forum.

Next to its theoretical capability foundations approach, [225] provides a capability type differentiation and a hierarchy approach as well as ideas about how to translate strategies into action. Moreover, the document provides a capability portfolio concept in terms of how to manage and exceed a target return on investment by managing capability as assets. The document was written by Leonard Greski the director of eCommerce Architecture at W.W. Grainger, a Fortune 500 company.

[224] based on webinar performed on 2015-03-15. It motivated and introduced the capability approach, challenges and mistakes in using them and options of how capabilities can support strategic planning. The most valuable part of this document refers to the proposed capability gathering, rollout and utilization concepts.

Nevertheless, we recognized that some of the documents dealing with business capabilities. Nevertheless, based on the *Integrated Enterprise Capability Approach* of Section 6.2.4 business capabilities are focused on the economic efficiency and outcome of an organization. IT Capabilities represent the realization of business value and maintenance of competitive advantages in terms of IT services and/ or IT products. EAM capabilities are required to bring both sides together in terms of managing the corresponding EA. Based on the underlying capability approach we transferred helpful concepts to our investigation. Identified intersections between the concepts of analyzed documents, used concept for satisfying change demands and the corresponding CMG changes are referred in Table 7.7.

Table 7.7 CMG v1.0 – changes after demonstration.

BB1: Preparation	Affected method element	**CMG changes**
WS1: Scope & Application Area	*Procedure*	More detailed specification of the scoping and application area definition activities (related to e.g. purpose, benefits, strategies) *(CR_1)*, Comprehensive goal and strategy analysis to find an adequate set of all required EAM capabilities *(CR_2)*,Integration of a stakeholder analysis concept in order to find the appropriate middle and upper management support *(CR_3)*
	Notation	Any form of project management documentation techniques (e.g. protocols, diagrams, software tools), documentation of agreements in business language & outside-in perspective [244], informal goal and strategy documentation, stakeholder diagrams
	Concept	Mind mapping, participatory workshops, project scoping techniques, stakeholder analysis
	Co-operation forms	During the scoping the *moderator* has to harmonize the demands of "various" *problem owner* in order to avoid hidden agendas as well as has to point out scaling effects of an EAM capability catalog. *(CR_1)*. *Project lead* and *moderator* have to determine and define these pick-up points clearly in advance *(CR_3)*.
WS2: Identification of terms & concepts	*Procedure*	Identification of terms and perspectives to get a consistent overview about already existing as well as used capability concept takes time and is scheduled with a sufficient time span *(CR_4)*, gathering first thoughts about an overarching engineering approach *(CR_5)*[245].
	Notation	Agreed vocabulary documented in wikis and/or glossaries *(CR_5)*, relationships between defined elements is additionally documented within informal models. For the documentation and the document distribution, progress reports and appropriate document- and knowledge management systems are maintained throughout the project.
	Concept	Terms of BB1.WS1 are exactly explained and supplemented within the specific application area, centralized data management, knowledge management systems, better differentiation between capabilities and processes: understanding, analyzing, communicating [244,232,245]
	Co-operation forms	*Project lead* must be sufficiently schedule time and communicate the schedule accordingly *(CR_4)*. *Project lead, EAM CM team and domain experts* have to agree on a common KMS to manage the selected concepts *(CR_5)*.
WS3: Description of an Integrated Enterprise Capability Approach	*Procedure*	Procedure is renamed to *Description of an Integrated Enterprise Capability Approach (CR_6)*, more detailed description of the approach, integration of two examples *(CR_7)*
	Concept	Adaptation of the context concept - changed to *focus area objects*, which are derived from the *Application Area*. Mind map, causal chain relationship model added as new concepts. Glossary is adapted.
	Notation	*Context objects* were changed in IECA descriptions (focus area objects)
WS4: Definition of the development strategy	*Procedure*	Strategy definition includes the following aspects: project purpose, time schedule, planned activities, required stakeholders and resources, agreed wording and understanding of fundamental concepts, overarching capability engineering and documentation approach *(CR_8)*.
	Notation	Concept description papers combined with a project- and communication plan, capability modeling language definition and visualization tools
	Concept	Capability driven development (CDD) [228], Management Approaches for Business Capability Modeling by TOGAF [192] were added.
	Co-operation forms	The *project lead* develops a communication plan (Appendix D3) for the project, which contains, based on the established development strategy, the communication paths of the different phases of the project and communicate this accordingly *(CR_8)*.
BB2: Catalog Design	Affected method element	**CMG changes**
WS1: Identification of Capability Candidates	*Procedure*	In order to avoid overloaded participants by to ambitious workshop goals the specification and organization of these workshops is done by a new role called WS method expert. This method expert organizes, supports scoping and attends at each workshop for a defined period *(CR_9)*.
	Notation	More detailed and flexible concept of the CIM (provision of an adaptable digital

<table>
<tr><td></td><td></td><td>template Appendix D4) (CR_{11}); alternative for visualization cluster maps, lists, diagrams; Formal protocols for documenting workshop objectives, decisions and action items (Appendix D1).</td></tr>
<tr><td></td><td>Concept</td><td>Capability nomenclature principle using appropriate, complete, simple and consistent vocabulary like one-to-one nomenclature [244, 232, 224]</td></tr>
<tr><td></td><td>Co-operation forms</td><td>The project lead should ensure that the implementing participants (EAM CM team and possibly even domain experts) are not overloaded with the tasks of the initial workshops. Thus, a breakdown into a series of workshops is useful (CR_9).
At the beginning of this WS the moderator should work with examples in the workshops to introduce the audience and issues (CR_{10}).</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td rowspan="4">WS2: Structuring & Summarization</td><td>Procedure</td><td>Structuring activities are performed within smaller groups, its results are controlled by the group of the previous WS (CR_{12}); adjustment of the BB2 control flow (possibility of iteratively going back to BB2.WS1) (CR_{13}), iterations on building and execution activities involve the refinement of capability structures [245,247]</td></tr>
<tr><td>Notation</td><td>Electronic documentation of the CIM (Appendix D4), agreements and decisions documentation in formal protocols (Appendix D1), Integration of an Template Document Capability Catalog</td></tr>
<tr><td>Concept</td><td>Pooling and clustering concepts and descriptions of capability hierarchy levels were added.</td></tr>
<tr><td>Co-operation forms</td><td>Smaller teams (small workforces) are formed and entrusted with different tasks for the structuring & summary, which are then brought together in larger workshops with the EAM CM team and other domain experts (CR12). Small workforces may, but are not obligated to be dissolved for each WS again and re-formed as needed.</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td rowspan="4">WS3: Identification of Relationships</td><td>Procedure</td><td>Identification of capability relationships dependencies/correlations, interdependencies, independence, synergies (CR_{14}); a simpler visualization example is introduced (CR_{15}). Introducing a more formal documentation of capabilities, possibly modeling software, for EAM capabilities (CR_{17}).</td></tr>
<tr><td>Notation</td><td>For the first versions the CIM can be used for visualization of dependencies, it can already be changed at this point to a more formal approach such as Chen notation (Entity Relationship Modeling) or the recommended 4EM capability extension and 4EM.Desk & Touch software (CR_{15}, CR_{16}).</td></tr>
<tr><td>Concept</td><td>Entity Relationship Modeling Approach, 4EM Method, tool support for a central accessible data repository (CR_{17})</td></tr>
<tr><td>Co-operation forms</td><td>The role of 4EM-method & tool expert is introduced in this WS, which includes the expertise in modeling of CAPM in 4EM.Desk & Touch (CR_{16}, CR_{17}). The existing capability catalog is examined on relations in the context of small workforces, which is then supplemented by a capability model as part of larger workshops with the EAM CM team, other domain experts and merged with the 4EM-method & tool expert (CR_{12}).</td></tr>
<tr><th>BB3: Detail Development</th><th>Affected method element</th><th>Change changes</th></tr>
<tr><td rowspan="2">WS1: Definition of Content Layer</td><td>Procedure</td><td>A concrete recommendation represents the integration of three standard levels in line with the capability structure [224, 245]. First, capability name and its description are noted. On the second level the descriptive elements are described. The third level represents the assessment level and involves e.g. capability status, specific attributes of capability elements, generic capability attributes and economic functionality (CR_{18}). Therefore, maturity models are useful concepts to divide the content detail development process into steps of increasing effectiveness.

<table>
<tr><th>1st Content Layer</th><th>2nd Content Layer</th><th>3rd Content Layer</th></tr>
<tr><td>Definition of capability candidates, structures and relationships

Capability Identification Matrix</td><td>Definition of capability descriptive elements

Integrated Capability Approach</td><td>Definition of general and specific capability criteria and its current and required status.

Maturity Model Approach</td></tr>
</table>

Definition of content layers (recommendation: 2 to max. 6 layers)</td></tr>
<tr><td>Notation</td><td>CIM template extension (new layers were added), visualization (e.g. net layer</td></tr>
</table>

		models, tree layer models, data cards, portfolios) State models. 4EM.Desk & Touch: interrelationships with other 4EM sub-models, use of existing or adding new attributes to document indicators.
	Concept	Content layers approach, KPI, deeper insights of the integrated capability approach are described
	Co-operation forms	To define the various content layers, the *stakeholder group* is asked about their quality requirements (by the *project lead*), which serve as the basis for the content layer definition. Further details are agreed on by the *EAM CM team* and consulted *domain experts*. *Small workforces* and the *4EM-method & tool expert* will be informed of the agreed conditions *(CR$_{18}$)*.
WS2: Capability Content Engineering	*Procedure*	More detailed description about the WS organization and involved stakeholder is added *(CR$_{19}$)*; content development activities are performed within smaller groups, at the end of a content engineering cycle all participants bring single results together and provides the possibility to modify them using group decisions *(CR$_{20}$)*, introduction of responsibility assignment matrices to find appropriate participants for the content engineering teams, recommended stakeholders stakeholder group: middle management [224, 245,225]
	Notation	At the latest from this WS onwards software-based support for depicting the various EAM capability contents should be used, 4EM.Desk & Touch is still recommended *(CR$_{21}$)*. Alternative CIM template extension (new layer for descriptive element description are added),
	Concept	Responsibility Assignment Matrix (e.g. RACI, PACSI, RASCI, RACIQ), Capability Stakeholder-to-Role Map
	Co-operation forms	Identified EAM capabilities are designed in more detail considering the BB3.WS1. *Small workforces* are formed, which relate to certain EAM capabilities or level of detail (i.e. exact description of the descriptive elements and its inter-relations to the corresponding 4EM sub-models for example) *(CR$_{20}$)*. Due to the possibility of 4EM.Desk & Touch to work collaboratively, the results are merged automatically and can be discussed and adapted within the framework of larger workshops with the *EAM CM team*, other *domain experts (CR$_{19}$, CR$_{21}$)*.
WS3: Development of Stakeholder Views	*Procedure*	The Information Demand Analysis (IDA) approach is referred, but not integrated so far, as method for identifying the required information demands for a role in a certain situation *(CR$_{22}$)*.
	Notation	4EM.Desk & Touch model visualization
	Concept	Based on a formal notation following visualization concepts are referred: Data and tree maps, Radar charts, Parallel coordinates, cone trees, layer models (Appendix D2)*(CR$_{23}$)*.
	Co-operation forms	For the development of different viewpoints (based on the data of the capability catalogs), both *domain experts* and *4EM-method & tool expert* can be used. However, in this context *project lead* has to ensure that the viewpoints are matched with the information demand of stakeholders (communication plan BB1.WS4)
BB4: Catalog Governance	Affected method element	**Change Description**
WS1: Assessment	*Procedure*	WS "Evaluation Concept" and "Catalog Evaluation" are merged to "Catalog Assessment" in order to keep the process as fast/simple as possible [245], counteract deficient quality and prepare the promotion of the functionality of the catalog during the rollout WS *(CR$_{24}$);* for evaluation purposes only stakeholder of previous WS are involved *(CR$_{25}$)*, focus on the outcomes in terms of benefits for existing and new stakeholder, not the models itself [244,232,225]
	Notation	-
	Concept	Quality Management, Investment- and Financial Model Utilization, Maturity Model, Balanced-Score-Card, Top-down evaluation [225]
	Co-operation forms	The evaluation of the results is conducted by the *problem owner* and *stakeholder group (CR$_{25}$)*.
WS2: Rollout	*Procedure*	WS is renamed from "Catalog Deployment" to "Rollout"; the WS is supported by training activities in order to win new user and educate existing ones in utilization *(CR$_{26}$)*
	Notation	Prepared training materials, CMG
	Concept	Techniques to get User Feedback (e.g. questionnaires, interviews, workshops)

	Co-operation forms	The introduction and use of the EAM capability catalog is performed by the *project lead* and the *4EM-method & tool expert*. Here, the *project lead* tries to reach more users and the *4EM-method & tool expert* educates newly acquired and existing users.
WS3: Maintenance	*Procedure*	Creation and integration of a catalog maintenance role system *(CR_{27})* including the split of the whole catalog into smaller capability sets that are assigned to domain experts with the required expertise *(CR_{28})*
	Notation	Formal protocols to document maintenance decisions (Appendix D1) 4EM.Desk-web service
	Concept	Using responsibility assignment matrices to define an appropriate role system for catalog maintenance activities in terms of an all-do-some approach.
	Co-operation forms	As part of the all-do-some approach the *domain experts*, who are assigned during the course of project, maintain the catalog together with the *EAM CM team (CR_{28})*. The maintenance process is supported by the *4EM-method & tool expert* that provides a 4EM.Desk web-service for the involved roles. The *EAM CM team* decides under consideration of catalog extension pattern, which kind of maintenance work has to be done taking into consideration the catalog extension pattern *(CR_{27})*.

Based on change requests described above the co-operation forms i.e. the RASCI based role model changed, which is shown in Table 7.8. Furthermore, the following roles were added: *Small workforce:* Smaller teams (small workforces) are formed and edit small packages of tasks, which are summarized together later. These small workforces usually consist of domain experts. Further roles may be involved, if it is necessary for the completion of tasks. Small workforces are usually temporary and may, but not need to, be dissolved after each WS again and re-formed as required.

4EM-method & tool expert: This role has expertise in modeling capabilities using the 4EM-method and the 4EM.Desk & Touch module. As 4EM method expert he has modeling experiences with the 4EM-method and knows the guidelines and principles in detail. As tool expert he can apply this knowledge for digitizing capabilities, which are developed in the framework of workshops. Thus, he supports the IOM cap team, small workforces, project lead and moderator with appropriate tool features (i.e. capability model, model visualizations, analytics, trainings). This support involves active listening competencies and putting forward supplementary questions regarding information or relationships between capabilities and possible 4EM sub-model components.

Table 7.8 Implied CR adjustments (colored cells) within the co-operations forms of the CMG v2.0 (R-responsible, A-accountable, S-supportive, C-consulted, I-informed).

Working Step	Problem Owner	Project Lead	EAM CM Team	Domain Expert (B/IT)	Moderator	Minute Taker	Small Workforce *(CR_{12})*	Stakeholder Group *(CR_{25})*	4EM Method & Tool Expert (CR_{16}, CR_{17})
BB1.WS1: *Scope & Application Area*	RA	I			R	S		I	
BB1.WS2: *Identification of terms and concepts*	AC	R	R	R	R	S		C	
BB1.WS3: *Description of the IECA*	AI	R	R	I		S		I	
BB1.WS4: *Definition of the development strategy*	ASI	R	R	I	R	S		R(A)	
BB2.WS1: *Identification of Capability Candidates*		AS	R	S	R	S			
BB2.WS2: *Structuring and Summarization*		AS	R	R	R	S	R		
BB2.WS3: *Identification of Relationships*		AS	S	R	R	S	R		R
BB3.WS1: *Definition of Content Layer*	C	ARS	R	C	R	S	I	C	I
BB3.WS2: *Capability Content Engineering*	C	AS	S	R		S	R	C	RS
BB3.WS3: *Development of Stakeholder Views (CR_{22})*	CI	AR	R	RC		S		CI	S
BB4.WS1: *Assessment*	R	AR	S			S		R	S

(CR$_{24}$)									
BB4.WS3: *Rollout*	I	AR	S	I		S		I	R
BB4.WS4: *Maintenance (CR$_{27}$)*	I		AS	R				I	S

Moreover, based on the above described change requests, some control flow changes are also implied. On this account the original graphical representation of CMG v1.0 does not to-fit any longer and a new graphical representation following a modeling notation should be an adequate solution. Therefore, we transformed the CMG v1.0 under consideration of the identified change requests to an easy to read BPMN-based process model, which is shown in Figure 7.2.

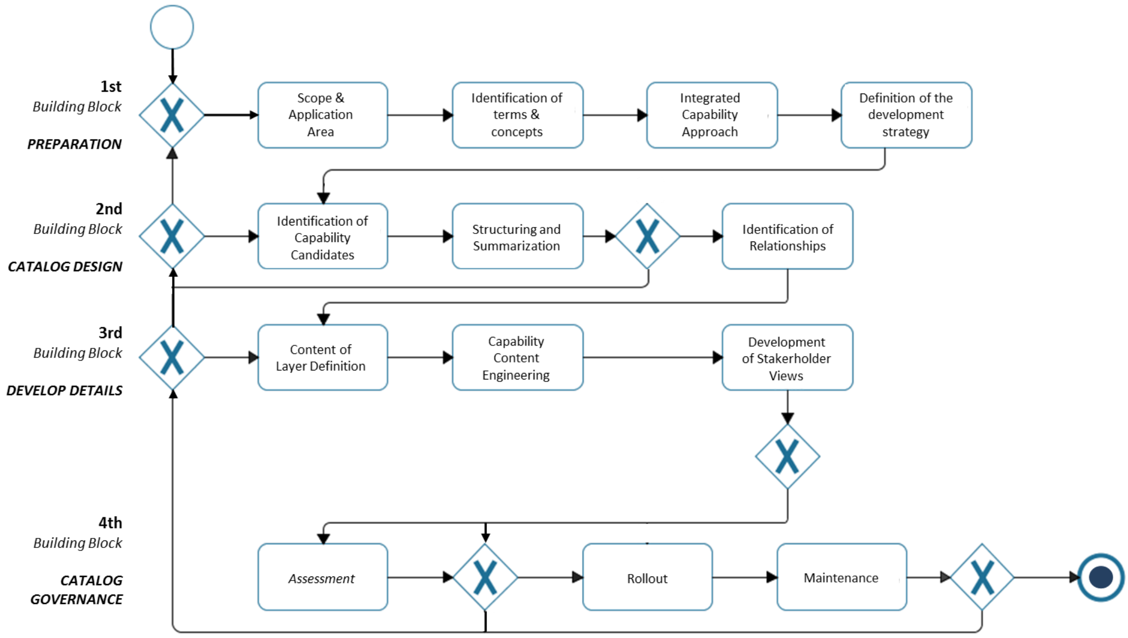

Figure 7.2 CMG v2.0 – Process Model.

Thus, it is possible to start iterations in the preparation BB1 as well, in case of changing application areas or scopes. Moreover, if additional capability candidates are identified, the process can start at BB2 for the next iteration as well. Starting in BB3 is useful, if the identification of capability candidates its relations and the catalog structure is mostly completed, but the depth of contents not. Therefore, all BB are extended by the possibility of redefining and adjusting the process by going back to each BB. Thus, differentiation of catalog upgrade- and update- activities of *BB4.WS4* is more clarified and embedded in the process model. Furthermore, a substantive smoothing was performed with respect to the mixture of business, IT and EAM capability examples and numerous new EAM capability examples were added and Business- and IT capability examples reduced. However, we have decided to remove not every business capability example, due to the fact that these are used to pick-up *advanced-capability-user*, who previously only worked with business capabilities. Moreover, for usability purposes the guide was transformed into a designed handbook and the preface, motivation and practical examples were updated. The resulting second version by the feasibility test includes a set of suitable procedures for identifying, structuring and governing of EAM capabilities and therefore contains the answer to *(RQ2).* The version resulting from the changes is published as the second version of the Capability Management Guide as a peer-reviewed book chapter as follows and is the basis for the evaluation in the following chapters:

> Wißotzki, M., Sonnenberger, A. "*Capability Management Guide*" In : El-Sheik, E. ; Zimmermann, A. ; Jain, L. ; (Eds.) : Emerging Trends in the Evolution of Service-Oriented and Enterprise Architectures, Management for Professionals, Springer, accepted for publication, estimated to appear in 2016.

8 EVALUATION

“How well does the artefact solve the explicated problem and fulfil the defined requirements?”[21]

“*The utility, quality, and efficacy of a design artifact must be rigorously demonstrated via well-executed evaluation methods*” [152]. Thus, an evaluation should provide evidence that a new problem solution achieves the purpose it was developed for [21,250].

In order to provide such a rigorous evaluation this chapter follows the DSR evaluation framework of [250] that supports in Section 8.2 the selection of an appropriate evaluation strategy and methods for the developed artifact (*Select Strategy & Goals*) under consideration of contextual factors like level of desired rigor and/or constraints on resource, time and/or money (*Analysis Evaluation Context*) described in Section 8.1. The evaluation *Design and Execution* activities in Section 8.3 examines to what extent the CMG v2.0 solves or at least mitigates the defined *(P_G)* and defined requirements within a naturalistic environment. Figure 8.1 illustrates the whole process and shows used controls and required resources described in the following sections. This chapter is based on previously published content of our research results and contains passages of the following publications [243,300].

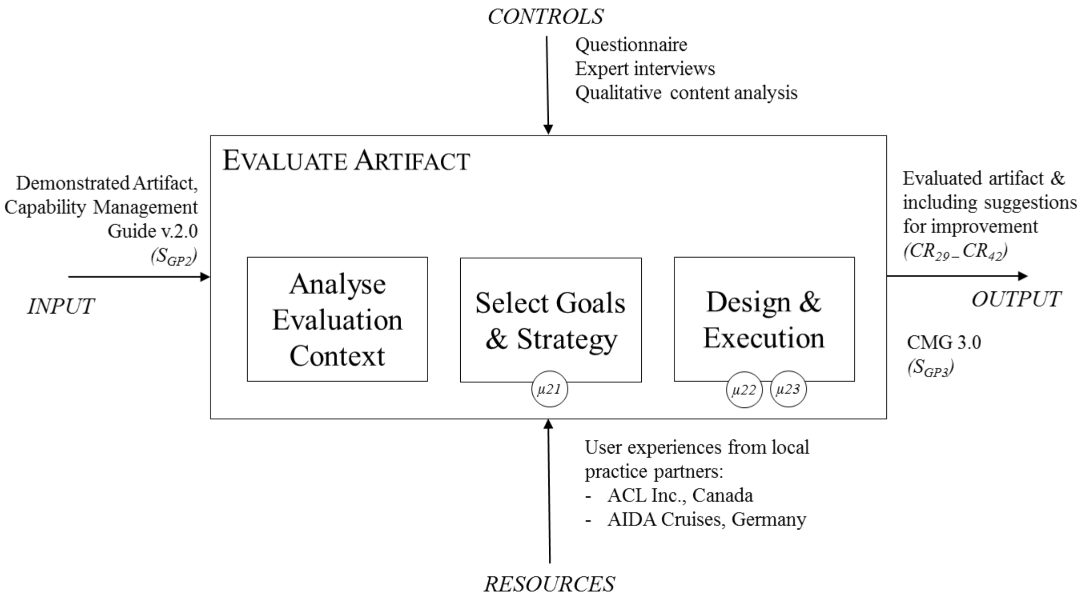

Figure 8.1 Research Process Step 5: Evaluate Artifact.

In order to perform a suitable scientific evaluation process [21] proposed the following principles *(μ21-μ23)*:

μ21. Evaluate requirements: All requirement sets defined in Section 5.2 should be evaluated.
μ22. Evaluate how the artifact solves the problem: How well can the artifact solve the defined *(P_G)*.

µ23. Describe how the artifact was evaluated: Description of what has been done to evaluate the artifact in terms of how local practice partner activities were observed while they were applying the artifact.

8.1 ANALYZE EVALUATION CONTEXT

Within this section relevant contextual aspects of the artifact evaluation are described and investigated. Therefore, we describe and characterize the local practice partner executing the evaluation under consideration of its costs, risks and resource constraints.

The following paragraph describes the characteristics and conditions of two local practice partners we acquired for the evaluation of CMG v2.0. Next to a short company description and its motivation to take part in the evaluation, we scrutinize and describe constraints regarding *time, people budget* and evaluation *support within the organization* [21, 250]. Table 8.1 summarized the mentioned aspects.

Table 8.1 Evaluation environment - local practice partner for artifact validation.

LP Information	**Evaluation Partner 1**	**Evaluation Partner 2**
Company Name	**ACL Ltd.** 1550 Alberni St Vancouver BC V6G 1A5 Canada	**AIDA Cruises** - German Branch of Costa Crociere S.p.A. Am Strande 3d 18055 Rostock Germany
Industry	IT, Software and consulting service provider	Tourism, cruise providers
Description	ACL is a software company that provides a data analysis and a cloud-based governance, risk management and compliance solution. The data analysis tool enables clients to extract and load data from disparate systems in order to continuously investigate large transactional data sets on patterns of irregularities which could indicate control weaknesses or possible fraudulent activities. ACL software is used by more than 100.000 users in 150+ countries [253]. Revenue information were not available, because ACL Ltd. is a private company, which is not obliged to publish financial information.	AIDA Cruises represents one of the leading cruise providers in Germany. In 2014 over 800.000 people traveled on 10 cruise liner, which are all in all equipped with over 18.600 beds. The company is owned by the American-British cruise company Carnival Corporation & plc – with a turnover of 15.3 Billion USD in 2013, it is the world's largest cruise ship operator. The over 7.000 AIDA Cruise employees are executively controlled by the subsidiary Costa Crociere Group based in Genua, Italy. [251, 252]
Motivation & expert description	Reorganization & Automation The Professional Services Group of ACL is responsible for the successful implementation of the ACL software as well as assisting their clients with the setup of a continuous monitoring program. Such a program requires a deep look into the client's current business processes and to assess whether there is a potential for automation of a process or sub-process which can lead to potential savings or synergies. In order to improve the communication between the involved stakeholders from different departments (e.g. Audit, Finance, IT, Data Owners), the ACL Specialist is going to implement the CMG v2.0.	Digital Transformation In particular, the online business has much potential for the AIDA product portfolio. Various booking packages, combinable additional packages and services to (potential) customers online and mobile are constantly available. In this context, business divisions and management suggest new products and services. Its integration needs to be discussed in the digital channels regarding feasibility (cost, time, action) and to improve this coordination process, the role of the Digital Transformation Manager wants to use the CMG v2.0.
Constraints	*People:* The responsible person conducting the activity described above is a Senior Specialist, ACDA. He captures the set of required EA elements and identifies potentials for automatization, eliminates redundancies and new services. To mediate between the business unit, IT department and executive management he is going to use the CMG v2.0.	*People:* Digital transformation managers are responsible for the transformation of e.g. new business models and changing existing ones by the use of digital technologies. Within this validation we consult a manager who participates in projects that brings the booking, onboard and after-sales services of the AIDA website to a mobile application.

	Budget: No monetary budget was approved since participation is voluntary and not part of funded research. A limited amount of time was budgeted for familiarization with the CMG and its integration into existing reorganizational activities. *Organizational Support:* Although no explicit project for the capability catalog development was announced, the procedures and concepts of the CMG v2.0 should still be used in order to support existing activities. *Time:* Due to the limited time budget and for reasons of calculability, the evaluation has to be performed within a prescribed time frame.	*Budget*: Since, the participation at the validation is voluntary and not part of a funded research cooperation no monetary budget was approved, just a limited time budget including familiarization period and its integration into existing operations. *Organizational support:* No explicit capability catalog development project was announced, but rather procedures and concepts of the CMG v2.0 should be used in order to support existing activities. *Time:* Due to the limited time budget and for calculability reasons we have to perform the evaluation within a prescribed time frame.
Conclusion	Under consideration of both the CMG relevant use cases and the given resource constraints, it was not possible to perform a time-consuming evaluation. Thus, the available evaluation partner had to use resources sparingly and very focused to get feedback.	

8.2 GOALS AND STRATEGY

Based on the context analysis, this section selects goals and strategy for evaluation activities. The evaluation should allow conclusions on how well does the artifact solve *(P_G)*, fulfil defined requirements and detect side effects by solving two *(P_L)*. Thus, the primary *evaluation goal (E_G)* is represented by:

> ***(E_G)*** *Improvement of the CMG v2.0 by using inputs from its practical use that highlighted requirement-related weaknesses considering (P_G) in terms of conceptual- and quality issues as well as change requests, side effects and operating-experiences.*

In order to reach this goal and to consider the required rigor of the evaluation the selection of an appropriate evaluation strategy and method is of central significance. Thus, the evaluation context (Sect. 8.1), evaluation goal and requirements are matched to the criteria of the DSR evaluation strategy and method selection framework of [250]. The evaluation strategy and corresponding method(s) is (are) chosen by matching the contextual criteria to the conditions of the different dimensions (Table 8.2). According to the bold labeled conditions of the vertical dimensions, this evaluation is characterized as *neutralist evaluation*, because we evaluate a socio-technical artifact in two real environments and its results could be generalized or transferred to similar use cases, because different perspectives were taken into account [21]. Thus, we can evaluate the effectiveness and side effects of the artifact in terms of how well it solves the *(P_L)* of the evaluation partners.

The scientific evidence of CMG practicability depends on research methods used within the evaluation execution. Nevertheless, under consideration of the evaluation context (Sect. 8.1) and in order to address *(E_G)* in a comprehensive way, we were compelled to exclusively use methods that could be carried out with the available people in compliance with the organizational support under consideration of the given time and budget restrictions (Table 8.1). Thus, the selection between an *ex ante* and *ex post* evaluation strategy was more complicated. *Ex ante* evaluations are used to evaluate an artifact which is not fully developed like an alpha version, design or model of a solution. Whereas an *ex post* evaluations are used to summarily evaluate an instantiated artifact in terms of a beta version or fully developed solution [21,250]. Thus, *ex ante* evaluations are used for formative purposes i.e. improve alpha versions of an artifact. The CMG v2.0 is fully developed and could be used for summative *ex post* evaluation purposes, but the evaluation context in terms of the short supply of our LP partner resources leads to more criteria matches on the *ex ante* dimension.

A complete implementation of the CMG v2.0 in the context of a separate project was rejected by both local practice partners due to time and risk reasons, but the approaches should be used under existing projects to identify EAM capabilities. To accompany this process in terms of ex post methods like *action research, case study* was rejected as well. Furthermore, an attempt was made to organize a *focus group* discussion between the two evaluation participants, which, however, did not take place due to organizational reasons (different time zones, lack of time). The methods *ethnography* and *phenomenology* were not suitable for the content-related CMG evaluation. However, both partners selected a survey gathering experiences of CMG usage. Consequently, we used an *exploratory sample* to learn something about the CMG usage and explore new approaches, but unfortunately without being representative for a population (*rigor*). However, the sample consists of specifically selected individuals, who provide very specific and valuable information for this research investigation (*purposive sampling*) and it was decided to perform an *expert questionnaire*. Although, based on the level of development of the CMG v2.0, a *summative evaluation* could have been carried out, no suitable method could be arranged with the LP partner due to the evaluation context (high costs, high risk to participate). The expert questionnaire survey provides an *ex post method*, but, it is limited suitable due to the small sample for a final evaluation. In this context, it was chosen to add an expert interview to the questionnaire in order to examine the results in more detail. Even if the interview is stated as *ex ante method*, the results of which would also help to evaluate the artifacts. According to [21,p.125] "*The point is that it is not critical that research methods are used for devising possible solutions, but that any approach for generating solutions is admissible, as long as it works*." Consequently, an expert questionnaire and expert interview is used for artifact evaluation considering that this hybrid- method selection results in threats on validity. The arising consequences are discussed in Section 9.1.

Table 8.2 A DSR Evaluation Strategy & Method Selection Framework, according to [250].

<table>
<tr><td colspan="2" rowspan="2">Dimensions</td><td>Ex Ante</td><td>Ex Post</td></tr>
<tr><td>Formative, lower build cost, faster, evaluate design, partial prototype, or full prototype, less risk to participants (during evaluation), higher risk of false positive</td><td>Summative, higher build cost, slower, evaluate instantiation, higher risk to participants (during evaluation), lower risk of false positive</td></tr>
<tr><td rowspan="2">Naturalistic</td><td rowspan="2">Many diverse stakeholders, substantial conflict, socio-technical artifacts, higher costs, longer time – slower, organizational access needed, artifact effectiveness evaluation, desired rigor: “Proof of the Pudding”, higher risk to the participants, lower risk of false positive- safety critical systems</td><td>- Real users, real problem, and somewhat unreal system
- Low-medium cost
- Medium speed
- Low risk to participants
- Higher risk of false positive</td><td>- Real users, real problem, and real system
- Highest cost
- Highest risk to participants
- Best evaluation of effectiveness
- Identification of side effects
- Lowest risk of false positive safety critical systems</td></tr>
<tr><td><u>Methods:</u> Action research, focus group, interview</td><td><u>Methods:</u> Actions research, case study, focus group, participant observation, ethnography, phenomenology, survey (qualitative/ quantitative)</td></tr>
<tr><td rowspan="2">Artificial</td><td rowspan="2">Few similar stakeholders, little or no conflict, purely technical artifacts, lower cost, less time – faster, desired rigor: control of variables, artifact efficacy evaluation, less risk during evaluation, higher risk of false positive</td><td>- Unreal users, problem, and/or systems
- Lowest cost
- Fastest
- Lowest risk to participants
- Highest risk of false positive regarding effectiveness</td><td>- Real system, unreal problem and possibly unreal users
- Medium-high cost
- Medium speed
- Low-medium risk to participants</td></tr>
<tr><td><u>Methods:</u> Mathematical or logical proof, criteria-based evaluation, lab experiments, computer simulation</td><td><u>Methods:</u> Mathematical or logical proof, lab experiments, role playing simulation, computer simulation, field experiment</td></tr>
</table>

8.3 DESIGN & EXECUTION EVALUATION

The following section describes the *planning, design* and *preparation* phase of carrying out our evaluation activities to address *(E_G)*. Therefore, the evaluation is focused on the global practice problem (Sect. 8.2) which points the way and substance of the evaluation in terms of “*What is the evaluation* *about?*"[293]. Thus, we investigate the following question within this evaluation activity: *Are the elicited requirements implemented in a way that makes the CMG v2.0 usable for global practice situations?*

The questions should provide feedback about the status of requirements fulfillment and additional activities and/or concepts, which both finally underline the readiness of the CMG for practical use. In order to collect data to answer the question, the following previously selected data collection and analysis methods were used (*µ23*):

- *Electronic document questionnaire (Sect. 8.3.1):* The respondents have to read the 86-page-long guide. After transferring respective content to its particular business settings the participants could directly provide feedback (in-document comments) in the electronic version of CMG v2.0 (MS Word file). Therefore, we provide a set of general and specific questions, which should be answered after/while studying the document. With this procedure we tried to gather direct feedback on figures and formulations in the document as well as receive more qualitative and quantitative feedback by completing the self-administrated electronic document questionnaire based on an exploratory / purposive sampling (Sect. 2.2.2).
- *Semi-structured face-to-face interview (Sect. 8.3.2):* In order to discuss user experiences and results experts from different companies were interviewed, with various responsibilities and various capability backgrounds. However, both experts have experiences in EAM, which represents the absolute precondition in terms of the defined primary target group. One of them was equipped with capability experience; the other respondents already came in contact with the topic, but never used capabilities in a business environment. Thus, we could evaluate the CMG v2.0 to the two defined target user groups with EAM backgrounds, *newcomer* and *advanced-capability-user*. A more detailed description of the local practice partners and interviewed experts is mentioned Table 8.1.
- *Quantitative data analysis (Sect. 8.3.1):* Based on the small sample of the questionnaire only a descriptive statistics analysis was performed (Sect. 2.2.3).
- *Qualitative data analysis (Sect. 8.3.2)*: The qualitative content analysis is used due to the date generated by the transcript of the semi-structured interviews and its open designed response options. The interviews are available in text form. This is done by transcription of tape recordings. The text analyzes based on the procedure of Mayring [210] in separate documents and can be requested at the author.

The basic design of both data collection techniques is to capture the requirement implementation (Sect. 6.4) and its adaptations of the demonstration phase outcomes (Sect. 7.2.4). Against the background of the evaluation context decisions had to be made, which requirements has to be assessed within the evaluation and which are less relevant from a practical point of view. Table 8.3 determines the artifact requirements sets specified for the evaluation and describe the decisions on its selection. For this purpose the selected requirements are assigned to the individual formulation of the question of the questionnaire and the interview (Table 8.3), same applies to all change requests from Section 7.2.4. The precise assignment, description of rating scales and background is documented in Appendex E and shown in Figure 8.2 as a summary.

Table 8.3 Overview - Requirements sets to be evaluated (*µ21*).

Requirement Set	Evaluation decisions (Q= Question in the Questionnaire Appendix E)	Requirements
Conceptual (1): Integrated Capability Approach	The ICEA is a fundamental concept of CMG and is used in various WSs. Thus, the understanding and applicability is of utmost importance for the implementation of the CMG. For this reason, the ICEA *(R_{C11}-R_{C12})* is generally interrogated *(Q10, Q11)* in the interview in terms of its comprehensibility and its use (BB1.WS3, BB3.WS2) within the CMG (BB1.WS3).	R_{C11}-R_{C14}
Conceptual (2): Standardized Management Method	This set of requirements is the basis for the content engineering and sequence of the CMG. This set of requirements is in the questionnaire *(Q12-Q17)* and queried in the interview. Since the interview orientates on the CMG sequence, issues are addressed with regard to major requirements and its respective allocation to the various WS (Figure 8.2).	R_{C21}-R_{C28}

Method (1): Method Engineering	The requirements relating to the method engineering are not considered in the evaluation, since it is assumed that these theoretical requirements are irrelevant for the local practice.	R_{M11}-R_{M17}
Method (2): Architecture	Due to the fact that flexibility considerations, as well as structure and level of detail are important design-related prerequisites to meet the qualitative requirements, these requirements are queried both in the questionnaire *(Q18-Q20)* as well as in the interview. In the interview, the questions are distributed to the interview (BB3.WS3) and the general part (General Questions).	R_{M21}-R_{M23}
Quality (1): Measurability & Benefits	Benefits can be understood more easily when they can be supported by measurable indicators. Especially with regard to the motivation to work with the CMG meeting these quality-related requirements is particularly more important. Therefore, it was chosen to interrogate these requirements both in the questionnaire *(Q1-Q3)* and in the interview. As this set of requirements focuses on individual components of CMGs and the interview focuses on the sequence, the questions are addressed to the associated WS (BB1.WS2, BB1.WS3, BB3.WS2).	R_{Q11}-R_{Q13}
Quality (2): Usage	In addition to the motivation for the use of CMG, the quality of its feasibility has to be measured. In this context, usability, readability and transparency are essential requirements. Since a sustained use of CMG correlates very strongly with these requirements, it is essential to ensure the respective implementation. Thus, it was chosen to interrogate these requirements both in the Questionnaire *(Q4-Q6)* and in the interview. Due to the fact that these requirements are addressed to the entire CMG, these are not process-oriented but assigned to specific components (Components, BB Structure) and are interrogated in the general question part of the interview.	R_{Q21}-R_{Q23}
Quality (3): Governance	Governance requirements describe how the artifact should be managed over time regarding maintenance, flexibility, accountability and completeness. To ensure the long-term use of the CMG, the controlling and maintenance has to be guaranteed. In this context, the set of requirements is queried both in the questionnaire *(Q7-Q9, Q15)* and in the interview. Since the requirements refer to overlapping concepts like perspective, co-operation forms, BB structure as well as to individual WS (BB4.WS2, BB4.WS3), the interview is divided accordingly (Ref Appendix)	R_{Q31}-R_{Q34}

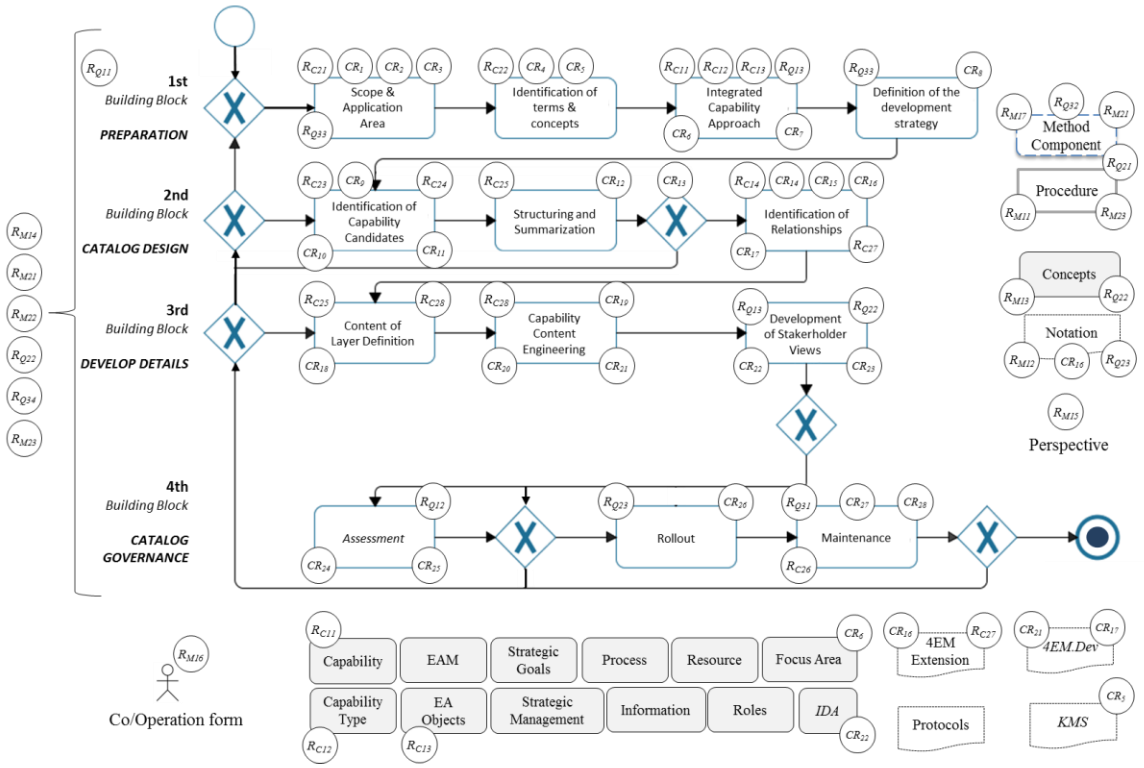

Figure 8.2 CMG v2.0 – Overview of requirements and change request ready for evaluation.

The used data collection methods in terms of preparation, distribution/execution, analyzing and interpretation are explained in the following sections.

8.3.1 ELECTRONIC QUESTIONNAIRE

In this section, we specify the questionnaire design based on the theoretical foundation for its construction (Sect. 2.2.2) and constraints of the evaluation context (Table 8.1). Within the *preparation & distribution section* (Sect. 8.3.1.1) the questionnaire design, distribution process and target group replies are explained. After the explanations of how the questionnaire is distributed the way of data analysis and its implications are provided (Sect. 8.3.1.2).

The questionnaire was designed to assess to measurability, usage and governance related requirements, conceptual- and method-architecture related requirements as well as a set of change requests (Appendix E1). The objective was to obtain additional feedback from both practice partners in front of the interview regarding the usage and the included concepts and structure. In terms of conspicuities like ambiguous text answers, very good/bad ratings, contradictory answers from both respondents, we investigated those aspects within the interview additionally.

8.3.1.1 PREPARATION & DISTRIBUTION

The questions are delivered with the 86-page-long guide (January 2016). We specified 20 questions grouped into nine CMG *quality-related-*, eight *conceptual-related and* three *method-architecture-related questions*. *Quality questions* are derived from the quality based requirements sets usage, governance, measurement and benefits (Sect. 5.2.3), whereas, *conceptual questions* are focused on concept-related requirement sets like the integrated capability approach and standardized management methods (Sect. 5.2.1). The *method-architecture* related questions are focused on the questions regarding the modularity, coherence and granularity of the CMG based on the second method implied requirements set (Sect. 5.2.2)

Moreover, the questions were not just intended to be directly and strictly answered in the questionnaire document, because simultaneously they should offer possible viewpoints to directly provide feedback within the CMG document. Thus, the participants have to feel free to comment whenever they want to by using the comment functions of the delivered electronic CMG v2.0 handbook (MS Word file). To enhance conformability and motivate extensive feedback, an additional author´s recommendation is delivered to keep the questions in mind. The recommendations should simplify the reading for the respondents and may inspire them to provide more experiences and insights. Each question, its background, data collection, related requirement and change request is shown in Appendix E.

The questionnaire is addressed to EAM experts, intended to be answered by persons of advanced competencies and skills within respective discipline. In our sample, the experts are familiar with areas like business model redesign as a wide-spread topic, meaning the knowledge and experience in technology driven restructurings of organizations as well as development and integration of additional digital service offers. Thus, both experts are familiar in managing business critical projects, which involves different departments and management levels as well as in most cases complex enterprise architecture changes. This knowledge in combination with their CMG experiences we wanted to retrieve in order to confirm and improve the current version.

Nevertheless, from preliminary discussions with both experts we were very cautious in terms of providing corporate data or project internals. This can be referred to the current and desired political/ hierarchical position within the company, but at least to protect their own positions. Due to these reasons we designed ordinal scaled questions supplemented by open questions. So, the questionnaire offers general and specific answer options and the respondents could decide what they are willing to divulge. When we were dissatisfied with given answers, it is specifically addressed (with corresponding references) in the subsequent interview (Sect. 8.3.2).

Next to the CMG v2.0 document, the questionnaire was distributed via Email in a separate MS Excel file. All documents including a cover & motivation letter, the electronic version of the CMG v2.0 and questionnaire were sent to the recipients at the beginning of January 2016.

8.3.1.2 RESULTS & IMPLICATIONS

Within this section, the received questionnaire responses are analyzed. The analysis of the 20 questions based on the pre-determined question classes *quality- conceptual-* and *method-architecture related* questions. All requirements and change requests within the questionnaire are examined a second time within the interview considering the answers of the questionnaires. Only this combination allows formulating conclusions on the expert's opinion regarding requirement- or change request fulfillment. However, these conclusions cannot be generalized due to the small *explorative and purposive samples*, representative conclusions about a population cannot be drawn. In this connection the results of the questionnaire cannot be analyzed by *inferential statistics*, but it is evaluated on a *qualitative descriptive basis*.

Both experts completely answered the questionnaire and sent it back 1.5 weeks before the interview. The offer for feedback by using the comment function within the CMG v2.0 handbook was not used. The precise answers to each question are listed in Appendix E1.

Quality- related results

As part of the quality- related questions *(Q1-Q9)* the entire CMG was generally classified by both experts as useful and valuable for their use case *(Q1)*, which in turn is positive for conclusions on *(R_{Q11})*. However, it was noted on one side that all WS could not be conducted because of the budget constraint and, on the other side, a more compressed version for smaller projects would have been more useful. The CMG was developed to support cross-divisional communication in terms of a high-level communication medium for EAM capabilities and its relation to goals and strategies implementing them *(Q2)*. Basically the CMG improved the cross-divisional communication for both experts. One expert pointed out that it can only be assessed with certainty at the project management level. Nevertheless, the responses can be interpreted as positive in terms of compliance with *(R_{Q13}, CR8)*. The IECA and its layered specification should provide possibilities of integrating indicators for measuring capability qualities. Both experts found it difficult to answer the question *(Q3)*. The use of maturity model was indeed rated as practicable and plausible in a conceptual dimension, but the backgrounds were not explained in more detail. Thus, *(Q3)* and *(R_{Q12})* were noted for further discussion within the interviews. It was assumed that an appealing design increases the interest and frequency of use studying the guide. To further contrast the guide from normal books, it has been layout out in landscape format. Both experts rated the design and visualization as optimal. "*Graphics were self-explanatory. The preparation and sequence of steps were logical and comprehensible* "*(Q4)*. These statements support both the fulfillment of requirements *(R_{Q21}, R_{Q22})* and the Change Requests *(CR_{15}, CR_{23})*. In order to make the CMG adoptable to a variety of stakeholder (EAM capability newcomers and experts), the guide has to be written in a common, practice-oriented business-style language, merging theoretical knowledge and examples from real-life settings. Again both experts classified wording and the way of expressions as intuitive without further comments *(Q5)*. These responses suggest a good understanding of the CMGs *(R_{Q22})*, and on the improvements by *(CR_6)* and *(CR_7)*. Appropriate structuring is assumed to facilitate the understanding and implementation of the CMG in a standardized and repeatable manner. In this context *(Q6)* has been recognized by both experts as intuitive without further comments. Thus, the experts estimated the current status regarding the standardization of using the CMG by means of structured procedures and its documentation as positive (*R_{Q23}, CR_{13}*). In order to provide a certain degree of flexibility the CMG method components should be suitable for adaption and integration of additional enterprise related aspect. With regard to the adaptation of individual WS on the respective use cases, opinions are slightly different *(Q7)*. Firstly integration of additional aspects was rated as intuitive and possible. Secondly, it was pointed out that not all steps have to be carried out or should be carried out in a more compressed form. Thus, *(Q7)* and *(R_{Q32})* were noted for further discussion within the interviews. The ease with which an actor can be made accountable for working within the CMG execution was answered by *(Q8)* with adequate and complete. Thus, both experts generally agreed with the suggested accountabilities within the RASCI assignments of the role model *(R_{Q33})*. The degree to what extent the CMG includes all desired components in for managing EAM capabilities of the respondents was asked in *(Q9)*. Regarding the integrity, under consideration of their own use cases, experts assessed the CMG as adequate and complete *(R_{Q34})*.

Conceptual-related results

As part of the *conceptual-related questions*, the *(R_{Cn})* in Table 8.3 are prioritized and the related *(CR_n)* are queried and evaluated the responses below. A comprehensible and reusable capability approach (IECA) was required that is easy to integrate into existing architectures as well as described by a standardized set of descriptive elements. This question *(Q10)* represents a control question regarding *(Q3)* and can equally be used for querying *(R_{C11})*. Responding to this question was recorded for a consolidation/ deepening within the interview, on one side no precise answer could be given, and on the other side a number of difficulties were mentioned such as clarity of the descriptions. In order to provide a flexible capability approach, we introduced a capability type differentiation concept based on the combination of descriptive elements *(Q11)*. Both respondents were satisfied with the presented concept *(R_{C12})*. Since the concept is also used for the identification of capabilities, the answers were not further commented and *(R_{C23})* must be examined in more detail in the context of the interview. A common understanding between different stakeholders with differing languages (not in the understanding of spoken language, but rather the specific working vocabulary) must be found. Thus, we provide recommendations for the identification of terms and procedure to specify a common understanding of respective preconditions (R_{C22}). Within the designated BB1.WS2 no description or explanation were missed by the respondents *(Q12)*. As better the governance structure of an organization or project including clearly defined roles and tasks, as better works the identification of stakeholders and their agreement on development conditions. Thus, we recommend stakeholder groups that could come into consideration (*R_{C21})*. The experts were able to use the suggested approaches, however, they asked for strategies to resolve conflicts and for further examples *(Q13)*. Based on IECA the CIM is intended to support the identification of specific capability candidates (*R_{C25}*). The CIM was rated as supportive by respondents. However, it was noted that the CIM could limit creative techniques such as brainstorming and should not be used in the same WS *(Q14)*. The method provides mechanisms that support the recognition of faults, their causes and its correction as well as integrate new requirements occurring from enterprises' changing environments (*R_{C26}, R_{Q31}, CR_{27}*). The maintenance concept was classified adequate and complete *(Q15)*. In order to document e.g. decisions, modelling results and share that information in a standardized way, the CMG provides a set of possible notations for different purposes like protocols for decisions or 4EM capability extension for modeling capabilities (*R_{C27}, CR_{16}*). The presented notations were rated as suitable by the respondents, however, they pointed out that appropriate experts must be available *(Q16)*. The content layer concept addresses the definition of the content and associated depth in order to provide both a final structure and relations of the capability catalog details (*R_{C28}*). The content layer structure was assessed to be helpful, but it was not used completely in the evaluation context *(Q17)*.

Method-architecture related results

Modularity is represented by the CMG BB design in order to its flexibility by recombining respective elements (*R_{M21}, R_{Q32}*). In this context, the CMG was once used sequentially (with some omissions) and once as a recombination of individual BB *(Q18)*. The interview queried which BB were combined in particular. The method should provide a logically ordered and consistent structure (*R_{M22})*. The answer to the question *(Q19)* with respect to the logical, orderly and consistently (coherence) sequence of the CMG was confirmed without comment and supports the comment *(Q4)*. Adequate granularity layer of the CMG should be used for communication purposes in terms of providing desired sets of information to various stakeholders (*R_{M23}*). Respondents confirmed that the CMG sufficiently provides concepts for the supply of information to stakeholders at various levels.

In summary, on 12 of 20 questions comments were made, which included additional explanations requested to requirements, change request, or included notes and experiences. Altogether 8 issues were identified, which were discussed again within the expert interviews again and were considered in the interview guide *(Q3, Q7, Q9, Q10, Q11, Q14, Q17,Q18).* The aggregate of the responses did not indicate that the experts classified the requested requirements or change requests as misses. Thus, the intended objective to obtain a positive feedback regarding the usage and the included concepts and structure can be classified that the intended objective had been achieved.

8.3.2 EXPERT INTERVIEW

The questionnaire was addressed to the chosen project leads providing privileged knowledge about digital business transformation with EAM. An expert interview is a suitable method to collect additional data, because it allows asking for further explanations and details. In terms of conspicuities of the questionnaire, we investigated these aspects during the interview in more detail. In this section, we specify the interview design based on constraints of the evaluation context (Table 8.1).

8.3.2.1 PREPARATION

Generally, the design of the semi-structured interviews is aligned to the prepared questionnaire of the previous section as well as considered practical experiences form our demonstration activities (Sect. 7.2) and corresponding theoretical foundations (Sect 2.2.2) like clear wording, the avoidance of leading questions, checked the necessity of questions as well as redundancies [280].

The main focus was to capture (a) experiences in terms of understanding and outputs, (b) information about the realization of conceptual, method implied and quality requirements and (c) consideration of questionnaire results of *(Q3,Q7,Q9,Q10,Q11,Q14,Q17,Q18).* Therefore, each question of the interview guide, related requirement, change request and/or related questions of the questionnaire are presented in the final version of the interview guide (Appendix E2).

In the next step the guideline was tested and revised by a research assistant from the University of Rostock. The pretest helped clarifying questions and trained the interviewer as well. Based on the gained experience from the demonstration the interview structure had to be adjusted only minimally and was specified as follows:

(1) *Introduction* (interview opening and includes the welcome and introductory questions, for example, the background of the experts or topic / purpose of the interview
(2) *Main part* (Concept and WS specific quality questions)
(3) *General Questions* (CMG v2.0 related quality questions, general feedback)
(4) *Conclusion* (Summary, questions of the interviewee, gratitude)

Additionally, the author requests answers in comprehensive and clear, causal statements. English and German wording is allowed.

8.3.2.2 EXECUTION

(1) The *interview introduction* includes a short welcome and purpose of the interview. Questions about the background of the experts and the associated company are asked in order to stimulate the willingness to talk.

(2) The *main part* of the interview is focused on the CMG v2.0 structure. The individual BB and WS were presented consecutively. Each step was shortly described to the experts and then they were asked about how their experiences with this particular WS and how they personally assess the maturity of the particular WS, BB and at least the entire management process. In contrast to the *demonstration* questions

about the 4EM capability notation were asked as well as impressions about the suggested software prototype 4EM.Desk. Furthermore, opinions about the requirements fit of the role model (co-operation forms) were asked within the interviews as well. Thus, all requirements and change requests have been considered as part of the expert interviews, which were left out during the demonstration (Table 8.3).

(3) The *general questions* part of the interview gathers information about requirements that are relevant for the whole CMG v2.0 as well as give the expert the opportunity to provide general feedback.

(4) The conclusion of the interview summarizes the results in order to provide experts the opportunity to add missing aspects and ask questions about further procedure (e.g. data protection, anonymity, receiving of study results). Finally the gratitude for the cooperation is pronounced to the interviewee and the access to the results of the interview is being granted.

The interviews went according to plan and the experts were very cooperative. Furthermore, they were able to answer all questions and gave a lot of additional subject-related information and insights. With regard to the discussions around CMG v2.0, the experts were able to provide competent answers and represented their views plausible. Care has been taken to ensure that experts could always speak freely and finish speaking. There was no need to break mental blocks by the interviewer, but it was sometimes necessary to interrupt the interviewee due to providing too much irrelevant information.

Risks influencing the interview results are shortly explained in the following paragraph. The experts appeared, despite differences in practical experience, not to be influenced in their responses. Furthermore, no refusal of self-disclosure or the effort to please the interviewer could be identified in both interviews. The terminology and presumed knowledge of experts was not exaggerated and could be fully understood by the interviewer. The iceberg, feedback- and catharsis effect could not be observed. There is no presumption of the occurrence of paternalism effect, but it cannot be excluded. The occurrence of the Hawthorne effect cannot be objectively verified as well. The procedures of the guideline were followed accordingly without restricting the experts in action. The experts answered most of the questions directly and without asking the interviewer further subject-related questions. The amount of questions with regard to clarification by the interviewer was acceptable. The entire interview guideline can be looked up at Appendix E2. During the two month studying and testing, the experts created additional notes and comments, which were also taken into consideration during the evaluation.

8.3.2.3 RESULTS & IMPLICATIONS

By linking the experts' experiences with CMG v2.0 we identified strengths, weaknesses and improvement potential in addition to general experts' opinions about CMG v2.0. In general, both experts have confirmed that the second version of the artifact could be used within its local practice environment *(Q1).*

Nevertheless, both experts provided a set of suggestions for improvements. Within this section we summarized identified suggestions that we used for adjustments (Sect. 8.4). Therefore, we assigned the recommendations of the respondents to the BB structure and a general section including all statements focused on the general CMG issues. Both interviews provide a transcript of 34 pages, 4 pages personal notes and 34 deductive categories after performing a qualitative content analysis. Table 8.4 provides an overview about content analysis results in terms of interview duration, identified categories and the used category references. The transcribed audio recordings and text analyzes based on the procedure of Mayring [210] and can be requested at the author.

The text-coding extracted expert statements from data sources that are associated with defined category system (deductive). Moreover, we inductively derived appropriated categories (without distorting the content-related essence of the material) by isolating and reducing text items that could be associated with *(P_G)*. Both Interviews were documented in German, therefore the results shown here had to be translated into English. In this context, little substantive amendments cannot be excluded without exception because of the language translation.

Table 8.4 Summary of the expert interview content analysis.

Interview facts	**AIDA Cruises**	**ACL Ltd.**
Interview duration	1:17 hours	1:04 hours
Results of the qualitative content analysis	34 Categories (deductive)	
Category references	Category System: *E*: Evaluation, *BB*: Building Block, *WS*: Working Step, *Co*: Co-operation forms, *P*: Procedure, *N*: Notation, *V*: Value, *U*: Usage, *M*: Method relevant, *G*: Governance relevant, *CMG*: relevant for the whole guide *Qn*: Considered set of eight questions from the questionnaire analysis (Sect. 8.3.1)	

The following explanations (Table 8.5-Table 8.8) summarize the results of the evaluation and explain confirmed requirements, extended or derived change requests ($\mu 22$).

Table 8.5 Change Requests of the CMG v2.0 – BB1 Evaluation.

Evaluation results for: **BB1: Preparation**	**Category & Questionnaire references**
WS1: The experts assessed the determination of involved parties / stakeholders, the procedures, concepts and documentation approaches for the *scope and application area* specification as sufficiently described (interview & questionnaire). From the well described *Role Model, the Problem Owner* was confirmed as the most important role for the implementation of the CMG. However, it was stressed that the benefits for the *Problem Owner* must be clearly indicated, as this provides the required budget. Thus, the role of the *Problem Owner* should be sought or positioned at executive level, senior management *(CR_{29})*. Furthermore, no changes or improvements could be identified regarding the regulations applicable to this WS requirements (R_{C21}, R_{Q33}) in the interview and questionnaire *(Q8, Q10)* or at least for the change requests *(CR_1-CR_2)* (interview). However, an extension has been identified for *(CR_3)*. Since the entire CMG is quite extensive and its contents was quite complex, a compressed version of the CMG was recommended to be provided in an executive summary, which is intended to help collecting stakeholders faster (*Pickup Point*). This executive summary version could be a 10 slide presentation as an additional document to the CMG.	[E.BB1.WS1], [E.BB1.WS1.N], [E.CMG.Q.U], [E.BB1.WS1.Co], Q13, Q8
WS2: In addition to the importance of this WS, it was clear that this can heavily time demanding. Since this WS represents a fundamental communication instrument for all forthcoming coordination and development activities and for this reason it has to merge, evaluate and finally determine several existing concepts, which can hold a great conflict potential between the participants. With this regard, it was proposed to provide appropriate method notes, which could support the conflict or crisis management between roles *(CR_{30})*. To speed up the overall process, it has been recommended to skip this WS, if it is obvious that no capability concept is available from the beginning, and to directly start with the introduction of IECA (BB1.WS3) *(CR_{31})*. No changes or improvements could be identified regarding the regulations applicable to this WS requirement *(R_{C22})* in both the interview and the questionnaire. In addition to this, there were no comments on the Change Requests *(CR_4-CR_5)* in the interview.	[E.BB1.WS2], Q12
WS3: The ICEA, which was partly classified as difficult in the questionnaire, was not confirmed as such by both experts in the interview and it was described as clear and conclusive. The importance of examples was pointed out to each capability to distinguish several types, since it is usually difficult to identify the types clearly. As part of the interview evaluation and under consideration of the responses to the questionnaire no changes regarding requirements *(R_{C11}-R_{C13}, R_{Q13})* and Change Requests *(CR_6-CR_7)* could be identified.	[E.BB1.WS3], Q3, Q10
WS4: The interviewed LP partners agreed to the importance and understanding of this WS. In	[E.BB1.WS4.P],

this context, the most important point of discussion was to ensure the necessary conditions for the CMG. Firstly participating stakeholders should be informed or involved as early as possible in the design of planning (see Role Model) to allow required capacities. It was pointed out that this is only possible with little resistance when the benefits of the necessary stakeholders are clearly defined *(CR_{32})*. As part of the interview evaluation and under consideration of the responses to the questionnaire no changes regarding the requirements *(R_{Q33})* and Change Requests *(CR_8)* could be identified.	Q8

Table 8.6 Change Requests of the CMG v2.0 – BB2 Evaluation.

Evaluation results for: **BB2: Catalog Design**	**Category references**
WS1: This WS was comprehensible and sufficient examples were provided according to the recorded statements of both experts. Furthermore, the respondents agreed that both real / practical and theoretical capabilities should be covered by the WS and that the challenge is to capture every single capability. It was noted that the used creative techniques for this WS could be hindered or restricted by the too early use of the CIM and it was proposed to use it at an advanced course of this WS, but no later than the following BB2.WS2 *(CR_{33})*. As part of the interview evaluation and under consideration of the responses to the questionnaire no changes or improvements regarding the requirements (R_{C23}, R_{C24}) and Change Requests (CR_9-CR_{11})) could be identified.	[E.BB2.WS1], [E.BB2.WS1.N], Q11
WS2: The activities within this WS were quite understandable for the respondent. The iteration between BB2.WS1 and BB2.WS2 was confirmed in this context. However, it was pointed out that it was not always clear which specific roles are involved in the WS and it possibly should be noted again in the Role Model *(see CR_{43})*. Furthermore, it was proposed to include a notice that the use of smaller working groups is only recommended at a specific group or project size *(CR_{34})*. Furthermore, it was discussed if this WS can be performed together with BB2.WS1. Basically, this decision is up to each CMG users, but the recommendation is to perform especially this step separately, as in this WS CIM should be used for structuring at the latest *(see CR_{33})*, which is in conflict with the intention of BB2.WS1. As part of the interview evaluation and under consideration of the responses to the questionnaire no changes regarding the requirements *(R_{C25})* and the Change Requests *(CR_{13})* could be identified.	[E.BB2.WS2] , [E.BB2.WS2.Co], Q14
WS3: The relations between capabilities must be known, since these dependencies are an important basis for the evaluation of decisions and its effects are connected with these dependencies. The need for this WS and the presented concepts were comprehensible, which was confirmed by both experts. The presented approaches for visualizing and modeling were indeed classified as expedient (4EM.Desk, ClusterMap), but it should be pointed out / ensured in the CMG that the appropriate methods of knowledge and tool knowledge are available. In this context, enhancements have been made to the change requests *(CR_{16})* and *(CR_{17})*. Extension to *(CR_{16})*: Guarantee that the participants can work with the notation by appropriate training. Extension to *(CR_{17})*: methodological knowledge and software tool for the 4EM-method and the 4EM.Desk software must be provided. For *(CR_{14}-CR_{15})* of the interviews and Questionnaire no changes were mentioned and same applies to the requirements (R_{C14}, R_{C27}).	[E.BB2.WS3], Q16

Table 8.7 Change Requests of the CMG v2.0 – BB3 Evaluation.

Evaluation results for: **BB3: Detail Development**	**Category references**
WS1: It was discussed whether this WS should be combined with other e.g. BB2.WS1 and / or BB2.WS2. Given the modular design *(R_{M21})* of CMG, combining BB2 and BB3 is basically up to the respective user, but the recommendation is to use a content top-down approach for the level of detail. The background of this approach is based on a maturity-based thinking, which implies that particularly capability-inexperienced enterprises must grow into gradually in the level of detail. Furthermore, the combination depends on how the CMG is carried out. If it is carried out as part of a project, the combination may well be discussed. If the CMG is gradually implement-	[E.BB3.WS1], Q17

ed through a number of smaller projects (usually with increasing maturity), the combination of WS is not recommended. Thus, an indication is formulated that this step can be combined with BB2.WS1, when the CMG is continuously carried out in a project. If the BB is implemented with a time lag in different projects, this WS should be carried out as a separate step of CMG *(CR_{35})*. Basic assembly would affect the modularity of the CMG. As part of the interview evaluation and under consideration of the responses to the questionnaire no changes regarding the requirements (R_{C25}, R_{C28}) and the change requests *(CR_{18})* could be identified.	
WS2: The concepts of the WS were adequately described and understood. Furthermore, the respondents agreed that it is not enough to write down capabilities, but the added value lies in the description of its components. Since these issues can be very complex, the CMG recommends using the modeling tools 4EM.Desk or one of the electronic versions of CIM. In this context, it was recommended to select the documentation dependent on the specific use case. In order to work with 4EM.Desk appropriate method and tool knowledge must be available. It can be worked collaboratively and with the help of standardized notations, which is only partly possible with the electronic form of the CIM. However, this electronic form, in turn, is easier to handle, since less knowledge must be available. Within the *(CR_{36})* an indication is formulated that the decision regarding the modeling tools has to be considered under the specific project situation, as well as pros and cons have to be weighed. As part of the interview evaluation and under consideration of the responses to the questionnaire no changes regarding the requirements *(R_{C28})* and the change requests *(CR_{19}-CR_{21})* could be identified.	[E.BB3.WS2], Q17
WS3: The definition of stakeholder views was a very important and well described WS for both experts, because this is the value adding aspect of the capability catalog. In this context, information is processed differently for different stakeholders. Thus, for example, executive level presentations based on notations are inappropriate, but rather high-level visualizations with prioritized KPI are helpful and recommended. On the other side the problem owner may prefer a higher level of detail than e.g. the executive level, and request appropriate models, depending on what was agreed in BB1.WS1. In principle, stakeholders do not have sufficient knowledge of methods, which should be considered when creating the specific view. Thus *(CR_{23})* is extended by the fact that the methodological knowledge of customers is actively addressed, and besides the formal based notation of views, a selection of various visualization techniques will be offered in addition. Both experts did not use a method to determine the information demand of stakeholders, besides the defined deliverables (BB1.WS4). So far, the information demand of stakeholders has been derived on the basis of embodied knowledge, which is of course highly dependent on the knowledge of the appropriate person and does not constitute a standardization. Thus, adding an extension to *(CR_{22})* is meaningful to the effect of explaining IDA as a proposed method more accurately and it is especially recommended for larger enterprises / projects. With respect to the distribution of access rights of the capability catalog special risk affinity was recommended, especially if information is lost (for example, theft). In this context, it is recommended to divide access right into risk classes *(CR_{37})*. As part of the interview evaluation and under consideration oft the responses to the questionnaire no changes regarding the requirements *(R_{Q13}, R_{Q22})* could be identified and the extensions of *(CR_{22}, CR_{23})* were described accordingly.	[E.BB3.WS3], Q2, Q5

Table 8.8 Change Requests of the CMG v2.0 – BB4 Evaluation.

Evaluation results for: **BB4: Catalog Governance**	**Category references**
WS1: The reflection and control of the results is a typical part of a management process and therefore classified as important WS. The review distinguishes between *theoretical*-and *existing capabilities*. *Theoretical capabilities* are capabilities where the needed descriptive elements are available in the enterprise, but not staffed with the needed resources. In extreme cases, this can affect all descriptive elements. The development of the missing resources is assessed under consideration of the desired outputs and staffed with the appropriate resources. The *existing capabilities* are all descriptive elements, which are available in a certain quality, but the desired quality of the output is not accomplished with the capabilities. In this case, current- and target state of the descriptive elements are assessed and adjusted based on the gaps of	[E.BB4.WS1], Q3

achievement. The problem should be described in more detail in the guide *(CR_{38})*, whereas maturity models and possibly several review iterations have been confirmed as a good starting point. Typical KPI, which were mentioned, are a combination of the costs and impact on target value caused by the capability catalog development, such as sales or ROI through improved strategic decisions. The review of qualitative improvements was classified as difficult such as improving communication between different areas (BITA), which do not always have a direct impact on the aforementioned targets and may only be assessed indirectly. In this context, the review was recommended by the *Problem Owner (CR_{39})*, because ultimately this role has been commissioned the CMG-project. As part of the interview evaluation and under consideration of the responses to the questionnaire no changes regarding of the requirements *(R_{Q12})* and the Change Requests *(CR_{24}-CR_{25})* could be identified	
WS2: The implementation of training as part of the rollout has been confirmed and should be an integral part of the rollout process. For the training seminars and / or workshops were recommended, but purely electronic trainings (e.g. online webinars) were not excluded, but they should have more of a complementary nature, since the use probability is classified higher on seminar training. Thus, training is recommended to be carried out through seminars and workshops, webinars is only recommended as a supplement or for express entry *(CR_{40})*. To support the rollout and use of developed catalog, its publication on central operation points in enterprises was recommended such as ERP, KMS, PMS or internal collaboration systems. The idea is the integration a viewer functionality on the catalog, which notifies interested parties automatically about updates of catalog elements (considering the risk categories) and, if necessary, to provide functionality for requesting further access rights to information *(CR_{41})*. As part of the interview evaluation and under consideration of the responses to the questionnaire no changes regarding the requirements *(R_{Q23})* and the change requests *(CR_{26})* could be identified.	[E.BB4.WS2], Q6
WS3: Within this WS, particularly the *all-do-some approach* was rated as a good approach to gather information for the catalog content, which in particular supports the relevance and use of the catalog. In this context, it was confirmed that the maintenance on the appropriate involvement of *Domain Experts* should run with the support of *4EM Method and tool expert*, as they have the necessary knowledge. The *EAM CM team* is responsible for this WS in operative business and provides support. As part of the interview evaluation and under consideration of the responses to the questionnaire no changes regarding the requirements *(R_{Q31}, R_{C26})* and the change requests *(CR_{27} -CR_{28})* could be identified.	[E.BB4.WS3], Q15

Table 8.9 Change Requests of the CMG v2.0 evaluation.

Evaluation results for: **CMG**	**Category references**
Value: The Management of EAM capabilities as a basis for strategic decisions was rated as helpful. The goal-oriented procedures within the ICEAs and its management by the CMG were confirmed. Thus, no additional CR, to those already mentioned, were identified regarding the Quality Requirements Set 1 *(R_{Q11}-R_{Q13})*.	[E.CMG.Q.V], Q1,
Usability: Basically the entire CMG was understandable as logic and its concepts were assessed as well understood *(R_{Q21} - R_{Q23})*. Except the aforementioned exceptions, the visualizations used were classified as suitable for the particular situation. However, it was repeatedly pointed out that the CMG is a very comprehensive method and a more compressed version was suggested as more helpful for stakeholder acquisition, express start in the method or for training purposes. In this context, already identified extension in BB1.WS1 *(CR_3)* has been confirmed. Further general comments and suggestions regarding Quality Requirements Set 2 was not disclosed.	[E.CMG.Q.U], Q4, Q5, Q6, Q7
Governance: The quality requirements set 3 describes how the CMG should be managed over time regarding maintenance, flexibility, accountability and completeness *(R_{Q31}-R_{Q34})*. Both experts have not missed anything fundamental in terms of completeness. Method elements were combinable and sufficiently flexible to integrate their own approaches or features. Regarding the accountability, a better overview of the roles involved and used IT systems, documents and notations was demanded, which should be provided as part of a new process model version *(CR_{42})*.	[E.CMG.Q.G], Q7, Q8, Q9

Method: The modular structure, the required coherence of the CMG and its level of detail was considered adequate and sufficiently classified (R_{M21} - R_{M23}). Thus, no additional to the already mentioned CRs and suggestions for improving (R_{Q11}-R_{Q13}) were mentioned.	[E.CMG.M], Q18,Q19,Q20

All in all the evaluation identified 4 extensions of existing change requests and 14 suggestions for new content relevant changes. These changes are referred to as Change Requests (CR_{28+n}), which represent small content-related adjustments of the CMG v2.0. Larger changes in terms of new requirement *(R_n)*, which includes further iterations in the *design and development* phase (Chapt. 6), were not identified.

8.4 ADJUSTMENTS & SUMMARY

Due to the fact that no new requirements were defined or existing requirements were changed, the adjustments of CMG v2.0 were defined and implemented without returning to the *design & development* and *demonstration* phase of the research process. Nevertheless, it should be noted that this is a further *design cycle* within the meaning of the DSR framework (Figure 2.1), which leads to an improvement of the artifact according to [152] and was derived from practice.

Based on feedbacks of both interviews and questionnaires we transferred the suggestions of improvement to a new version of the CMG. Thus, the CRs are implemented straight forward, which results in a third version of the CMG. Appropriated solutions for satisfying respective CR and are referred in Table 8.10.

Table 8.10 CMG v2.0 – changes after evaluation.

BB1: Preparation	Affected method element	**CMG changes**
WS1: Scope & Application Area	*Notation*	An executive version of the CMG in the form of a short presentation *(extension of CR_3)* was created and a reference for obtaining stakeholder was incorporated in the guide.
	Co-operation forms	The role description of the *Problem Owner* was amended in terms of its affiliation to the executive or senior management *(CR_{29})*. Based on *(Extension of CR_{22})* the role of *IDA-method expert* is used in this WS, which includes the expertise of executing the IDA in order to support the project lead to identify required information supply of the Problem Owner during the CMG execution.
WS2: Identification of terms & concepts	*Procedure*	If no capability concepts are used in the enterprise and this fact is coordinated with the involved roles, this WS can be skipped and it can directly be started with the introduction of the ICEA in BB1.WS3 (CR_{31}).
	Concept	(*CR_{30}*) emphasizes the role of the *Moderator* in this WS since a moderator should also have mediator skills in the framework of the workshop control. These skills are methods for supporting conflict management [396] or negotiating strategy [397] supported.
WS4: Definition of the development strategy	*Procedure*	Within this WS the *Problem Owner* and *Stakeholders* need to assure their support (e.g. budget, personnel, resources and/or information). The support is usually only granted, if it is clearly defined what they will receive for their support. In this context, for example, target requirements can be worked out in terms of KPI or other benefits and be defined for further extending of the CMG. Ultimately, it must be clear by this WS, which stakeholder receives which benefit for the support *(CR_{32})*.
	Co-operation forms	*Based on (extension of CR_{22})* the role of *IDA-method expert* is used in this WS, which includes the expertise of executing the IDA in order to support the project lead to identify required information supply of the Stakeholder Group during the

		CMG execution.
BB2: Catalog Design		**CMG changes**
WS1: Identification of Capability Candidates	*Procedure*	The CIM was removed from the WS and implemented in BB2.WS2, because the suggested creative techniques could be hindered by a too early use of the CIM *(CR_{33})*. The iterative structure of BB2.WS1 and BB2.WS2 supports the CIM as tool for the identification of capabilities in the advanced stages of the identification and structuring activities, i.e. in a further iteration of the WS.
	Concept	(CR_{33}): CIM has been removed from the concepts for BB2.WS1.
WS2: Structuring & Summarization	*Procedure*	The procedure how to use the CIM has been inserted into the BB2.WS2 *(CR_{33})*.
	Notation	CIM digital template (Appendix D4) was adopted*(CR_{33})*.
	Concept	CIM was supplemented *(CR_{33})*.
	Co-operation forms	The use of the *Small Workforces* to support the structuring of certain components of the CIM is only recommended above a certain project (group) size*(CR_{34})*. The artificial separation in small groups is not useful. Thus the *Project Lead* decides on basis of the project participants structure, whether this role is occupied within the BB2.W2.
WS3: Identification of Relationships	*Procedure*	The presence of training material for the 4EM method and the software tool 4EM.Desk is pointed out in the CMG and linked in the glossary *(Extension of CR_{17})*. Furthermore, it must be ensured that stakeholders can understand and use the 4EM notation. This can be ensured by small trainings, conducted by *4EM-method & tool expert*, or small webinar sessions / tutorials *(Extension of CR_{16})*.
	Concept	Glossary extension: training material references 4EM Method and 4EM.Desk *(Extension of CR_{16}, CR_{17})*.
	Co-operation forms	The role of *4EM-method & tool expert* should also have competences relating to the implementation of training for structuring methods and tool knowledge in addition to its expertise in modeling of CAPM in 4EM.Desk & Touch (*Extension of CR_{16})*.
BB3: Detail Development		**Change changes**
WS1: Definition of Content Layer	*Procedure*	This WS can be combined with BB2.WS1 and / or BB2.WS2. However, it is only recommended if the CMG is continuously carried out in a project and the *Project Lead* considers the combination as necessary due to the given conditions (e.g. budget, time). If the BB is implemented in different projects with a time lag, merging is not recommended *(CR_{35})*.
WS2: Capability Content Engineering	*Procedure*	From this WS capabilities, its descriptive elements and KPI can be described in more detail (depending on the selected content layer). In this context, as these issues quickly become very complex, a modeling tool should be used at the latest. 4EM has been recommended for mapping relationships in BB2.WS3 and can be used accordingly by using the software 4EM.Desk. In particular, the support of Small Workforces, which allows collaborative and distributed work on capability models, argues in favor of using 4EM.Desk. The only disadvantage of the latest version 2.7b is the fact that Content Layer 3, for the evaluation of KPI, is not yet supported. Therefore further modeling alternatives are advised in the CMG. Ultimately, the *Project Lead* has to take the decision with respect to the modeling tools under consideration of the respective project situation by weighing the pros and cons *(CR_{36})*.
	Notation	4EM.Desk 2.7a, Archimate 2.0 modeling tools
	Co-operation forms	*Project Lead* is accountable for the respective WS and must ultimately decide on the modeling tool.

WS3: Development of Stakeholder Views	*Procedure*	Since the *Stakeholder Group* does not always have sufficient knowledge of methods to capture the requested information on the proper content layers, reporting must be adapted accordingly. Thus, in particular the knowledge of methods of the stakeholders must be estimated and considered *(Extension of CR_{23})* to draw conclusions to the desired manner of the information presentation (different visualizations, lists, etc.). On one side, results of BB1.WS1 & BB1.WS4 can be analyzed in more detail or an equivalent method may be used. In this connection, reference is made to the information demand analysis [53,313], which is present as a publication *(Extension of CR22)* and which is particularly recommended for larger projects. To access information of the capability catalog appropriate access rights should be assigned. For example, these access rights can be addressed to the role of each person in the enterprise (not within the CMG) like CIO, SVP, Enterprise Architect, Application Architect. An designed capability catalog contains strengths and weaknesses of an enterprise and should necessarily protected against e.g. theft, undesired access *(CR_{37})*.
	Notation	4EM.Desk access rights for the use of restricting views of the models.
	Concept	Comprehensive overview of various visualization options added: Periodic table of visualizations (Appendix D2).
	Co-operation forms	The role of *IDA-method expert* is used to define appropriated stakeholder views based on previously (BB1.WS1, BB1.WS4) and actually identified information supplies *(Extension of CR_{22})*.
BB4: Catalog Governance		**Change Description**
WS1: Assessment	*Procedure*	The facts of the current- and target state review of descriptive elements is described in more detail in the guide by an example *(CR_{38})*.
	Notation	Maturity visualization by spider charts (CR_{38})
	Co-operation forms	In particular, not directly measurable KPI such as satisfaction, improvement of communication need to be assessed by the *Problem Owner*, because ultimately this role commissioned the CMG project *(CR_{39})*.
WS2: Rollout	*Procedure*	Trainings are conducted by seminars and workshops in the first rollout phase. In these trainings, the benefits and the use of the capability catalog are explained. Webinars and / or tutorials must only be created as a supplement and is recommended for express entries *(CR_{40})*. To support the rollout and use of the developed catalog, it is recommended to integrate the rollout around central work process points in enterprises such as integration into existing workflows, as well as systems such as ERP, KMS, PMS or internal collaboration systems *(CR_{41})*. This is done by a guard / viewer role of certain content of the capability catalog (considering the risk classes, *CR_{37})*.
	Co-operation forms	Project Lead organizes trainings and the creation of electronic training materials.

Based on change requests described above the co-operation forms i.e. the RASCI based role model changed, which is shown in Table 8.11. Furthermore, the following role was added:

IDA-method expert: This role has expertise in gathering the information demand within the CMG. Thus, the IDA method expert is able to determine the information needs of different roles systematically and prepare it for further processing within the CMG. For this reason the IDA method expert focuses on the approach of [53], which supports the information demand methodologically as “ (…) constantly changing need for current, accurate, and integrated information to support (business) activities, whenever and where ever it is needed.” [53, p.80].

Table 8.11 Implied CR adjustments (colored cells) within the co-operations forms of the CMG v3.0.

Working Step	Problem Owner	Project Lead	EAM CM Team	Domain Expert	Modera-tor	Mi-nute Taker	Small Work-force	Stake-holder Group	4EM Method & Tool Expert	IDA Method Expert (CR_{22})
BB1.WS1: *Scope & Application Area*	RA	I			R	S		I		
BB1.WS2: *Identifi-cation of terms and concepts*	AC	R	R	R	R	S		C		
BB1.WS3: *Descrip-tion of the IECA*	AI	R	R	I		S		I		
BB1.WS4: *Defini-tion of the develop-ment strategy*	ASI	R	R	I	R	S		R(A)		R
BB2.WS1: *Identifi-cation of Capability Candidates*		AS	R	S	R	S				
BB2.WS2: *Structur-ing and Summariza-tion*		AS	R	R	R	S	(R)			
BB2.WS3: *Identifi-cation of Relation-ships*		AS	S	R	R	S	R		R	
BB3.WS1: *Defini-tion of Content Layer*	C	ARS	R	C	R	S	I	C	I	
BB3.WS2: *Capabil-ity Content Engi-neering*	C	AS	S	R		S	R	C	RS	
BB3.WS3: *Devel-opment of Stake-holder Views*	CI	AR	R	RC		S		CI	S	R
BB4.WS1: *Assess-ment*	R	AR	S			S		R	S	
BB4.WS3: *Rollout*	I	AR	S	I		S		I	R	
BB4.WS4: *Mainte-nance*	I		AS	R				I	S	

For a better overview regarding the accountability of the involved roles and the selected IT systems, documents or notations, a new process model version was compiled *(CR_{42})*. The new process model is based on the process model 4EM notation (Figure 8.3) and can be found in its comprehensive form in Appendix A3.

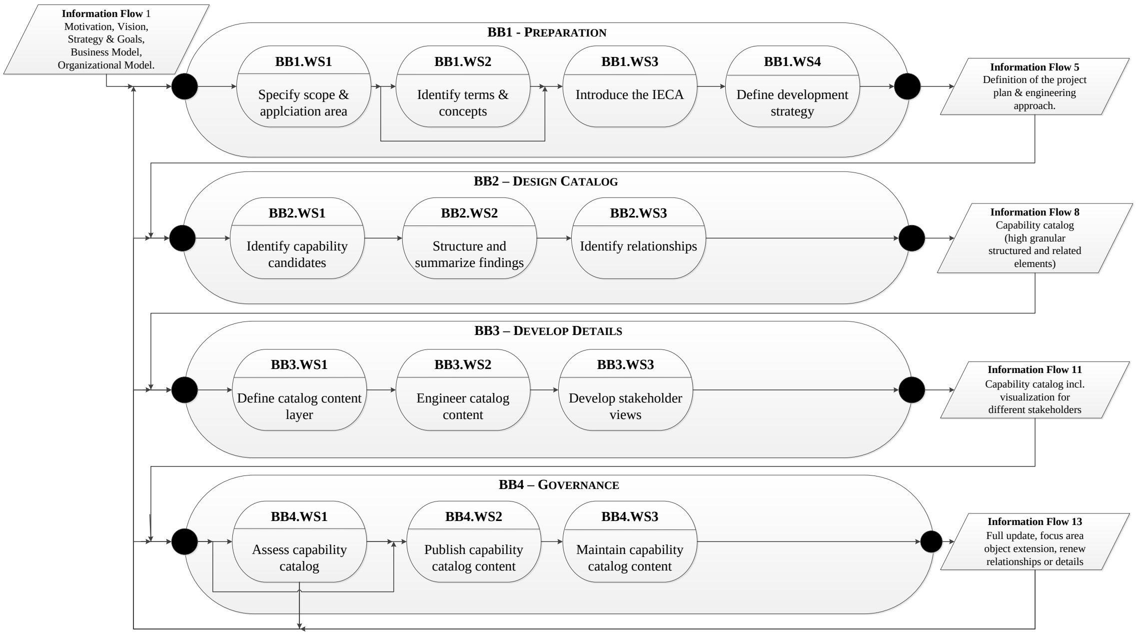

Figure 8.3 CMG v3.0 – Process Model.

In addition, the entire CMG manual of 86 pages has been shortened to 73 pages and an 11 pages executive presentation has been created and added to the CMG v3.0.

With the help of the demonstration and evaluation results, we were able to test the CMG with four different practice partners. From over 8 hours of interview material as part of the qualitative content analysis 107 categories were extracted to infer the fulfillment grade of 32 requirements. Both the Demonstration and the evaluation revealed no conceptual changes of requirements. The 28 change requests generated from the demonstration were implemented in CMG v2.0 and interrogated in connection with the evaluation. The evaluation identified four extensions of existing change requests and 14 suggestions for new content relevant changes, which have been implemented in the current CMG v3.0, but have not been re-evaluated by a practice partner.

Except the aforementioned content-related changes, the requested requirements (Table 8.5-Table 8.8) were generally classified as fulfilled by the respondents. In this context, the methodological support of EAM capability management by the CMG was rated as helpful and positive. Based on the above estimates and under consideration of the development status of the CMG, it is concluded that the research question *(RQ)* could be answered with the presented artifact.

The current version 3.0 is included as a complete manual in Appendix A and is published as output of this research process phase.

9 CONCLUSION & REFLECTION

This section summarizes and critically reflect the research process and the achieved results. Therefore, significant outcomes of the work are ultimately compiled and critically assessed. Finally, an outlook on further research topics and development opportunities is provided, which are associated with the results of this work.

9.1 SUMMARY

Enterprises interact with different environments that involve different types of challenges. One challenge represents the digitalization of processes, products and services which affects enterprises and creates both promising business opportunities e.g. new business models as well as required changes within an enterprise. In order to handle effects of these challenges, an enterprise defines goals implemented by strategies. An organization has to specify an appropriate set of transformations, which are being summarized by these strategies. A successful strategy implementation is accompanied by an appropriate alignment or, more correctly, coordination between business and IT. EAM supports this condition of business and IT during the corresponding transformations. Exactly for this purpose the EAM is used, because it provides information supporting decisions regarding the alignment of business and IT. The practice analysis has shown that the quality of such decisions also depends on the EAM capabilities as a mediator between strategy- and IT management. We argue that enterprises require specific EAM capabilities to be able to plan, implement and control the coordination between the strategy management and IT management efficiently. However, there has not been any methodical approach to identify and manage these capabilities. This assumption is based on various local practices analyzes (alfabet AG, OpenGroup) and its situational problems was summarized and abstracted in the following root causes:

- *RC_1:* Lack of a consistent EAM capability understanding,
- *RC_2:* Standardized course of action is not available,
- *RC_3:* Missing stakeholder communication concept,

and was shifted and generalized by results of an extensive knowledge base analysis of capability research, considering the last 16 years, from a local- to a global relevance. Based on the problem definition, the goal for artifact development was specified as follows:

> *(**G_{GP}**) Development of a method that systematically supports identification, structuring and maintenance of EAM capabilities through a structured process gathered in an enterprise specific capability catalog.*

Based on this goal, a total of 32 requirements were derived from theory and practice, which were classified into *conceptual-*, *method* and *quality implied requirements.* The resulting first version of the Capability Management Guide (CMG) was segmented into four BB and 14 WS. The CMG structure is based on the method-implied requirements, which describe the basic elements needed to develop a method. The procedures, used concepts and notations were based on contents of the *conceptual requirement sets*. The fulfillment represents the main contributions of the CMG and involves the following key activities:

- Understanding of the preconditions for capability management,

- Receiving of management attention,
- Finding of enterprise specific EAM capabilities,
- Specifying its structures, relations and contents in a catalog,
- Govern its assessment, catalog rollout procedures and maintenance actions.

In order provide these actions *(RQ1)* was answered by developing a unified EAM capability approach, based on the combined outcome of seven different systematic literature reviews and a research cooperation. The approach includes a conceptual capability structure that supports the differentiation of different types and suggests a set of descriptive elements and characteristics, called *Integrated Enterprise Capability Approach (IECA)*. Under consideration of the feedback from research community and the local practice the concept was published in [85]. The capability approach is introduced within the first stages of the CMG and from there it is a central part of the following CMG activities. For instance, we proposed a *Capability Content Layer Concept*, which can be used for a flexible content engineering in terms of a desired granularity (flexible adjustment of content processing of respective capabilities). Moreover, the IECA was the basis for the development of the identification concept within the *Capability Identification Matrix (CIM)* and the used notation, which was implemented as the 4EM-method extension by introducing a capability sub-model. The software prototype 4EM.Desk 2.7a, which is based on the aforementioned approach, supports modeling capabilities and is used from BB2.WS3 onwards.

Within a first CMG practical demonstration (Bombardier Transportation, Stadtwerke Rostock AG), the basic feasibility of the proposed approaches were tested and 28 content-related adjustments were integrated considering particularly selected practice-oriented documents, which results in a second version of the CMG. Thus, the second version includes a set of suitable procedures for identifying, structuring and governing EAM capabilities and therefore contains the answer to *(RQ2)*.

Within a final evaluation the CMG v2.0 was assessed by two practice partners (ACL Ltd, AIDA Cruises). Under consideration of the evaluation context, the 32 requirements and the 28 content-related adjustments were interrogated by a semi-structured expert interview and an earlier questionnaire. The analysis revealed a set of 14 new content-related adjustments and four improvements of already existing ones, which have been integrated in the current version 3.0.

Finally, the CMG supports the EAM and thus the alignment between the *Strategy Management* and *IT-Management* by providing an instrument for: a high-level representation of EAM acting, a common language between strategy and IT responsible, and a concept for a continuous capability management. Based on the presented results and considering the limitations, the present work fulfilled its given research objective *(RG)* to develop a method for the EAM capability management which complies with practical requirements and scientific rigor. Last but not least, this is supported by peer-reviewed publications of various versions of the CMG [87,300]. Figure 9.1 and Figure 9.2 summarize the results of the thesis. As a conclusion, the central research question:

> ***RQ:*** *In the context of strategy management, how could the management of EAM capabilities be supported methodically?*

…could be satisfactorily answered by the CMG method.

PROBLEM

(P_G) An (1) unified EAM capability approach represented by a set of related architecture elements, which is taken as a whole, (2) identified, (3) engineered and (4) maintained by a (5) procedure with structured actions, techniques, guidelines and illustrations in order to support various stakeholders is missing.

ARTIFACT

(G_{GP}) EAM capabilities have to be identified, structured and maintained systematically through a structured process gathered in an enterprise specific capability repository. The method has to operationalize the following global practice goals.

KNOWLEDGE BASE ANALYSIS

The knowledge base analysis showed that there are various capability definitions in literature, but the found concepts could not solve *(P_G)*. Thus, *RC_1:* lack of a consistent EAM capability understanding, *RC_2:* standardized course of action is not available and *RC_3:* missing stakeholder communication concept, were confirmed for global relevance.

PRACTICE

The beginning of the investigation was initiated by a research cooperation with alfabet AG (EACN project), supplemented by two projects of the Open Group (EACI, CBPP). Feasability and evaluation were proofed in collaboration with ACL Ltd, AIDA Cruises, Bombardier Transportation and Stadtwerke Rostock AG.

REQUIREMENTS

Requirements were distinguished between *conceptual-*, *method-implied-*, *quality-* and requirements. *Conceptual requirements* relate to desired purposes of the artifact in terms of inputs, behaviors and outputs. *Method-implied requirements* refer to properties regarding the construction of the specific artifact type. *Quality requirements*, sometimes called non-functional requirements, are those that could be used to evaluate the other requirement types.

CONSTRUCTS

The most important construct used in this research are represented by: (1) Design science research methodology by Peffers et al. [26], (2) the DSR handbook by Johannesson & Perjons [21], (3) the method engineering approach of Goldkuhl et al. [216], (4) the notations and concepts of the 4EM-method [15].

PROBLEM INVESTIGATION

Studied practices showed a demand for a holistic capability concept and a method which can assist in the identification and management of EAM capabilities. *(P_L)* and its 11 sub-problems *(P_{Lnm})* were analyzed by *(RC_n)*, which served as the basis for the global relevance test against the knowledge base *(P_G)*.

DEFINE REQUIREMENTS

31 requirements were derived from *(P_G)* under consideration of local practice sub-problems *(P_{Lnm})*, its root causes *(RC_n)*, *(G_{PGn})* and artifact type method specific engineering principles.

DESIGN AND DEVELOPMENT

According to the method implied requirements, we follow a method engineering approach. The development of the method is aligned to proposed elements and concepts. In accordance with the quality requirements proposed vocabularies are renamed without changing its concepts and relations.

DEMONSTRATION

Two practical partners were interviewed to test the feasibility of the first version of the CMG. 28 change requests were implemented considering particularly selected practice-oriented documents in a second version of the CMG

EVALUATION

The 31 requirements as well as the 28 change requests of CMG 2.0 were evaluated by two practice partners. The analysis revealed 14 new change requests, and 4 extensions, which have been incorporated in the current version 3.0.

STRUCTURE

The CMG consists of four building blocks summarizing activities belonging together. Each block contains several main activities called working steps. Every working step involves a structured set of procedures, concepts and notations in order to fulfill its specific tasks. The interrelation of BB and WS is displayed in a process model, along with the required roles.

FUNCTION

(1) *Capability Approach:* The IECA specifies descriptive elements, differentiation of capability types, hierarchies and a more unified and repeatable capability structure. (2) *Identification*: The CIM comprises concept & activities for EAM capability identification. (3) *Engineering*: The content layer approach & the 4EM-method capability extension provides functions for capability content engineering and modeling. (4) *Maintenance*: up-to-date EAM capability catalog is ensured by a governed process and the concept of capability catalog extension pattern. (5) Procedure: (1-5) are combined in a method following an method engineering approach.

EFFECTS

EAM capabilities support the alignment between the strategy management and ITM more efficiently in terms of e.g. high-level representation of organizational acting, common language between business and IT responsible, the identification of organizational requirements for a successful strategy implementation. Thus CMG affects the structure and / or the behavior single element of an enterprise as well as the structure and / or behavior of a group, organizational unit and/or entire organization.

Figure 9.1 Summary – Research results.

Development & Evaluation of a Capability Management Method

A Guide for Planning, Engineering and Controlling an EAM Capability Catalog

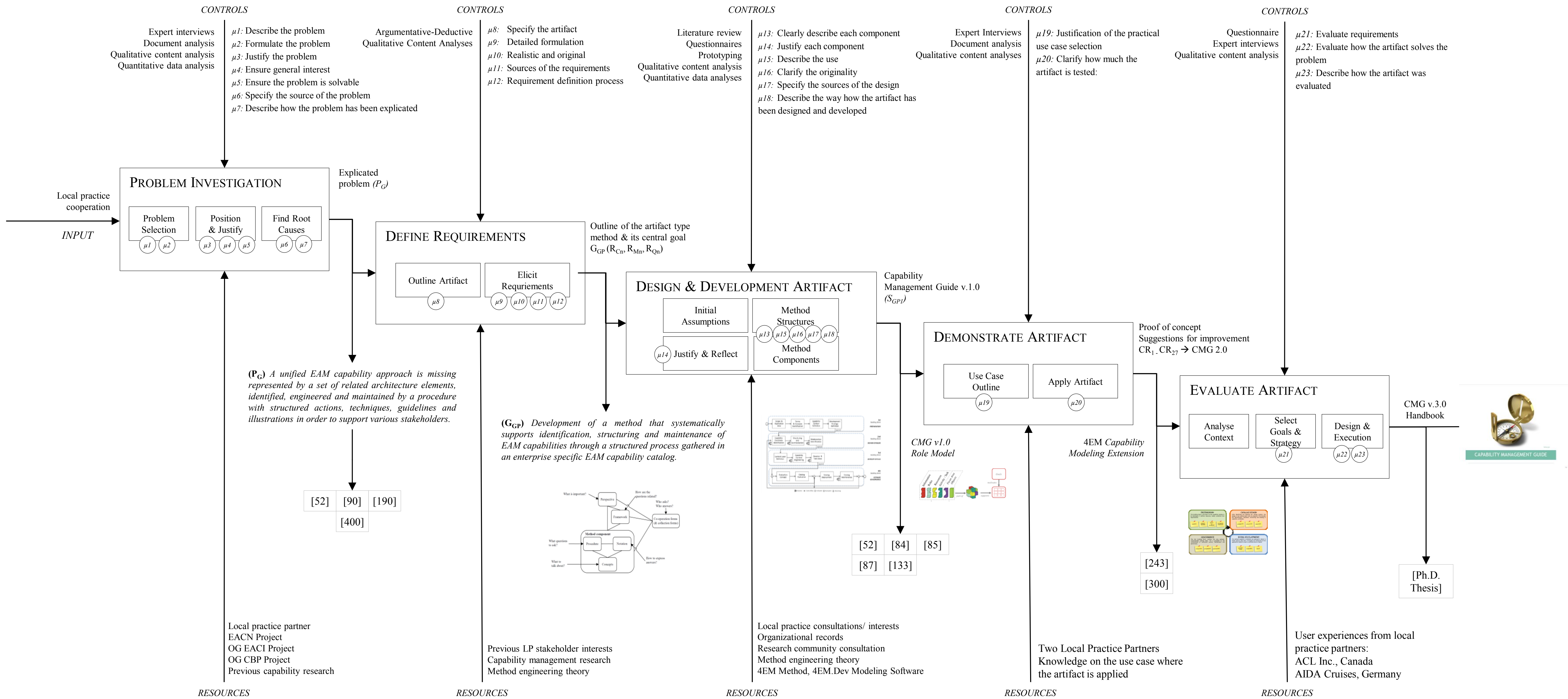

Figure 9.2 Overview Research Process & Results

9.2 REFLECTION

For the reflection of the present investigation within this section, it is reviewed how the selected DSR research strategy and the related guidelines have been complied with. Furthermore, threats to validity are concluded and the handling of occurring limitations is explained.

9.2.1 DSR CONFORMITY

At this point the DSR evaluation guidelines of Section 2.2 are applied to this work with the objective to describe how the artifact and research process is aligned to each criterion.

Design as an artifact ($\mu_{DSR}1$): The CMG method handles identification and structuring procedures for EAM capabilities and supports governance and maintenance functionalities. As outlined in Chapter 5, the artifact is classified as *method* based on the DSR analysis framework by [119]. The *method* development was based on a set of requirements from different local practices by involving feedbacks from scientists and practitioners (Chapter 6). Its feasibility was established by two demonstration activities (Chapter 7) that lead to a second version of the method. Furthermore, its practicability was requested a second time by assessing defined requirements and change requests during the evaluation activities within Chapter 8.

Problem Relevance ($\mu_{DSR}2$): The problem relevance is outlined in Chapter 4. Based on three local practice situations a lack of operational concepts and shortcomings of existing approaches in theory provides the foundation for a set of local practice problems that claimed a missing concept and supportive procedures for EAM capability management (Sect. 4.1). A root cause and knowledge base analysis confirmed that the identified problem is persistent, widespreaded and unsolved. Thus, the problem of general interest (Sect. 4.4) was derived whose solution provides a contribution to various local practice situations by providing a method for EAM capability management .

Design Evaluation ($\mu_{DSR}3$): In principle, the evaluation refers to Chapter 8, but additional opinions and proposals concerning the current state of development were collected during the *development phase* (Chapter 6) and the *demonstration phase* (Chapter 7). Due to the evaluation context, it was not possible to conduct a comprehensive, sensitive and time consuming evaluation. Due to the constraints an *ex post summative evaluation* could not be considered (Sect. 8.1). Two selected practice partners (*purposive sampling*) were willing to conduct the evaluation by participating in the interviews. (see evaluation context of Section 8.1). In addition to the interviews, both evaluation partners had two months to complete a questionnaire, which mainly queried concept- and quality-related requirements. The reason for querying only these requirements is that our local practice partner are not solution-process oriented, but desire an artifact, which can be practically used considering e.g. usability, maintainability and appropriated procedures [21]. Thus, the evaluation of 32 requirements and 28 change requests was carried out on the basis of questionnaires and interviews, which are usually used for *formative ex ante* evaluation.

The interview was conducted on the basis of a guide, which considered all requirements and change requests, and the fulfillment of which were worked out on the basis of a *qualitative content-analysis*. The results of the *quantitative analysis* of the questionnaires gave evidence on requirements and change requests, which was given special emphasis in the interview. The fact that the *exploratory and purposive samples* is very small and does not allow any conclusions regarding a population, the risk of false positive cannot be excluded as there are only two opinions, which were taken into account. Thus, a final conclusion about the fulfillment of requirements represents a constraint to the evaluation, because a multiple perspective evaluation in terms of a *summative ex ante evaluation* was not possible to perform and cannot be taken as an indicator of the fulfillment of requirements with regard to the global practice.

However, according to [152, p.85] "*A design artifact is complete and effective when it satisfies the requirements and constraints of the problem it was meant to solve*". In this context it can be claimed with reference to the previously surveyed LP partners that the proposed CMG can solve different situational

LP problems. Thus, it was shown as part of the evaluation that at least the transferability of the developed artifact is available to a certain amount of different LP situations.

Research Contributions ($\mu_{DSR}4$): As outlined in Section 1.4 the artifact and its development provided clear and verifiable contributions to the knowledge base. Hevner et al. [152,p. 87] specify that "*the artefact must enable the solution of heretofore unsolved problems. It may extend the knowledge base (...) or apply existing knowledge in new and innovative ways*".

Based on [152] and the developed artifact, the content contribution of CMG to knowledge base is summarized as *contribution type*. A *contribution type* is determined by the form of which the produced artifact extends the knowledge base. [107] differentiate on the basis of the DSR knowledge contribution framework providing the following four types: *Improvement, Invention, Routine Design and Exaptation*, which are shown in Figure 9.2.

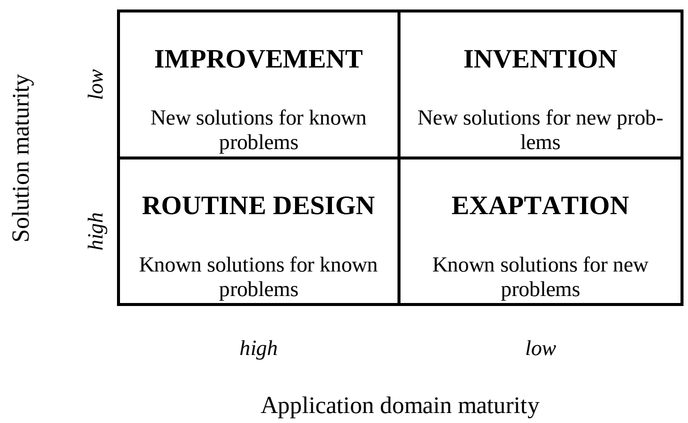

Figure 9.2 DSR knowledge contribution framework, according to [21,107].

In this context, the artifact contribution type of CMG can be specified as *improvement*, because the solution is a new one to an existing problem. The existing problem is specified to the extent that the artifact was developed for a problem within an existing application context, but no or only a sub-optimal solution exists [107]. Here, the local practice analysis was the starting point to motivate the need within the application context (capability research) for a solution of *(P_G),* which was confirmed by the knowledge base analysis and the nonexistent solution. It was concluded that there is an application context, but no solution *(P_G)* and the contribution of CMG as prescriptive knowledge in terms of an improvement can be summarized within the capability research context.

Therefore, two substantial publications types are distinguished: *Published work of the thesis* describes all publications that represent research results, which are directly connected with the artifact and its development. The CMG describes a novel, unsolved and practically motivated method which was accepted by different peer-reviewed book chapters and conference publications. *Related* work for the CMG development involves contributions that are not directly applicable to the artifact, but important for getting a deeper understanding of the problem environment and a multidisciplinary research problem. They represent smaller research results and experiences performing individual research process phases.

Research Rigor ($\mu_{DSR}5$): The rigor of an investigation relates to the research process and methods used to develop the artifact. Thus, the rigor of the research process relates to the chosen design science research methodology (DSRM) by Peffers et al. [26], because its process represents an aggregation of a variety of possibilities for DSR conform research processes (Sect. 2.2.1) and provides a *problem-focused* process initiation as well. To design a stringent research process, a series of constructions principles *($\mu 1$-$\mu 23$)* for each process step were defined and summarized at the end the respective step.

The selected methods for data collection and data analysis are suitable techniques for DSR projects recommended by [21]. Based on the theoretical foundations (Sect. 2.2.2, Sect.2.2.3) the application of each method in terms of preparation, execution and results are individually outlined under consideration of its contextual environments to provide an adequate transparency. For data gathering all in all 8 systematic literature reviews, 6 expert interviews and 6 questionnaires were conducted and spreaded on different phases of the research process (Figure 2.4). Quantitative- and qualitative analysis techniques are used on basis of the delivered explorative samples.

Rigor of a research process also includes the estimation of changes in the artifact environment [152,57], which are classified in Section 8.4. The artifact affects the structure and / or the behavior of every single element in an enterprise (EAM Capability) and of individuals (e.g. decision maker in an enterprise) as well as working groups and the whole organization in terms of e.g. change projects, strategy development and implementation), whereas, industry and society are not affected by the artifact.

Finally, this section reflects rigor in terms of the discussion about the whole investigation and the compliance with several guidelines and principles as well as describing compromises.

Design as a Search Process ($\mu_{DSR}6$): The CMG can be conceived as the result of an extensive search process following coordinated problem investigation, requirement definition, development, demonstration and evaluation activities. The term "coordinated" refers to search results and interpretation of each phase, which represent the input for subsequent activities. For the problem investigation an exploration of within the field of capability research were conducted by 8 different SLAs and a root cause analysis. The research was motivated by three practical use cases (Sect. 4.2). In order to find a solution for *(P_G),* requirements within the local practices were sought, which also address *(P_G)*. During the *development phase* the overall problem *(P_G)* was decomposed in sub-problems (Sect. 6.1). With regard to the method engineering components (*perspective, framework, co-operations forms, method components*) for each sub-problem solutions were sought, which have been developed under consideration both the knowledge base and/or practice.

Communication of Research ($\mu_{DSR}7$): This aspect is part of the defined research process and was continuously taken into account throughout the whole investigation. Therefore, intermediate results were repeatedly communicated to the research community or discussed and demonstrated in practical applications *(μ_{DSR4})*. Thus, results were reviewed with the help of peer-reviewed publication and discussed with the research community, which was used to improve the artifacts. The communication to the practice partners occurred by the provision of scientific publications, which was made available in addition to the respective guideline version, as well as through the provision of additional materials such as presentations and technical reports. Within the acquisition of practice partners, especially for the problem investigation phase, demonstration and evaluation phase, it was assured to provide the results of this work as an incentive.

To substantiate the mentioned guidelines and research strategy selection [96] provides a checklist to evaluate DSR conformity of a research investigation. Table 9.1 presents those set of questions (Ω1-Ω7) and answers to each question as well as chapter(s) providing corresponding argumentation and description of the answer.

Table 9.1 DSR checklist for ensuring validity, relevance, and rigor of methodological efforts [96, p.20].

Questions	**Answer**	**Chapter/ Section**
Ω ***1.*** *What is the research question?*	How can the management of EAM capabilities be methodically supported?	Sect. 1.2
Ω ***2.*** *What is the artifact? How is the artifact represented?*	By answering the central *RQ* and providing a solution for *(P_G)* a method is established that supports enterprises in identifying, structuring, engineering and maintaining its EAM capabilities. The answer to *RQ1* delivers an empirical and knowledge based grounded capability approach. Significant method components from theory and practice and formal method engineering re-	Sect. 5.1

	quirements are used to answer *RQ2*. The artifact is called Capability Management Guide (CMG) which is demonstrated to and evaluated by practitioners and is available in version 3.0.	
Ω 3. *What design processes will be used to build the artifact?*	The process follows the *Design Science Framework Methodology* according to Peffers et al. [26], starting from a problem centered initiation	Sect.2.2.1
Ω 4. *How are the artifact and the design processes grounded by the knowledge base? What, if any, theories support the artifact design and the design process?*	The *design & development* process is based on a multi-methodological analysis of capability approaches (including definition & frameworks) in theory and practice, requirements & guidance of method engineering literature. Identified theories, that support the artifact design and its process will be compiled and integrated as needed.	Sect. 4.3, Sect. 6.2, Sect. 6.3, Sect. 7.2.4
Ω 5. *What evaluations are performed during the internal design cycles? What design improvements are identified during each design cycle?*	During the *design and development phase*, feedbacks from the research community as well as practitioners were considered for the development artifact. During the *demonstration phase* improvements were documented as change requests and implemented as adjustments. These change requests (CRn) were already assessed together with the defined requirements (R_{xy}) in the *evaluation phase*. Both existing CRs were extended as well as the fulfillment of CRs and requirements were confirmed.	Chapter 6, Chapter 7, Chapter 8
Ω 6. *How is the artifact introduced to the application environment and how is it field-tested? What metrics are used to demonstrate artifact utility and improvement over previous artifact?*	The artifact was provided to four LPs for different application scenarios. It was tested with two LP partners during the *demonstration- and evaluation phase*. For this purpose a number of different data collection methods and analysis techniques were used such as questionnaires, semi-structured interviews, systematic literature reviews, quantitative data analysis and qualitative content analysis. The defined requirements and change requests always served as design basis for the testing. The adjustments to the respective test version always led to a new CMG.	Chapter 7, Chapter 8
Ω 7. *What new knowledge is added to the knowledge base and in what form (e.g. peer reviewed literature, meta-artifacts, new theory, new method)?*	In this work a number of different contributions to the knowledge base were produced. Besides a number of peer-reviewed conference papers, these are the publications of the predecessor versions of the CMG method: *CMG v1.0 [87], CMG v2.0 [300], Exploring the Nature of Capability Research [400], Elements and Characteristics of Enterprise Architecture Capabilities [85].*We published three book chapters, six conference papers and one technical report that directly went into this thesis. Moreover, two books, nine conference papers and two technical reports are related work for this thesis.	Sect. 1.3.1, Sect. 1.4
Ω 8. *Has the research question been satisfactorily addressed?*	Basically, this question can be answered positively, because it was possible to develop a method which supports identifying, structuring, designing and maintaining EAM capabilities, based on an integrated enterprise capability approach. However, several limitations are present because the CMG was not carried out as a separate project within the evaluation, but rather tested as support for ongoing projects. Nevertheless, all LP partners confirmed the used concepts and the practicability of CMGs. This fact answers the *RQ* indirectly.	Chapter 8

This section has reflected the research process and the produced artifact against the DSR guidelines of [152]. Finally, we come to the conclusion that this investigation is found to meet the required DSR criteria by justifying a set of guidelines and control questions. Table 9.1 represents a summary.

Table 9.2 Summary DSR classification

Classification Area	Commitment
Problem class & type	Wicked problem / type 1
Research philosophy	Theory of scientific knowledge
Research discipline	Information Systems
Research Paradigm	Design Science Research
Paradigm Classification	Design Research
Research Artifact	Method
Artifact Contribution Type	Improvement

9.2.2 THREATS TO VALIDITY

The construction principles and guidelines found in the investigation are manifold in order to contribute to scientific rigor, in particular, for a mixed-method approach using *quantitative- and qualitative techniques* for analysis and interpretations [58]. It is important to mention that weaknesses of a method are compensated by strengths of another method to produce valid results [399]. In this context an early identification of *threats to validity* and actions to mitigate the threats can minimize the effect on findings [135]. Common threats to the used methods were already discussed at the end of the respective section (Sect. 4.3.3, Sect. 6.2.4, Sect. 7.2.2, Sect. 8.3). Hereinafter, these threats should be observed from a higher-level, holistic view of the whole research process. This may include that threats to validity are divided into the following categories: *construct validity, internal validity, external validity,* and *conclusion validity*.

With respect to *construct validity,* the results of this investigation are highly dependent on the people being questioned and interviewed. Only persons with EAM experience and interest in capability management are able to review the suitability of the proposed CMG. To obtain a high quality of the exploratory sample, only experts having worked in this area for a long time and hence provide very specific and valuable knowledge were selected. In particular, conducting interviews implies a number of risks influencing the interview results (Sect. 2.2.2.1), which should be considered when interpreting the results. These risks were considered at the end of each interview, prior to its evaluation (Sect.7.2.2, Sect. 8.3.2). Since the involved local practice partners cooperated with the research group for some time and also participated in scientific studies many times, these effects were classified as insignificant (*reactive bias*). Furthermore, there is a risk that the questions of the questionnaire and within the interview could be misunderstood or the data may be misinterpreted (*linguistic/ cultural bias*). In order to minimize this risk, questionnaire and interview guidelines were double-checked and pretested by another researcher (correct interview data). The questionnaire is electronically documented and stored. The interviews were recorded, transcribed and electronically documented and stored as well. To ensure the construct validity, relations between identified descriptive elements of a capability resulting from the knowledge base analyses of Section 4.3 were examined. Therefore, 961 interrelations were analyzed, which lead us to a weighted relationship model [190,300], which was the basis for the integrated capability approach.

The *internal validity* should ensure that the conclusions in this work also appropriately reflect what we were investigating. A common risk is that the data collected in the interviews did not completely capture the view of the experts regarding the usage of the CMG (*ability to make inferences*). This threat has been especially reduced for the evaluation by a two-step approach. In this context, the questionnaire was firstly designed that the most prioritized requirements and change requests (Table 8.3) were sent out to the participants in advance of the interview and collected again. These responses were evaluated and prepared for an intensification of the interview. In the second step, the questions about the prioritized requirements were divided into in sub-questions and to some extent into control questions to query different perspectives of the CMG (Appendix E). The combination of the described approach virtually allowed gaining first impressions how the experts assessed the CMG and the interview questions were designed to query this aspect more intense. By executing a stringent research process considering the 23 principles related to the individual process steps, a distortion caused by rushed decisions and interpretations should be minimized. To gain access to privileged knowledge regarding the CMG use, exploratory experts were selected for the interviews. Due to the pre-selection of samples, a *selection bias* cannot be excluded. However, the potential privileged knowledge was of utmost importance for the CMG development and the risk of a selection bias was acceptable. It cannot be excluded that the researchers behavior has unconsciously influenced the answers to the questions (*experimenter bias*). This fact has been reduced by the interview guidelines, but a certain influence by the researcher cannot be fully excluded. Within our conducted interviews the corresponding respondents (demonstration, evaluation phase) were aware of additional respondents, but it can be assumed that this knowledge did not cause any noticeable different behavior (*compensatory rivalry*).

A potential threat of the demonstration and evaluation conclusions regarding the *external validity* is the actual sample for questionnaires and interviews comprising only four experts. Moreover, due to the evaluation context (Sect. 8.1), the stringent *ex post summative evaluation* could not be conducted. Thus, conclusions on the generality of the artifact can only validly be made to the extent that the CMG is applicable for various local practice situations. Nevertheless, there was an attempt to reduce this threat by a specific selection of participants. In addition to that, it was ensured that the samples always included participants of the specified user groups. Nevertheless, it will be part of the future work to conduct evaluations with more participants.

With respect to *conclusion validity*, interpretation of data is most critical. In order to minimize this threat, the evaluation design included capturing the relevant states of requirements and change requests by questionnaires and interview questions. The avoidance of incorrect conclusions was ensured considering the following issues: (1) concluding that there is no connection between the statements of the respondents and the CMG, when in fact there is one i.e. a change request or a conceptual change of requirement or an additional was overlooked; (2) concluding that there is a connection between the statements of the respondents and the CMG, when in fact there is no one i.e. change requests were identified, which are not relevant for the requirement compliance. Both risks highly correlate with the interpretation of the data by the researcher and cannot be traced appropriately. For restricting this risk, the aforementioned qualitative content-analysis by Mayring [210] was used, which contains a structured and iterative review process of qualitative data.

Beside the classic threats to validity consideration, we examine the threats to the quality of mixed method research, according to [58,399]. In this context, the following aspects are considered:

- *Sample integration:* The fact that meta-inferences may arise by pulling together interference of the questionnaire and interview evaluation was deliberately considered and presents no risk, because of the small sample no generalization to a population was made. Instead single inferences of the quantitative- and qualitative analysis were used to get deeper insights into the opinions of the experts, which should also be achieved by interviewing exactly the same individual. Therefore, no miss-match arose between the used explorative samples in the evaluation (Sect. 8.3.1.1, Sect. 8.3.2.2).
- *Inside-outside:* During data acquisition, analysis and interpretation a distant relationship to the acquired data and interpretations (insider's view and the observer's views) was ensured. The insider's view was supported by peer-reviewed publications within the demonstration phase [241,242,243]. Within the evaluation phase a pretest of the data collection was carried out, but the evaluation was not tested by another participant of the research group. The observer's view was also only justified for the demonstration phase within the peer-reviewed publications, but this is not applicable to the evaluation phase.
- *Weakness minimization:* In order to identify weaknesses of the limited samples of interviews and to prevent threats to conclusion validity, an additional practice-oriented document analysis was performed as part of the demonstration phase (Sect. 7.2.4) and an additional questionnaire was conducted as part of the evaluation.
- *Sequential:* It cannot be excluded that results would differ slightly when the sequence of questionnaire and interview would have been reversed. This could be verified by a multiple wave design of the questionnaire and the interview, but it was not possible due to the small sample. Nevertheless, this risk is considered as insignificant for the results.
- *Conversion:* Common pitfalls within the questionnaire analysis as verbal counting and over counting can be excluded. Over-generalizations cannot be completely excluded, but in order to minimize this risk it was indicated within the evaluation that the results merely provide evidence of the fulfillment of requirements and change request and are retested in the interview. Only if there are no discrepancies between the answers, it was concluded.

- *Paradigmatic mixing:* In order to minimize this risk of competing dualisms of paradigmatic assumptions, we have made our paradigmatic assumptions explicit (Sect. 2.1) and conduct our investigation according to the stated assumptions (Sect. 2.2.1).
- *Commensurability*: The risk of missing cognitive and empathy skills and a possible inability to switch perspectives, can be considered as low by appropriate trainings of the respective researcher (e.g. attending the university in-house training: 2 days of conflict management, 2 days of communication for managers).
- *Multiple validities*: The threats of the individual studies were described at the end of each evaluation and as part of *classic threats to validity*.
- *Political*: This risk can be considered as insignificant for the *evaluation phase*, since no different researcher was responsible for data collection, evaluation and interpretation. Within the *demonstration phase* differences in perspectives about contradictions and paradoxes arising from e.g. analysis and interpretation of the data cannot be excluded as a total of four individuals were involved. This risk has been mitigated to the extent that the individual results of the data collection, analysis and interpretation were subject to peer review [241,242,243].

In summary, actions have been taken to mitigate the risks identified, which from our perspective results in an appropriate confidence level regarding *construct and internal validity*. In order to increase the confidence level regarding *external validity and conclusion validity*, future work has to conduct a *summative ex post evaluation* using appropriate methods (e.g. action research, case study) and *representative samples*. Thus, the primary limitation of this research relates to the lack of empirical evaluation of the CMG. Ideally, the CMG has to be tested as a project to develop an EAM capability catalog of various local practice partners. Previously, the local practice partners were selected based on personal and business contacts. To acquire a representative group of local practice partner a more thorough list of enterprises has to be created by a *random sample*. This group of partners should consist of both *advanced-capability user* and *newcomer*, irrespective of the enterprise size. The implementation of the projects should be accompanied and evaluated by appropriate methods (as discussed in previous paragraphs).

As part of quality considerations of the mixed-method approaches threats to *sample integration, weakness minimization, paradigmatic mixing, commensurability* and *political* can be considered as reasonable. If a mixed method approach is used in the *summative ex post evaluation*, it should be concentrated on a corresponding inside-outside legitimation and checked by considering a multiple wave design (*sequential*). The risk of over-generalizations can be reduced by a representative sample (*conversion*).

9.3 OUTLOOK

After the research objective *(RG)* and the related research question *(RQ)* are met and answered positively and the identified research gap could be closed, at this point possible future work in terms of: (1) future artifact related developments and (2) future capability research work will be discussed.

(1) The following aspects summarize possibilities for future work related to the CMG:

- *More use cases:* As mentioned in the reflection section, the CMG must be tested as project to develop an EAM capability catalog of various local practice partners. The development of the CMG and the previously achieved methodological experiences regarding the application of the CMG lowers risk and efforts for future collaborations with local practice partners. In view of the above, new practice partners from different enterprise sizes and different sectors, with or without knowledge of CMG implementation, should be motivated. Especially the CMG pitch deck and the express entry possibility should convince potential partners more rapidly.
- *Range of languages:* So far, the CMG is only available in English, which does not affect the cooperation with enterprises in English speaking regions. However, due to language barriers the willingness to cooperate can be quite adversely affected on a national level. In this context, an

appropriate version would be advisable for the German speaking region. Since we assume that this could particularly increase the acceptance by SME.

- *Software support:* The current 4EM.Desk prototype is available in version 2.7a, which is optimized for modeling 4EM sub-models and for modeling EAM capabilities. The mapping of descriptive elements of a capability via sub-model links and dependencies between capabilities among each other can be displayed. However, there is a lack of auditing, observer, evaluation and monitoring functions, which should help displaying indicators and / or further additional information to track and evaluate its development. These functions and a selection of visualization forms for various stakeholders belong to the future development plans. In addition to that, standard roles with appropriate standard views (z.B.Viewer, EAM Capability Owner, CIO) and preconfigured functions should facilitate the express entry to the Capability Catalog for different stakeholders.

(2) The following aspects summarize possibilities for future research related to capability management:

- *Capability-based business- IT integration:* Automatic adaptability of business models based on analytics of large amounts of data gathered by sensors within physical and virtual enterprise environments represents just one example that could involve new challenges or at least adds complexity to existing one. It is becoming more important that the capability-supported architecture adjustments are capable to perform quickly and effectively in the future. The knowledge and opinion regarding the own EAM capabilities remains an important success factor. But not only the knowledge of EAM capabilities contributes to business success, but also its interaction with other capability types. The previous considerations in literature focused on the position to regard business and IT as two poles, which must be conveyed between by means of EAM. If agility and interoperability of business shall increase in the future and the speed of architectural changes further increases, an alignment approach between the poles is no longer sufficient. Thus, this approach needs to be reconsidered, which will ultimately result to an integration of business and IT in our opinion.
  Against this background and in addition to the development of the CMG, including its current restrictions on EAM capabilities, a generalization of additional capability types such as business and IT can be considered. Thus, a starting point for future work is the design and evaluation of CMG regarding further capability types, which, inter alia, can judge the integration and the overlap-free collaboration between business and IT.

- *Capability-based startup/enterprise engineering:* The increasing digitalization is described in literature as challenge and a driving factor for fast changing market conditions, short technology lifecycles etc. Furthermore, capabilities were focused on handling these challenges for enterprises. However, these challenges are also opportunities for existing and new enterprises. Capability-based startup / enterprise engineering could help enterprises to establish capabilities and focus the capability-based enterprise structure. Starting with a business idea and during the founding period, it is important to evaluate the required capabilities with regard to the respective business idea. These capabilities can be structured and evaluated with the help of the CMG and, based on the descriptive elements, the organizational structure can be defined in more detail in terms of processes, roles, information and further resources as enterprise architecture. The focus areas can thereby also be structured more precisely next to Business, IT and EAM e.g. investor acquisition, crowdfunding, social media management. A continuous integration of capabilities from concept level up to the physical enterprise level can provide agility as soon as the business model changes within the startup phase. For example, an investor wants to customize or replace product, service components such as functions, or to change the implementation plan or the reduction of time-to-market. A capability-based enterprise can immediately speak with investors about potential impacts of the change due to the identification of high-level capabilities. Furthermore, the internal adjustments necessary can be identified immediately as well due to the capability-based architecture. In this connection, the CMG can be used as a management tool for various capabilities and for the development of enterprises.

- *Sport Management:* Besides the described enterprise capabilities, the approaches described in this work could be also used as a target-based management tool in sport management. The sport management is the goal-oriented planning, change and control of sports organizations (clubs, associations, enterprises), individuals (professional athletes) or related services. According to [394], sport management identifies the targeted design in sport, the management of sports organizations. Thus, it is conceivable to use the CMG also for the control of e.g. associations, sport teams or athletes. With regard to the Usain Bolt example in the introduction of this work, this would mean by starting to assess the athlete's objectives, what activities / processes (training) and any related helper (trainers, physiotherapists, marketers) are required, and what financial resources or technical devices must be applied to achieve the athlete's goals. The prerequisite is that the athlete and his team have sufficient information about the current competitions and the implementation of activities. If a particular goal is achieved, the sport management has to ensure whether and at what quality these capabilities continue to be used or to be connected to existing, in order to achieve new goals. In addition, the CMG can be used as a target-oriented and capability-based management tool.

Finally, we believe that the CMG and the associated structured design also may be transferable to different use cases in a modified form and it has to be decided depending on the case, which of the presented concepts could be used.

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APPENDIX A: CMG V3.0 HANDBOOK

A1: FINAL VERSION OF THE CAPABILITY MANAGEMENT GUIDE

Matthias Wißotzki

CAPABILITY MANAGEMENT GUIDE

ABSTRACT

Digitalization, shorter product cycles, oversupply of markets and the increasing customer requirements both determine and affect the movement from an industrial to an information society. As a result companies are faced with new challenges to keep their market position, transparency and efficiency.

Enterprises overcome these challenges by implementing strategies. In order to implement strategies successfully and achieve desired goals enterprises should have certain capabilities. Thus, the demand for a methodical capability management approach is growing.

This guide provides a process for identifying, structuring, and maintaining enterprise architecture management capabilities.

The introduced method is based on an integrated capability approach that results from a number of scientific investigations and practical experiences from industry cooperations. Comprised of four building blocks, the capability management guide represents a flexible "engineering" approach for capability catalog developers, designers and evaluators

Contents

Version 3.0
May 2016

Universität Rostock Traditio et Innovatio

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1 Preface

Due to the global digitalization, fast shifting business models and short technology lifecycles, modern enterprises need a strategy how to deal with those unpredictable changes in order to stay competitive. The concept of capability driven management concepts like capability-based planning or investment is getting more and more attention by executives and scientists. Information Systems (IS) and management journals as well as conferences have been publishing an increasing number of capability related articles in the last decade. A common understanding corresponding to the identification of capabilities, their management, types or elements has not emerged yet. This guide encapsulates the body of capability research & practices to provide a process that supports capability management activities.

Origin

The underlying process guide is supposed to support the identification, structuring and management of an enterprise's capabilities. The process was developed as part of a Ph.D. research project at the University of Rostock, Germany and is currently available in version 3.0. The two previous versions were developed based on different projects with industry and steadily improved and adapted over the years. For more information please visit www.wirtschaftsinformatik-rostock.de.

Document Structure

The handbook is structured as following:

Chapter 2 – Motivation: The briefly outlined challenges are explained to stress the importance of the topic.

Chapter 3 – CMG Overview: The method is visualized as level map, highlighting the specific main aims and benefits within each step.

Chapter 4 - Foundation: Important concepts for a common understanding are presented, followed by an overview of the underlying process & role model. Now, the audience is prepared for the last section the "How to use", which presents the reading recommendations of the manual.

Chapter 5 to 8 – Capability Management Guide: The four building blocks of the CMG are explained in detail within single chapters. Every building block is separated into enumerated, following working steps and their aligned objectives, roles, possibilities for documentation and visualization, as well the used definitions. Examples stress the recommendations.

Chapter 9 – Conclusion: The chapters 5 to 8 are summarized and assessed in overall terms.

Chapter 10 – Glossary: Named approaches and methods are shortly explained. Further literature is required if interested in details.

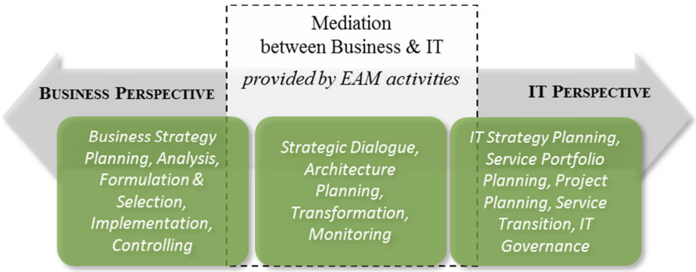
Chapter 11 – References: The used literature sources of the founders as well as practice-oriented papers are referenced for further studies.

Target Group

The guide is developed for all interested parties, independent of the enterprise size, branch or market. It includes working steps and specific recommended tools to visualize and notate these ones. Hence, it is adoptable to different capability related circumstances.

Generally this work is addressed to all organizational departments and parties interesting in the capability topic itself, business and IT alignment issues or managing challenges of strategic transformations. In our experience, these are primary Enterprise Architects or other responsible persons of the Enterprise Architecture Management and IT Management disciplines dealing with the topic. Due to the application of capabilities as communication and planning instrument (mediating role), the manual is suitable for both parties.

The graphic below illustrate the role of EAM in its mediator role between business and IT perspective.



Newcomers to Capability Management

Newcomers need to understand what Capability Management is for & its limit is. Problem definition & scoping, capability development as well as structuring & governance are important topics in order to use the full potential of capability based approaches. In this case we recommend following the whole process *BB1* to *BB4*.

Advanced Capability User

Advanced user can use the guide in different ways, depending on the situation of use. Therefore, the guide can be used as reference work for reading up on subjects of interest for the advanced capability user. Capability gathering approaches, structuring methods, type differentiation, helpful capability frameworks & maturity models are subjects covered in *BB2* to *BB4*. Each BB can be used independently of the other, provided that the background knowledge is sufficient.

2 Motivation

What are the benefits?

Dynamic markets, ever-shrinking product cycles and a persistent need for innovation are just a few challenges faced by companies looking for long-term success and corresponding strategies.

What does that mean? Companies need to know themselves. Only then a long-term, economically efficient and structurally effective existence is possible.

The pure identification of structural enterprise components is quickly done in most cases. Even the differentiation of those components into departments is possible. And then? Our research offers a close relationship between strategic choices (e.g. strategic initiatives & projects) and the capabilities needed for successful implementation.

It is crucial to evaluate which capabilities are currently available and which capabilities are required in the future, when for example:

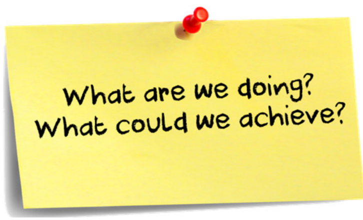
- New business models, products or services are introduced,
- Collaborations or mergers & acquisitions are planned or received,
- New technologies or applications have to be integrated.

We understand capabilities as expressions describing the totality of factors like roles, resources, processes and information required by a company to enable the achievement of business strategies. This approach is necessary to refine existing capabilities in particular models and/or to be able to merge them with existing architectures.

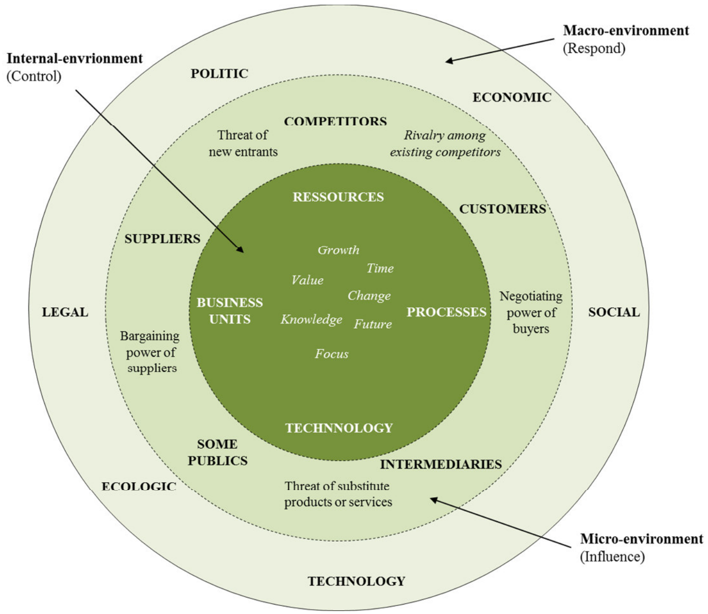
If we look at a company as a whole, there is a sum of considered components (processes, roles, departments, resources, equipment and locations). As a result of their interaction, it is often difficult to decide what you are able to do. For instance, if a single, required component, which is needed to produce something, is missing, the whole product is not produced in the agreed quality.

A rapid and precise identification of capabilities is the basis for adequate, company-specific measures and development directions. Decisions regarding outsourcing and insourcing, market positioning, corporate culture, innovation opportunities, etc. can be better established.

Thus abilities can answer the following question:



All in all, the capability management guide needs to cope with several internal and external, market-depending and global, business and IT factors.



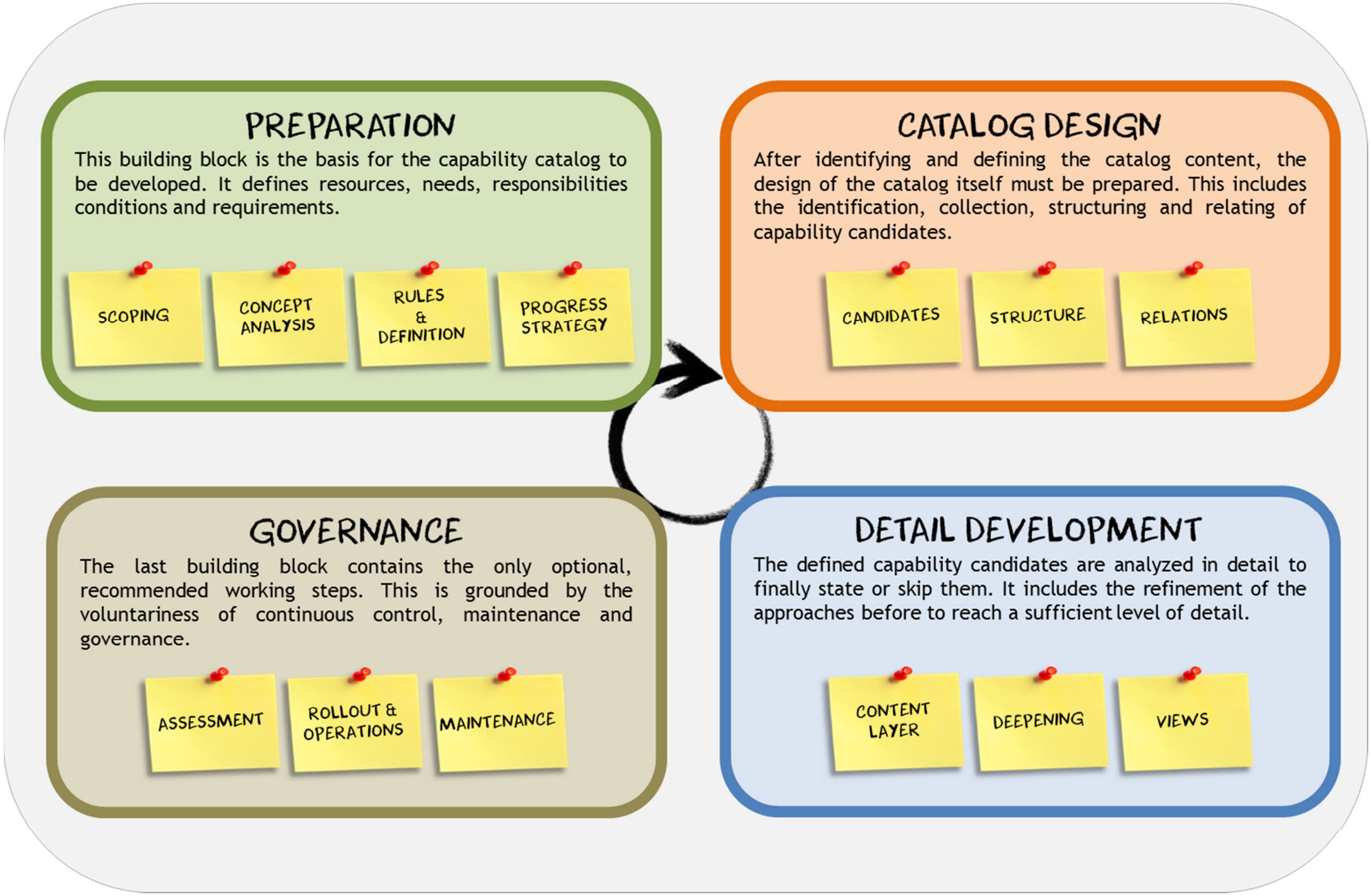
Therefore, the objectives are focused on the following requirements:

- Scoping and preconditions for capability management
- Identification of involved stakeholders
- Identification of capability types and their relations
- Structuring of capabilities and their models as a catalog
- Governance of the resulting capability catalog

Consequently, the introduced guiding process should help to systematically derive capabilities, gathered and maintained in a repository - called capability catalog. The process is developed for all interested parties, independent of the enterprise size, branch or market. It includes working steps and specific recommended tools to visualize and notate these ones. Hence, it is adoptable to different circumstances. Generally it is addressed to all organizational departments and workers interesting in the topic itself, strategic alignment or even managing the challenges enterprises are faced to in the present days.

3 CMG - Overview

The guide consists of four Building Blocks, which are illustrated by a level map. Every Building Block consists of several working steps. These are shortly summarized by the following aims:



4 Foundations

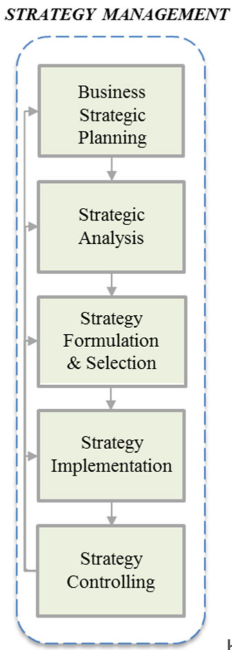
In this chapter, firstly, the used and assumed understanding of terms is defined. Afterwards the process- & role model of the CMG is visualized and shortly explained. The description of the appropriate usage of this guide follows at the end.

What terms are important? What is the process model about? How to use the aligned manual?

4.1 STRATEGY MANAGEMENT

In general, *strategies* could be understood as impulses for actions to be taken to reach a certain goal. The term “strategy” originally comes from the military field and represents an adjustable construct used to convert an actual state into a target state. Moreover, the own market positioning in comparison to that of competitors needs to be identified and either maintained or improved in consideration of market conditions, stakeholders, and available/required resources.

Strategy management comprises all activities that guide and control the realization of strategies.



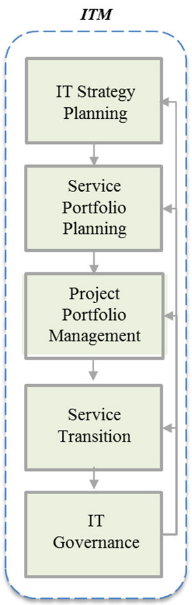
According to Fischer (2008), we follow five fundamental management steps (see figure) when it comes to the realization of business strategies to achieve defined goals. Enterprises are able to achieve defined goals with the aid of long-term planned behavioral patterns. There are different approaches regarding the specific content of a corporate strategy (i.e., there is no universal consent in the literature).

However, modern approaches for strategy formation usually concentrate on the market positioning of products and services and enabling operationalization thereof inside a business model. The strategy formulation involves the creation of an action catalog for strategy implementation. In order to be effective, such an action catalog requires controlling techniques and a structured view of its capabilities though.

4.2 IT MANAGEMENT

The strategy management determines the schedule how strategic potentials for the success of an enterprise to be set up for putting it in a competitive position. The increasing digitization of the last decades, the relevance of IT has increased significantly and is now one of the most important conditions.

The goal of ITM is to ensure the feasibility of all processes and tasks that depend on IT Services and IT Infrastructure.

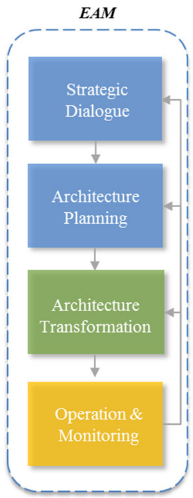


IT Services and its operation are essential for all processes in a company. ITM improves a set of enterprise-wide affecting aspects such as service standardization and quality, customer satisfaction and enhances the ROI of IT expenses. Therefore, IT in enterprises has a much higher strategic importance nowadays due to increasingly sales - related components of business models, i.e. digital products and services. In this context, the strategic focus has to be linked to the enterprise, which must be ensured by a corresponding process and suitable methods.

4.3 ENTERPRISE ARCHITECTURE MANAGEMENT

Elements from different enterprise departments and corresponding architecture levels are also affected inevitably by strategy implementations. This means that planning, analysis, formulation, implementation and monitoring of respective architectures should be involved in these processes. In this context, the literature often refers to business-IT alignment (BITA), whose key activities are caused by the theoretical and managerial separation between business and IT.

In this context, the fundamental challenge of BITA is due to the lack of overarching understanding and different rates of development for / of changes, which has particularly experienced much more attention by the increasing IT penetration in recent years, both by theorists and practitioners. Thus, BITA is a key task for enterprises that meet high dependency between business units and IT at strategic changes. The Enterprise Architecture Management has been developed as a proven solution for this key task in recent years. Achieving corporate goals by implementing strategies leads to transformations within business- and IT.



Enterprise Architecture Management is understood as a single management discipline. The main EAM functions are:

- strategic dialogue & planning,
- transforming and
- monitoring complex enterprise architecture implementation.

4.4 CAPABILITY MANAGEMENT

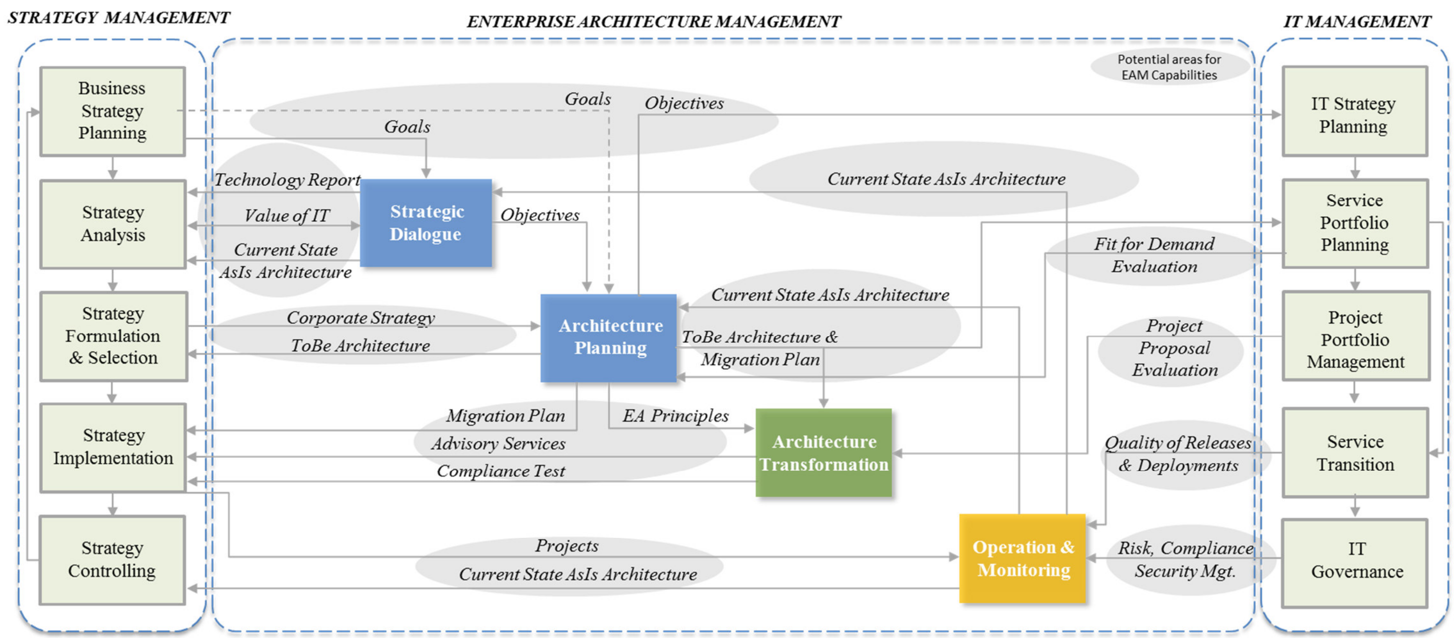
EAM requires to document states of the past, the present, as well as the possibility of how it could be in the future. From these states, plans are derived and transformations are triggered. The main challenge is to extrapolate which decisions are responsible for the present situation and which ones are the best to plan desired future situations. Obviously, these strategic plans should be aligned with the whole enterprises architecture.

EAM is aligns Strategic- and IT management activities.

In order to align both perspectives successfully upcoming (inter) dependencies and relationships should be known and discussed. If not, problems are emphasized by the fact that business critical projects fail in 2 out of 3 enterprises which is reduced to the circumstance that a lot of decision makers failure caused by conflicting interests, insufficient information quality or decisions taken elsewhere (Capgemini 2012).

Therefore, it is not only important to be aware of the existing challenges and problems, but also to continuously gather and asses information about organizational knowledge, corresponding responsibilities, available resources and processes required for the strategy implementation.

Exactly for this purpose we will use the capability concept,



The Role of Enterprise Architecture Management, according to (Fischer 2008, Stutz 2009) because capabilities could provide information for supporting the different management perspectives and could avoid mistakes before they arise. Each company is equipped with various capabilities that are specific to its organizations, but many of them are not aware of them.

For this purpose the guide is developed, because it identifies EAM capabilities required for an efficient operationalization of an enterprise strategy.

The figure summarized the three different management perspectives, its interrelations and spaces for EAM capabilities. These capabilities should be derived systematically through our process, gathered and controlled in a discipline called capability management.

In terms of its organizational value capabilities support:

- high-level representation of organizational activities
- strategic decisions like mergers & acquisition, out- and insourcing or budgeting
- transparency
- a common language between business and IT responsible
- identification of new competitive advantages
- the identification of organizational requirements for a successful strategy implementation
- scenario planning
- relating IT perspective to business value

4.5 PROCESS & ROLE MODEL

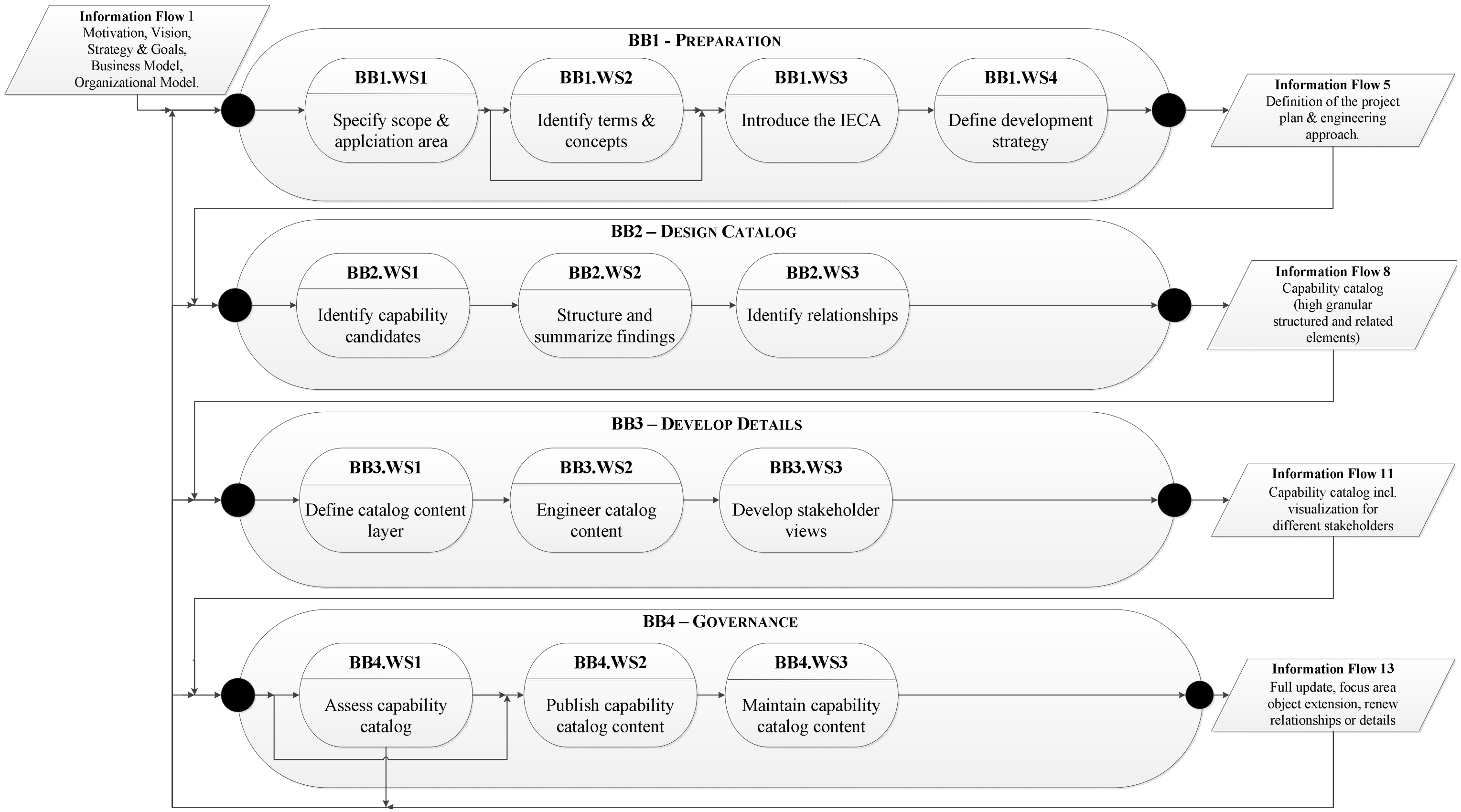
The initial Capability Management Guide (CMG) model v1.0 was developed by M. Wißotzki, University of Rostock, in 2014. The second version was enhanced by first user experiences. This section offers a process and role description of the CMG 3.0. The process is aligned to the 4 Enterprise Modeling Notation (4EM).

The process consists of four Building Blocks (BB´s) each focusing on distinct contents and having distinct outputs. In short, the first building block sets preparation conditions like problem, scope, and stakeholder definition. The second building block designs the capability catalog structure, whereas the third block develops the detailed capability content. The governance building block covers catalog evaluation and maintenance issues. Every Building Block consists of several working steps (WS). These are shortly summarized by the following central goals:

- *Identification of involved parties* and definition of terms and preconditions
- *Identification of capability types* and corresponding capabilities for operationalizing of strategic goals
- *Systematic derivation of capabilities*, gathered and maintained in a repository called capability catalog

CMG Process Overview *(small version)*

A comprehensive overview of the process model (incl. Roles and Concepts) is provided in the Appendix.



Role Model

This section defines those roles that describe how different actors interact and co-operate, when executing the different WS of the CMG.

Therefore, we used a responsibility assignment matrix that is based on following five RASCI activities: Responsible (R), Accountable (A), Supportive (S), Consulted (C), Informed (I). The table shows the RASCI matrix for CMG 3.0.

Working Step	PO	PL	EAM - CM	DE	Mo	MT	SW	StG	4EM	IDAE
BB1.WS1: *Scope & Application Area*	RA	I			R	S		I		
BB1.WS2: *Identification of terms and concepts*	AC	R	R	R	R	S		C		
BB1.WS3: *Description of the IECA*	AI	R	R	I	R	S		I		
BB1.WS4: *Definition of the development strategy*	ASI	R	R	I	R	S		R(A)		R
BB2.WS1: *Identification of Capability Candidates*		AS	R	S	R	S				
BB2.WS2: *Structuring and Summarization*		AS	R	R	R	S	(R)			
BB2.WS3: *Identification of Relationships*		AS	S	R	R	S	R		R	
BB3.WS1: *Definition of Content Layer*	C	ARS	R	C	R	S	I	C	I	
BB3.WS2: *Capability Content Engineering*	C	AS	S	R		S	R	C	RS	
BB3.WS3: *Development of Stakeholder Views*	CI	AR	R	RC		S		CI	S	S
BB4.WS1: *Assessment*	R	AR	S			S		R	S	
BB4.WS3: *Rollout*	I	AR	S	I		S		I	R	
BB4.WS4: *Maintenance*	I		AS	R				I	S	

Problem Owner (PO): The administration and the creation of an EAM capability catalog require resources which must be provided by e.g. the executive- or senior management. The problem owner (also sponsors) are convinced of the positive impact of the CMG output in order e.g. to cope with the aforementioned challenges regarding the perspective. Thus, the role of the problem owner includes being the initiator and the budget manager, who finances the implementation of the CMG (if not as single role, the problem owner could be a member of the stakeholder group).

Project Lead (PL): The project lead, also in large projects, is often represented by one person (deputy possible) who is responsible for project planning at BB level, the operational project management (incl. control of schedules, results and resource consumption of each WS) and reporting to the stakeholder group. In this regard, this role is responsible for providing any required documentation (minute taker), the selection and exemption of domain experts and the integration of the EAM capability management team. Thus, the project lead has a key role in the CMG.

EAM Capability Management Team (EAMCM) is composed of a defined, fixed over the course of the project, group of EAM Experts who know the current structures and processes in the company and can be extended, depending on the application, to additional domain experts. The main task is the technical integration of the results of different WS activities to support at the relating project level. In addition to the conceptual support of BB1 activities, the role is focused on BB2, BB3 and the associated active participation of capability design and engineering activities.

Domain Expert (DE): Domain experts (e.g. business and IT leader) have the necessary knowledge of the enterprise in question or domain and application context for capability design and engineering purposes. These subject matter experts have embedded knowledge about the enterprise environments, organizational structures, business model and processes, responsibilities, regulations or problems of the enterprise. This means that any member of staff, from an ordinary worker to executives and enterprise stakeholders, may be a potential domain expert. The competence of the experts is one of the most important aspects in the CMG.

Stakeholder Group (StG): The stakeholder group (possibly steering committee) typically includes members from different areas of the enterprise that are involved or at least interested in achieving the project goal. This may include the person in charge of departments, budget officer or employee representatives. In larger projects, the stakeholder group/ steering committee is the project's top-most decision-making body, to which the project lead reports. The stakeholder group finally decides on project plan (problem owner participation), obtains official acceptance of milestones and deliverables, decides about changes in project plans in case of new requirements and delays in project work, supports the acquisition of resources, and decides about resource allocation

Moderator (Mo) *or facilitator moderates* workshops or meetings and is responsible for target achievement und compliance of the methodological framework (e.g. WS goals). A workshop may have multiple moderators who take turns during the workshop and focus on different aspects. In particular larger projects could have several moderators in the same group of participants, but one of them must then be the assigned the leader to clarify who is accountable for results.

Minute taker **(MT)** capture meeting notes, decisions, results and tasks to be done during the moderated workshops or meetings. The documents are used afterwards to distribute decisions made or record the reasons for particular agreements between the participants.

Small workforce (SW): Smaller teams (small workforces) are formed and edit small packages of tasks, which are summarized together later. These small workforces usually consist of domain experts. Further roles may be involved, if it is necessary for the completion of tasks. Small workforces are usually temporary and may, but not need to, be dissolved after each WS again and re-formed as required.

4EM-method & tool expert (4EM): This role has expertise in modeling capabilities using the 4EM-method and the 4EM.Desk & Touch module. As 4EM method expert he has modeling experiences with the 4EM-method and knows the guidelines and principles in detail. As tool expert he can apply this knowledge for digitizing capabilities, which are developed in the framework of workshops. Thus, he supports the IOM cap team, small workforces, project lead and moderator with appropriate tool features (i.e. capability model, model visualizations, analytics, trainings). This support involves active listening competencies and putting forward supplementary questions regarding information or relationships between capabilities and possible 4EM sub-model components.

IDA-method expert (IDAE): This role has expertise in gathering the information demand within the CMG. Thus, the IDA method expert is able to determine the information needs of different roles systematically and prepare it for further processing within the CMG. For this reason the IDA method expert focuses on the approach of (Lundquist 2007), which supports the information demand methodologically.

4.6 HOW TO USE - READING RECOMMENDATIONS

The process model, described in section 4.5, is the basis for the guide. In alignment to the building blocks every activity, its focusing questions, variants of visualization as well as the need documentation techniques explained in detail.

4.6.1 Basis

These activities are the basis for using such a process model.

Building Block (BB) - The process consists of four building blocks summarizing activities belonging together. Each block contains several main tasks.

Working Step (WS) - Every building block consists of different workings steps that can be developed by answering helping questions.

4.6.2 Terminology

Capability – An enterprise capability represents the ability of an organization to join a set of *descriptive elements* i.e. knowledge and roles able to execute a specific activity with available resources in order to support strategy goals under consideration of its focus area. The focus area objects determine the capability type.

What do you need to know?

Capability Types - A wide range of capability types exists. Basically a distinction between business, EAM and IT focused capabilities is made. More capability variants exist, but are not further explained here due to defining and analyzing them as part of the process.

Descriptive Elements of a capability – They are named and characterized as:

1. *Resource:* This element aggregates all tangible/material and intangible/immaterial goods of an enterprise (e.g. financial, physical, human, technological, organizational resources) that are required in order to own a capability. Without the appropriate resources enterprises just theoretical own this capability. If an enterprise really requires a capability, it has to allocate sufficient resources.

2. *Goals:* As an enterprise represents a goal-oriented system, every capability should be assigned to a certain goal (e.g. business, IT, EAM) from a logical

perspective. It was thus examined whether a reference was made to the goal concept (e.g. competitive advantages, satisfying customer wishes, provide services).

3. *Focus Area Elements:* characterized the environment of an enterprise or an overarching subject and is an inherent part of the definition for the purpose of seizing a relationship to a desired *capability type*.

4. *Activity/Task/Process:* Amount of interdependent and linked activities which convert input into output. The input is defined by different resources like employees and time. A specific set of (potentially still unknown) successive tasks is needed to require a specific goal. Hence, a capability is associated to business processes that represent the sequence of structured activities in order to fulfill a certain task.

5. *Knowledge:* Even though knowledge might be classified as an immaterial resource, we consider it as a distinct concept here due to its multiple references. Hence, a capability is linked to an information concept that represents a requirement for owning this specific capability. If we identified information and its demand in a specific (enterprise) context, we classified a knowledge demand.

6. *Role:* A capability is assigned to a certain owner in term of roles or actors. An actor may represent a single person or an organizational unit that is defined by its roles and corresponding responsibilities, decision authorities, and financial capital.

Capability Catalog – It is a document or database enumerating the specified capabilities. Such a catalog is expected to be complete, systematic and including descriptive details. Hence, it varies in its extent, design and focus. Such a catalog is:

because it is easy and fast to create, understand and use.

because it is nearly constant by years and wide-ranged applicable.

because many clients have demonstrated unambiguous, repeatable and ongoing benefits using these tools.

… and a starting point for architecture planning, even though they are relatively simple to create, easy to understand and use.

Management – The main tasks, excluding the specific tools, methods and stakeholders, are: planning, structuring, governing, decision making and controlling of the enterprise. Obviously, the variety is big and depends on the focus. The sum of tasks reaches specific goals. Therefore management is a continuous task and depends on the organizational influences requiring plans and measures.

Capability Management – Due to both decreased complexity as well as increased transparency, integration and (inter)operationalization, the knowledge and maintenance of enterprise capabilities is needed. Therefore, the management discipline is focused on: scoping and planning, development as well as controlling. It aims to optimize the economical actions in order to current capabilities, enriched by strategic and operational decision-making by the development of future capabilities.

4.6.3 Conventions

Ellipsis *(…)* – Are indicators for continuation, such as an incomplete list of example items, or a continuation from preceding text.

Bold – Highlighting specific terms.

Italics – Used for references, e.g. sections, BB, WS or terms already defined.

Black Frames - Emphasizing notations that refer to often observed difficulties in practice and more attention should be given to.

4.6.4 Issues

To describe the working steps in an easy and comprehensive way in practice, there is a structural classification into main issues.

Procedures & Roles - Each building block has specific objectives and actions to reach. The objectives, activities and used concepts are explained as well as the required set of roles is described.

Indicative Questions - The mentioned questions just act as a spotter to create a capability catalog step by step. There is no guarantee for its completeness, even in order to promote accurate and generalized opportunities.

Documentation - There is a large variety of notation and visualization tools and models. Some (recommended by the majority) are explained to decrease the selection pool as well as the possible and resulting frustration. Moreover, several kinds of storage media like databases, database-supported media, wikis and glossaries are usable in all working steps. This is grounded in the need of visualization, transparency and reproducibility at each time. The important of a storage media is rated (in order) as low, average, high or very high.

Capability Catalog - Starting from *BB2* working step 2 the state of the art of the capability catalog is summarized to stress the differences of ongoing the process.

Useful Concepts - The several usable approaches within every working step are summarized as a list, ranging from mind maps and brainstorming towards complete frameworks. Italics indicate words as link to the glossary.

4.6.5 Spotters

Spotters are used as instrument to stress the most important issues. Two kinds are differentiated:

Key Questions - The green colored questions for each issue regarding a single working step are used to point out the main focus.

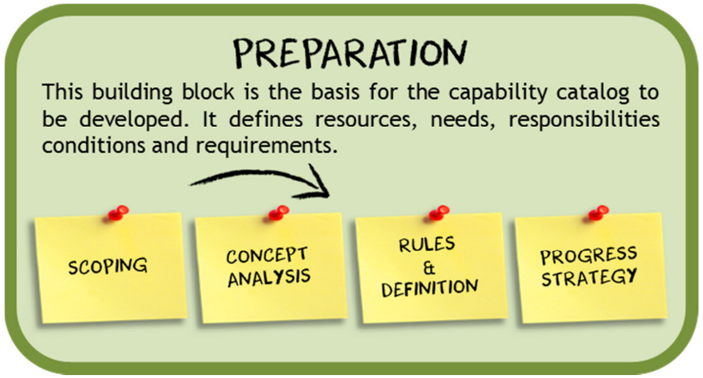
5 BB1 - PREPARATION

The first building block defines conditions for the capability catalog to be created. Hence, the following requirements should be handled:

- Problem definition and clear scoping of the application area
- Define developer and user groups of the capability catalog
- Negotiate terms and perspectives
- Define capability types and context objects
- Agree on a common development procedure
- Form the outer frame of the catalog

Within this Building Block it is critical to derive requirements regarding to the future capability catalog because of neglecting the current constraints.

As a result, the first building block is divided into the following four, visualized working steps:



5.1 *WORKING STEP 1:* SCOPE & APPLICATION AREA

In the first WS stakeholders and the focus of the required capability catalog are clarified. The involved parties have to agree on collaboration and communication principles, on the application area and on the goals of the capability catalog that is to be created.

PROCEDURE & ROLES

Problem Owner and the goal of the required capability model must be clarified within this WS. The Problem Owner should be part of the executive team or senior management level in order to provide the required budget and resources. He has to choose a *Project Lead* who carries out the catalog development project. Moreover, he agrees on the application area and the scope of the capability catalog that is to be created.

Problem Owners is accountable and responsible for the initiation of the capability catalog development project and defines its scope and first deliverables.

To summarize, the main question that has to be answered within this working step is:

For which purpose do we need capabilities?

Example - the detection of business weaknesses as well as IT alignment could be reasons for creating an EAM capability catalog. The objectives depend on the alignment motivation like profit-, strategic- or improve-oriented motivation.

Accordingly, several driving questions are relevant for scoping:

- ✓ *What is the purpose/ motivation for capability oriented thinking?*
- ✓ *Which goals & strategies need to be supported?*
- ✓ *What are the benefits for our organization?*
- ✓ *Which area of application requires a capability catalog?*
- ✓ *Are there any industry-specific capabilities that need to be considered?*
- ✓ *What is the proportion of profit about?*
- ✓ *What are the driver & constrains?*

Example - The following table illustrates an exemplary analysis of a capability catalog's application area with respect to a potential goal to improve the business-IT-alignment.

Goal	Improve our Business-IT-Alignment	*Challenge*: "IT is not able to deliver to the business strategy say 75 % of CFOs" (Gartner 2011)
Strategy	Development & maintenance of an architecture inventory	*Benefits*: Reliable architecture information, standardized communication, cross-company comparability of applications, reduced efforts for current landscape analysis & ad-hoc reporting, ability to identify redundancies & change impacts
Application Area	Enterprise Architecture Management	*Activities*: E.g. situation analysis, elaborate options, develop target state, roadmapping & migration planning, project portfolio planning, etc.

Nevertheless, capabilities affect the behavior of the whole enterprise. Consequently different *Stakeholders Groups* need to be involved by using its individual pick-up points in order to diminish this behavior and support the preparation of the capability catalog.

Which kind of stakeholders should be involved e.g. managers, architects or other kind of addressee?

A stakeholder analysis supports the identification of parties that are or at least should be involved, their interests, and corresponding pick-up points. Therefore, a short PitchDeck presentation provides an executive summary of the CMG in order to illustrate advantages and motivates potential participants. Moreover, the following questions need to be answered:

- ✓ *What kind of support do stakeholders expect from a capability catalog?*
- ✓ *Who will have which benefits?*
- ✓ *Who is responsible for development?*
- ✓ *Who has an influence on the capability catalog development project?*
- ✓ *Who provides the input and must be involved as a result?*
- ✓ *What are the expectations of involved persons/groups/stakeholders?*
- ✓ *What is the general attitude towards the project (positive, negative, or neutral)?*
- ✓ *How great is the influence of specific persons/groups (small, medium, high, or crucial)?*
- ✓ *Who initiated the project for what reasons?*

- ✓ *Who already is or needs to be informed about project goals/addressed problems?*
- ✓ *Who is essential to initiate the project and who will be affected by project outcomes?*
- ✓ *Will answers to these questions be documented in form of a project description and also approved in some sort of project contract?*
- ✓ *What is the general attitude of users and stakeholders towards the project?*
    - *Supporter, neutral, opponent*
    - *Interested / not interested*
    - *Engaged / not engaged*

Involved Roles to answer the questions: Problem Owner (AR), Project Lead (I), Moderator (R), Minute Taker (S), Stakeholder Group (I).

Besides the aforementioned activities of the Problem Owner, moderators can be used to carry out scoping workshops. Potential stakeholders (in addition to the problem Owner) of Capability Catalogs are identified and informed, which can be composed of different levels of management such as Executive, Senior or Middle. To ensure that all decisions, action items and agreements are documented, Minute Taker support all activities in this WS.

As better the governance structure of an organization including clearly defined roles and tasks, as better works the identification of stakeholders and their agreement on development conditions. According to (CEB 2015) we recommend to motivate a selection of the following stakeholder groups:

Executive Management: because it articulates the vision of how capabilities will drive enterprise value, ensure that the senior management are engaged in the initiative, approved the overall concept and release the budget for the catalog development.

Senior Management: because it represents knowledge carrier of organization's mission, operations, and performance objectives, identifies potential capability stewards who will be accountable for required information, validates drafted capabilities to ensure that they accurately represent activities of their business unit, function or organization.

Middle Management: because it articulates how their units operational activities are linked to strategic goals, can validate drafted business capabilities to ensure that they accurately reflect the activities of their function.

Enterprise Architects: because its knowledge about enterprise architecture, modeling techniques & industry frameworks is essential to engineer capabilities in depth.

Business Architects: is deep understanding about most important business activities is crucial for capability engineering.

We recommend three facts that should be taken into account when identifying stakeholders:

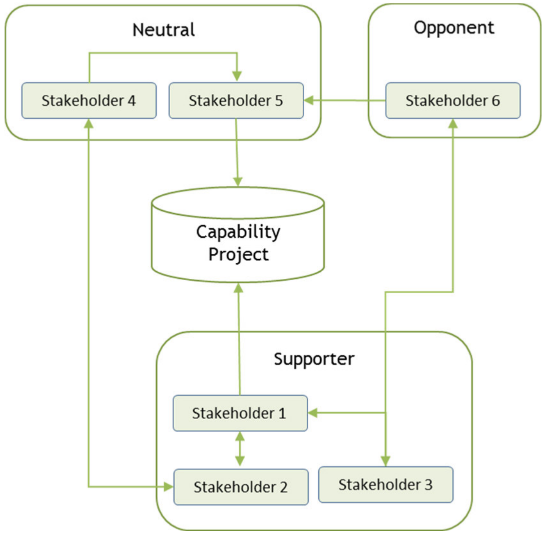
1. *Find stakeholders who could give feedback:* Comments, changes, additions, incomes and outcomes to a capability catalog project like:
    a. Managers with an enterprise-wide understanding.
    b. Domain experts with knowledge on what they do.

2. *Integrate a business unit or functional division:* Who is interested in future changes and has a positive attitude towards the topic. For example: Development of a capability catalog to support the relations between business and IT.
3. *Locate an executive or senior manager* by illustrating benefits of a capability-oriented thinking.

Most work recommends the *senior and middle management* as main addressees. These hierarchical layers provide the majority of required information and resource responsibility for capability engineering initiatives. The definition of the general scope and application area, overall budget and distribution of resource responsibilities is embedded in executive layer. Architects combine the different (architectural) views with the management information. If for any reason a distinction in such management groups is not possible chosen stakeholders should provide at least the following characteristics, rated from low to high importance:

- Architecture work & technical mastery like technical and deep domain expert knowledge
- Strategic thinking like long-term business oriented thinking
- Business & IT understanding like knowledge about enterprise processes & architecture
- Engagement skills like collaboration, decision-making, change management, facilitation

For all involved stakeholder a common (moderate) business language as well as specific enterprise vocabulary should be in order to document results understandable, transparent and identifiable. Especially, capabilities should be defined and documented with understandable terms, which at least depend on involved stakeholders and its chosen languages. We recommend that any form of documentation should be written from an outside-in-perspective to allow addressees and may project external stakeholders to understand it (*Minute Taker*).



DOCUMENTATION

Relationships and dependencies of this WS could be documented within a project concept or scoping description, visualized by models like goal models, business models and/or stakeholder diagrams, bubble diagrams, portfolio charts, organizational charts, spider charts etc.

However, storing of reached results is of significant importance and could be supported by:

1. *Centralized* and/or distributed data storage; e.g. MS SharePoint Services, local and/or global storage server and file systems, internet based services
2. *Access* to documents and database(s): e.g. provided servers, online-platforms, wikis, personal (electronic) files, cloud services, knowledge management systems

USEFUL CONCEPTS

- *Brainstorming*
- *Mind map Glossary/Vocabulary*
- *RASCI Model*
- *Goal Model and Strategy models*
- *Project Management and Project Scoping*
- *Information Demand Analysis*
- *Stakeholder Analysis*

Finally, table 4 summarized the inputs, throughputs and outputs of this WS.

INPUT	*THROUGHPUT*	*OUTPUT*
Vision, Strategy & Goals, Business Model, Organizational Model	Scoping & basic conditions for the capability catalog	Approved scope, problem owner commitment, identified stakeholder group

5.2 *WORKING STEP 2:* IDENTIFICATION OF TERMS & CONCEPTS

The understanding and choice of a capability concept may vary among relevant stakeholders. So a common understanding between different stakeholders with differing languages (not in the understanding of spoken language, but rather the specific working vocabulary) must be found.

Starting with a general capability approach may create a common understanding of the perspective at hand. Nevertheless, obtaining an overview of already existing definitions and concepts is advisable in order to either use or extend present concepts.

If no capability concepts are used in the company and this is coordinated with the roles involved, this WS can be skipped and it can be directly proceeded to WS3.

PROCEDURE & ROLES

This working step identifies terms and perspectives to define a consistent capability concept.

A deductive procedure is recommended: starting with a general example of the capability approach with a common understanding, specific constellations can be derived.

The brief overview of existing and documented terms must be extended and modified in detail. For example, present approaches can be adapted to new situations or its relation within an enterprise can be reconsidered. Primary contacts of this WS are the Domain Experts.

How do we identify already existing, documented terms and concepts?

The driving questions are:

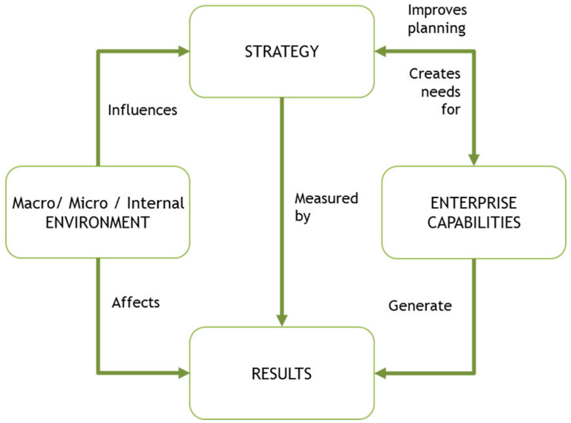
- ✓ *Are there any existing capability definitions, maps, projects, catalogs, contracts etc. within the organization?*
- ✓ *What is the understanding of used terms about?*
  - *Internal, external, common*
- ✓ *What hopes are desired by developing such a catalog?*
- ✓ *How is the concept of capabilities applied?*
- ✓ *How can we implement the identified capability concept into the existing organizational structure?*
- ✓ *Which degree of detail is currently reached?*
- ✓ *Which architecture types are involved and/or influenced?*

Involved Roles to answer the questions: Problem Owner (AC), Project Lead (R), EAM CM Team (R), Domain Experts (R), Moderator (R), Minute Taker (S), Stakeholder Group (C).

The Project Lead compiles the EAM CM team that supports him in the project implementation. The team may be composed of different Domain Experts, however, it should have at least expertise in EAM. In order to harmonize existing capability concepts different Domain Experts are interviewed in smaller workshops by a moderator. Results are documented by the Minute Taker and analyzed by the EAM CM Team. After consultation with the Problem Owner and Stakeholder Group, the results are integrated as a working definition in the next WS.

Due to the fact that a number of various roles are involved, this WS carries conflict potential between participants. In this context, the moderator should particularly possess mediator skills and methods of conflict management.

Example - According to Leonard Greski (2009) we visualized capabilities relationships within an enterprise:



Enterprise capabilities influence the results of transformations specified and measured by strategies. Architectural components like processes, information, roles and physical resources are assigned to these enterprise capabilities. These basic components are part of the business architecture model and have to be considered in order to analyze its causal correlations.

DOCUMENTATION

Results like written explanations of the single terms & statements are sufficient and should be collected in a central glossary, (internal) wiki and/or file repository (see WS1).

Relationships between defined concepts could additionally be visualized within informal or formal models. Nevertheless, no single visualization tool or technique is recommended for this working step, but we recommend orienting on enterprise standards like project management standards, or knowledge management procedures.

USEFUL CONCEPTS

- *Architecture Model including Organizational Chart/Organigram*
- *Formal and informal, hierarchical and non-hierarchical Overviews*
- *Glossary/Vocabulary*
- *(Business) Anchor Model*
- *Getting to Yes: Negotiating Agreement Without Giving In*

INPUT	*THROUGHPUT*	*OUTPUT*
Approved scope, problem owner commitment, identified stakeholder group	Identifies used terms & perspectives to define a consistent capability concept	Approved capability working definition & architecture concept, assumption of required capability types

5.3 *WORKING STEP 3:* DESCRIPTION OF AN INTEGRATED CAPABILITY APPROACH

In this step, the fundamental capability approach & focus area definition is worked out. A focus area affects the enterprise architecture elements and management function selection that can be used to characterize the environment of a capability.

The integrated capability approach represents an object-based concept including its focus area and relations within the enterprise architecture.

PROCEDURE & ROLES

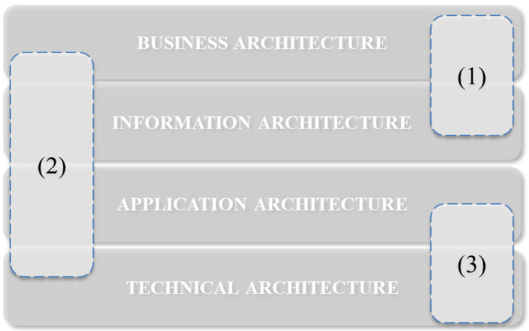
The enterprise environment contains the description of any information characterizing a specific situation. Consequently, the sum of internal and external factors influencing a specific situation has to be identified and defined.

Within this working step these architectural objects including its relations and focus area are assigned to a capability concept in order to specify its structure and type.

Which types of capabilities could be distinguished?

Our *Integrated Enterprise Capability Approach (IECA)* supports the identification of specific capability types required for effective operationalization of specific goals & strategies. In line with an enterprise architecture approach, both the focus area and the elements required for a capability could be identified, assigned within an EA and finally results in a specific capability type.

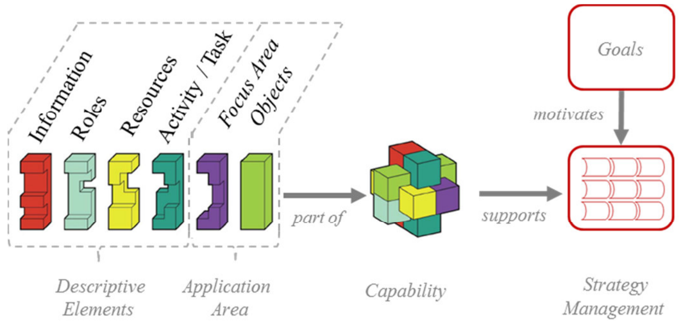
We distinguish between three basic capability types: (1) *Business Capabilities*, (2) *EAM Capabilities*, (3) *IT Capabilities*



Capability type is connected to an overarching subject i.e. application area (BB1.WS1) and/or an enterprise environment (internal/external), which describe the specific situation of capability usage and/or demand.

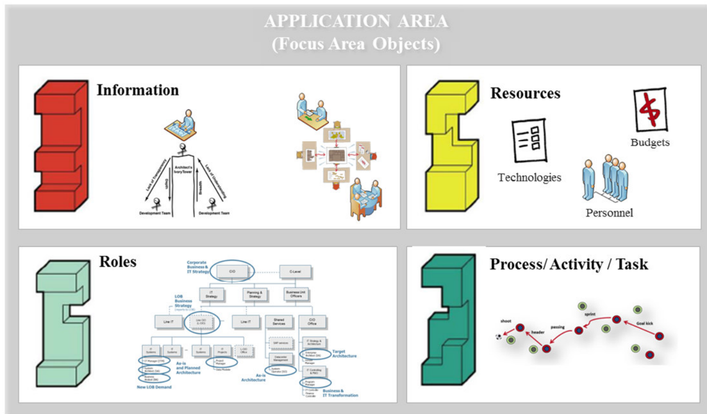
Each type is characterized by a set of focus area objects, which in turn depend on the area of application. For instance, the focus area of *business capabilities* represents a combination of business architecture elements (e.g. product, market, or customer) and management activities, whereas the *EAM capability* focus area objects are defined as a combination of architectural elements (e.g., application, information flow, or component) and management functions.

Next to the application area and corresponding focus area objects, the specific definition of a capability requires an additional set of elements: the required information, roles/actors with competences to help create a specific outcome, the relevant activities or processes, and appropriate resources. The conceptual structure of a capability and its relation to strategy management could be illustrated as follows:

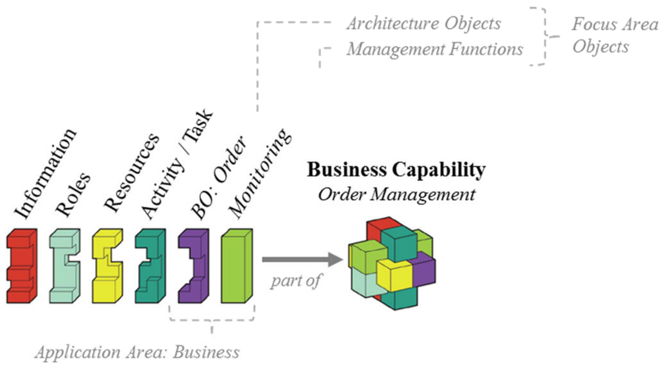


Integrated Enterprise Capability Approach

The focus area and descriptive elements are assigned to architectural layers of the organization's EA, which could be broken down more detailed other than the conceptual examples described here.



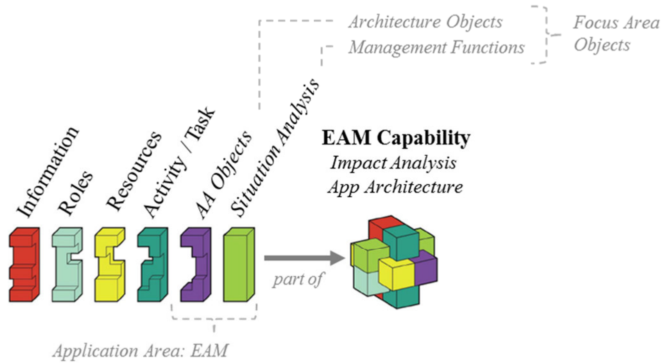
Example - The focus area objects for business capabilities could depend on industry-specific aspects, since business capabilities are able to enhance both competitive advantages and core competences due to their uniqueness, inimitability, and contribution to the generation of better customer value. In this context, certain architecture objects or functions such as *Business Object* (e.g. Order) or management functions (e.g. Monitoring) are defined as focus area objects, since an interaction of these creates a customer value. Time horizon (e.g., current, future), activity-based or management aspects (e.g., planning, implementation, audit, maintenance), impacts (e.g., core, support) might be other candidates for focus area objects as well.



Example of a Business Capability

Furthermore, industry-specific aspects are crucial for identifying and defining focus area objects for business capabilities.

Example - An EAM capability generally describes the ability to combine information relating to specific application area like architecture objects (focus area object) and management functions (focus area object) for e.g. an EAM Capability "Impact Analysis Application Architecture" is constructed of the focus area objects application architecture and its elements and the EAM management function "Situation Analysis". Furthermore, respective EAM capability is a combination of information relating to e.g. information about current architecture models or standards, roles with corresponding competences to create a specific outcome that are applicable in a process with appropriate available resources.



Example of an EAM Capability

The indicative questions, helping to define which context objects are required:

- ✓ *Do we need related, underlying and/or linked information, roles, resources, and processes for our capability definition?*
- ✓ *Which descriptive elements are important for us?*
- ✓ *Which capabilities do we need and use?*
- ✓ *Which capability types exist in specified practice?*
- ✓ *Are there any context objects derivable from the application area? If yes: How?*

Involved Roles to answer the questions: Problem Owner (AI), Project Lead (R), EAM CM Team (R), Domain Experts (I), Minute Taker (S), Stakeholder Group (I).

This WS is performed by the Project Lead, which transfers the results of WS1 & WS2 with the EAM CM team to IECA in order to define the application area and to derive the corresponding focus area objects. This results in the sought capability type and its specific structure. The results have to be communicated to the Problem Owner and, if necessary, to domain experts and potential stakeholders.

DOCUMENTATION

Decisions on application area, focus area objects and capability type and concept should be collected in a central glossary, (internal) wiki and/or file repository (see WS1, WS2).

USEFUL CONCEPTS

- *Integrated Enterprise Capability Approach*
- *Enterprise Architecture and its elements*
- *EAM Functions*

INPUT	*THROUGHPUT*	*OUTPUT*
Approved capability working definition & architecture concept, assumption of required capability types.	Description of the specific capability type by using the Integrated Enterprise Capability Approach (IECA)	IECA understanding & capability type & concept definition

5.4 *WORKING STEP 4:* DEFINITION OF THE DEVELOPMENT STRATEGY

The content-related elements of required capabilities have been explained. Now, questions of how the catalog is constructed should be answered in this section.

PROCEDURE & ROLES

During the development of strategies, it is necessary to obtain management approval and support. In addition, all relevant organizational units and employees (*BB1.WS1*) have to get access to required information and documents. In fact, informing relevant stakeholders about, e.g., the upcoming activities and the corresponding timeframe is essential in order to obtain the required support.

Who is on board?

The relevance of the overall project to the enterprise, the purpose of the capability catalog, a time schedule, planned activities, the involved parties, a common understanding of how capabilities will be applied—all of these aspects need to be clear and/or available right at the beginning. The main objective here is to create openness among the involved parties or, say, stakeholders to upcoming analyses in order to have a positive influence on both quality and correctness of the identified capabilities. The need for personnel and monetary resources required in the context of a capability development project may have to be justified during the first building block as well.

The following aspects may generally support the value justification:

- ***Added value*** of the capability catalog in accordance with the overall performance of an enterprise, e.g., cost savings or quality enhancements
- **Development of competitive advantages** with the aid of capability-based planning and investment
- **Improvement of the documentation** and auditability of organizational requirements used to achieve goals

Two situations can be differed and should be considered during the definition process of this WS: there is already an existing catalog or a new catalog has to be developed. Furthermore, the strategy definition should include: purpose, time schedule, planned activities, stakeholders, resources, common wording and understanding, documentation & engineering approach. Obviously, the previous three working steps provide the basis for the development strategy, e.g. the purpose and addressees defined in *BB1.WS1*, the defined elements like resources in *BB1.WS2* as well as the context (*BB1.WS3*) to derive possible effects and, as a result, to plan comfortable in time in this working step.

The driving questions are:

- ✓ *How can we anchor strategic goals into our capability catalog?*
- ✓ *How can we learn & translate existing processes into capabilities?*
- ✓ *What personnel and financial resources are needed to realize the development project?*
- ✓ *How can the output of the project be valued and accordingly measured (financial, organizational, personnel)?*
- ✓ *How are the capabilities used or usable in practice?*
- ✓ *How is the timeline and division of responsibilities for each activity?*

Involved Roles to answer the questions: Problem Owner (ASI), Project Lead (R), EAM CM Team (R), Domain Experts (I), Moderator (R), Minute Taker (S), Stakeholder Group (R(A)), IDE Method Expert (R).

This WS involves almost all the roles of the CMG. The Problem Owner and the EAM CM Team are the main actors and co-ordinate activities. The Project Lead develops a communication plan for the project participants, which contains, based on the established development strategy, the communication paths of the different phases of the project and communicates this accordingly. Furthermore, the project lead creates the project plan. This includes the required resources, which is approved by the Problem Owner, and the integration of the Stakeholder Group. The Stakeholder Group may perceive different tasks like e.g. Steering Committee, a consumer of results or supporter / sponsor. To achieve an optimal fit of the CMG results, at this point a method should be used that determines the relevant information Demand (IDA Method Expert).

Example – a comprehensive strategy planning view should consider the following three levels (cp. Ulrich and Smallwood 2004):

- *1st Intellectual Level*: It has to make sure that stakeholders from top to bottom know what the strategy is, what it is crucial influenced by and what is its need and importance.

- *2nd Behavioral Level*: Time plans and the real spending in strategic issues as well as their degree of influencing must be analyzed.
- *3rd Procedural Level*: The continual invest in strategic essential procedures must be stressed.

Example - next to the planning perspective, the engineering approach, the engineering concept has to be defined. For the engineering approach we recommend three different ways (according to Espana et al. 2015):

- *Goals-oriented:* Starting with defining and modeling a goal hierarchy, required capabilities to reach the organizational intentions and objectives must be analyzed. Top-down-modeling is recommended.
- *Process-oriented:* Starting point is a process underlying a business model, which is further modeled and defined in order to adopt it in different scenarios. This approach assumes (at least) an existing organizational process model.
- *Concept-oriented:* Static aspects (e.g. structures, materials, customer profiles) of enterprises, called concepts, have to be modeled and analyzed in order to illustrate organizational knowledge.

Capability Engineering Approaches (cp. Espana et al. 2015)

Aspect of Comparison	Goals-oriented	Process-oriented	Concept-oriented
Starting point of modeling	Goals	Process(es)	Static aspects
Basic intention	Enterprises gain to reach their goals. Capabilities fulfill them.	Capabilities are a set of processes.	Any kind of resources flow into capabilities as well their effects.
Preconditions with respect to models	Goal hierarchy	Process Model	Structured and defined organization (worker, organizational structure, resources)
Primary Stakeholders	Executive & Senior Mgt.	Domain experts, product owner, Senior & Middle Mgt.	Product managers
Degree of flexibility of the modelling strategy	Iterative & incremental modeling process	Flexible process engineering with regard of capability design revision & cope with ill specified goal or concept models	Flexible with regard to the business process specification & cope with different levels of concept granularity
Organizational Impact	Reinforces strategic vision & clarifies the IT-business alignment	Improvement of the total enterprise context	Grouping of organizational concepts

DOCUMENTATION

The authors recommend a central storage/ repository idea for the capability catalog documentation due to more comfortable and easy data access by other information systems. Furthermore, isolated solutions and redundancies are avoided as far as possible. An overview of the different engineering approaches is summarized by the following table. (cp. Espana et al. 2015).

USEFUL CONCEPTS

- *Enterprise Modeling*
- *Project Management Approaches*
- *Capability Design and Delivery (CDD)*
- *CAAS Capability Modeling Approaches*

- *Enterprise Modeling*
- *Business Process Model (BPM)*
- *Goal Model*

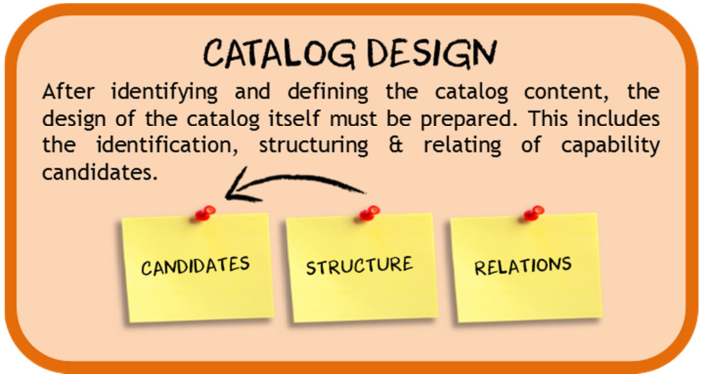
- *TOGAF Business Capability Guide, (TheOpenGroup 2015)*
- *Gartners Business Capability Modeling (Burton2013).*

INPUT	***THROUGHPUT***	***OUTPUT***
IECA understanding & capability type definition	Detailed scoping of the project & alignment to the outcomes of the previous working steps	Definition of the project plan & engineering approach → development strategy

6 Building Block 2: Catalog Design

Subsequent to the determination of the basic conditions within the first building block, the design of the capability catalog is initiated.

Hence, capability candidates are identified, collected, structured as well as their relationships identified. The building block consists of the following three key activities.



According to Ulrich and Rosen (2011) & Wißotzki and Sandkuhl (2015), the following list presents a number of basic principles for the capability identification and definition. The primary relating working steps are mentioned.

- BB2.WS1: Capabilities define what is done, not how to do something.
- BB2.WS1: Capabilities are nouns.
- BB2.WS1: Capabilities are defined in terms of their application area (i.e., there should be no technical terms for describing business capabilities).
- BB2.WS2: A capability should be enduring and stable, not volatile.
- BB2.WS2: Capabilities are not redundant.
- BB2.WS2: There is one capability map for an application area.
- BB2.WS3: Capabilities can have relationships to other capabilities (capability types).

6.1 *WORKING STEP 1:* IDENTIFICATION OF CAPABILITY CANDIDATES

The phase starts off with the “capability candidate identification.” The focus of this activity is the definition of the first capabilities.

PROCEDURE & ROLES

Prior to any analyses, it is important to accurately define the area of application and coordinate the required work (*BB1.WS1*). The area of application determines the content and concepts that are significant for the identification process. Therefore, the output of *BB1* provides the basis for the planning of required identification activities, involved experts, and the effort estimation.

For the actual identification process, there are several possibilities that have been successfully used in other fields such as enterprise modeling. The following table summarizes different methods of analysis with respect to their field of application within the capability candidate identification stage.

Analysis Method	Field of Application within Capability Identification
Brain Storming	The utilization of creativity techniques such as brainstorming in the course of the initialization process of a capability catalog is helpful for quickly seizing ideas and combining these with existing concepts. The goal is to gather several ideas in a minimum of time with the aid of problem-oriented associations and combinations. As the point of origin there might be, e.g., goals, packages of measures, processes, or a context matrix.
Survey	Represents the main technique for gathering information in the context of descriptive capability elements. In particular, these elements are used to either describe the context or improve the comprehensibility of a subject by creating a uniform language.
Document Analysis	Is used for either preparation purposes or as an initial step within the identification process (e.g., existing strategy maps, process models, domain architectures).
Written Cases	Are used in addition to surveys to identify the time and material input necessary to carry out a certain task.
Moderated Workshop	Characterizes identification activities and/or solution development steps that are applied in order to achieve consent among the involved parties. A joint analysis of current as well as prospective capabilities has an influence on quality, feasibility, and acceptance

The initial activities for identifying capabilities should be kept as short as possible. In general, these initial activities result in a roughly structured collection of individual capabilities or at least capability ideas.

Example - The following table illustrates a couple of examples of typical industry-related business capabilities in order to provide guidance for a simple one dimensional (only one capability context element) capability identification.

Capability Application Area e.g. by industry	Business Capability Examples
Utility	contract management, policy management, claims management, customer management, network capacity management
Automotive	production equipment manufacturing, customer management, supply chain management, incoming goods processing factory
Banking	safety management, credit management, compliance management, trade management, risk management, order management, real estate management
Software	product life-cycle management, pre- and after sales, test & validation management, license management
Mining	production planning, ore extraction, waste management, logistics management, plant management, smelting, materials management

Naming of capability represents another important issue of this WS. In terms of classification purposes we recommend to name capabilities by nouns, whereas other organizational elements (e.g. processes, business functions, value streams) should use noun-verb declarations.

How can we name the capabilities precise and explicit?

A suitable declaration facilitates a fundamental goal of a capability management in terms of being an instrument of communication between different enterprise perspective by enhancing the understanding and transparency of *what* these perspectives do. Nevertheless, even at this early stage suitable declarations should fulfill the following principles:

- intangible
- Conclusive and consistent,
- non-redundant,
- goal enabling,
- Focused and transparent,
- Describing and comprehensive,
- As significant as possible,
- process-independent & stable over time
- Statement-like.

Questions helping to identify capabilities are:

- ✓ *What kind of abilities do we need to do our business?*
- ✓ *Could we derive capabilities from core processes?*
- ✓ *Could we derive capabilities from value chain?*
- ✓ *Could we derive capabilities from business functions?*
- ✓ *What kind of analysis methods could we use for an initial identification?*

Involved Roles to answer the questions: Project Lead (AS), EAM CM Team (R), Domain Experts (S), Moderator (R), Minute Taker (S).

The first identification activities are made by the EAM CM team, which is supported by Domain Experts and enlarged by them during the next working steps or further iterations. These Domain Experts obtain special knowledge from practice or scientist in order to support the identification process. However, this WS ends in a roughly structured collection of capabilities that could be visualized by different techniques.

DOCUMENTATION

Documentation Examples - Cluster maps (box-in-box), Capability Identification Matrix (tables), mind maps, simple lists or text or other collection documentations are usable. A common capability visualization technique repents the cluster map (Figure). However, irrespective of the chosen techniques each of them should be centrally saved as editable document for the engineering team and authorized stakeholders.

The documentation of identified capabilities should be:

- as short as possible,
- as significant as possible,
- consistent and
- transparent.

USEFUL APPROACHES

- *Analyzing (Methods)*
- *It* contains of primary (e.g. internal logistics, operations, external logistics, marketing & sales, service) and supporting (e.g. infrastructure, human resource management, technology, procurement) activities. [Lassmann(2006)]
- *Workshops* and The *Open Group Architecture Framework* - specific *Enterprise Architecture Framework* by The Open Group. It provides an approach for designing, planning, implementing, and governing enterprise information. [http://www.opengroup.org/subjectareas/enterprise/togaf]
- *Trainings*

- *(Cluster) Maps*

INPUT	*THROUGHPUT*	*OUTPUT*
Definition of the project plan & engineering approach → development strategy	Identification of capability candidates	Roughly structured collection of EAM capability candidates

6.2 *WORKING STEP 2:* STRUCTURING AND SUMMARIZATION

After collecting initial capability suggestions, the results need to be analyzed (considering its type), discussed, and, if necessary, restructured.

PROCEDURE & ROLES

Within the step “structuring and combining,” redundant elements are removed and capabilities that have a strong coherence as to content are aggregated or further specified. Within this stage, content-related aspects are combined to create a catalog that is both easy and clear to understand.

Example – based on Becker et al. (1995) and Sandkuhl et al. (2015) the following principles could service for first review activities:

- *Accuracy* - the capability candidates comply with the corresponding excerpt of the application area.
- *Relevance* – capability candidates should be included with a purpose, not all reality should be represented in the catalog.
- *Economic efficiency* – the costs of follow up do not exceed the intended benefit.
- *Clarity* – models should be presented legibly and clearly, without more constructs than necessary
- *Comparison* – candidates created with different techniques should be aligned at least to some extent.
- *Systematic Structure* – candidates created should be connected into some structure in order to represent how they contribute to each other e.g. hierarchies.

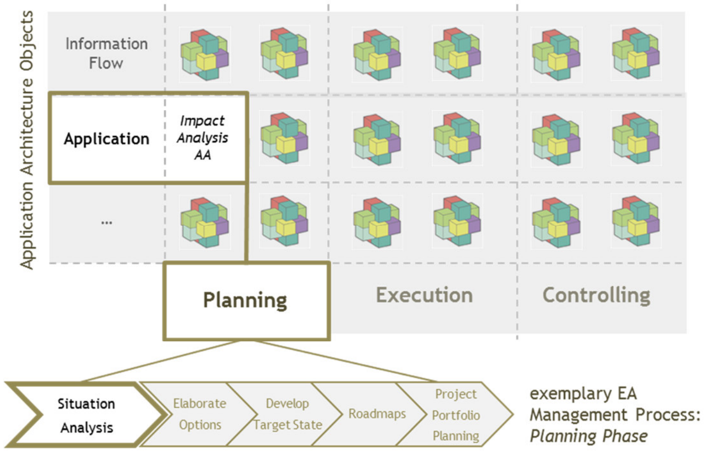
A capability catalog does not serve its purpose if users are not able to gain a certain understanding of the catalog after an initial training. In case there is a large amount of capabilities, these could be aggregated or categorized. Accordingly, similar capabilities are either pooled or integrated using appropriate decomposition levels. It is necessary to have this agreed by the involved stakeholders and to document questions and critical comments that may occur. Subsequent to first refinements of the capability catalog, participants work on additional iterations with the aid of the collected questions and critical comments in order to suggest further changes and enhancements.

Next to the one dimensional example from the previous WS, we recommend an additional approach for a multidimensional capability structuring process in order to handle two or three capability focus area objects. The origin of this identification concept is a so-called *Capability Identification Matrix (CIM)*. At the axis of the identification matrix the focus area object of a capability type are positioned. In case that more than two focus area objects are defined, the set has to be stretched to multidimensional spaces. Engineers should consider that this set is much more complex. Consequently, we recommend not more than three focus area objects in order to avoid complexity at the beginning and enhance handling and understanding, because the identification of first capability candidates represents the main objective of this working step.

Example **-** In context of our IECA an EAM capability like "*Impact Analysis Application Landscape*" (IAAL) could be structured as follows. The already defined focus area objects "architectural objects" and "management functions" name the X- and Y-axis of the capability identification matrix. At the X-axis, we position the following simplified EA management processes:

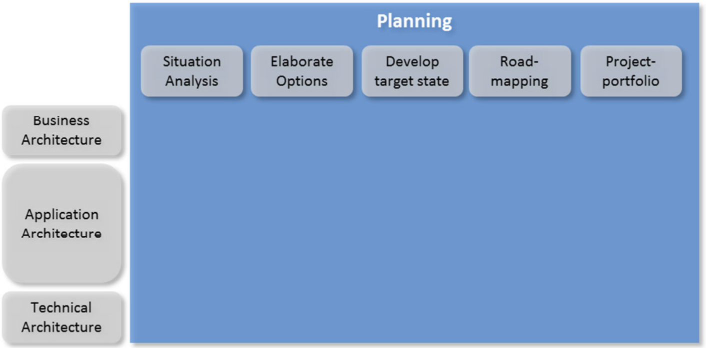
- "*planning*" - involving the phases: situation analysis, elaborate options, develop target state, road mapping & migration planning, project portfolio planning.
- "*transformation*" – involving phases: project set-up, design solution, implement solution, roll-out.
- "*monitoring*" – involving phases: control & evaluate EA, manage change needs

The Y-axis (architectural objects) contains architecture elements of the business, application and technical layer. For our example an application architecture objects called "application" is selected. This architecture element represents an IT system that provides features in a business manner to user or other applications. Applications based and operate on elements of the technical architecture. The matrix cell at the intersection of the "application" object and for this example "situation analysis" of the "planning" phase represents a possible EAM capability. The engineering team has to discuss & decide about the meaningfulness of this intersection in terms of "Does this intersection represent a capability for us? The current situation of an application and its relations to other architecture objects provides important inputs for additional process like transformation or changing activities. Consequently, the question above could be answered with yes. The upcoming EAM capability is exemplary called "*Impact Analysis Application Landscape*" capability. The following figure illustrates the example.



Concept of the Capability Identification Matrix

Considering the handling and understanding, no more than three context elements should be used for this approach.



Structural Concept of an EAM Capability Identification Matrix - Management Context Element Planning

The objective of this step is to classify identified capabilities, create a consistent structure, fix capability names and prepare stable descriptions in order to keep the amount of as small as possible, but as large as needed. Therefore, the following CIM activities should be considered:

- Review of the first substantial results of the brainstorming activities
- Pooling of redundant elements with similar stating points
- Register coherences between capabilities (aggregates, interrelation)
- Further analysis and reorganizations are needed.

Consequently, initial identified capability candidates have to be analyzed, discussed and, where necessary, restructured. Restructuring can be differed into:

1. ***Removing*** - of unnecessary elements
2. ***Grouping*** - similar capabilities are either pooled or integrated using appropriate criteria like:
   - *Collection criteria* e.g. all capabilities of the same business, all capabilities required for value proposition; capabilities required to reach defined results, capabilities related to specific roles, task or business functions; capabilities related to a specific business partner, capabilities required to overcome a business challenge.
   - *Aggregation levels* e.g. high levels for a first complete overview, pooling of same (sub-) hierarchies levels.
   - *Miscellaneous* e.g. competitive & support, importance, customer faced, operative & strategic, business & IT, available & theoretical, general & specialized, enabling & disable
3. ***Extending/Modification*** - includes the further specification or aggregation of elements.

Are there any misleading words in the terminology definitions?

The following driving questions support the structuring process:

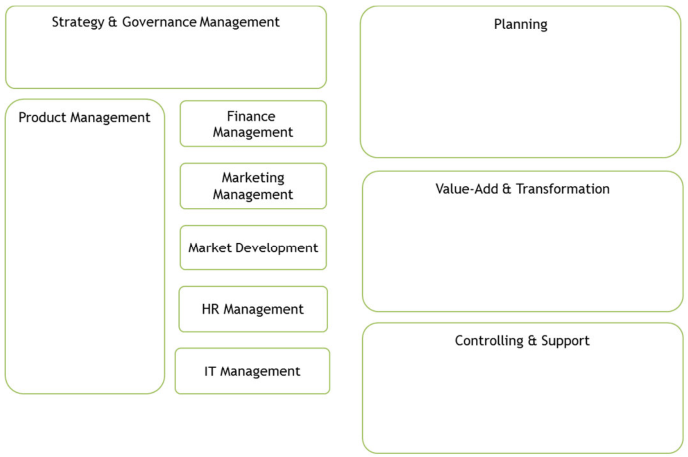
- ✓ *Are there similar or rather redundant capabilities?*
  - *Yes: Is it possible to aggregate or reduce these ones? Or do they have to be more specified in relation to a better distinguishing?*
- ✓ *Is the capability catalog unambiguous and easy to understand by the stakeholders?*
  - *No: Are there any techniques like reduction, composition and decomposition to increase it?*

Involved Roles to answer the questions: Project Lead (AS), EAM CM Team (R), Domain Experts (R), Moderator (R), Minute Taker (S), Small Workforces (R)*.

* The use of the small work forces to support the structuring of certain CIM components is only recommended above a certain size group. Thus, the Project Lead will decide on the basis of project participant structure, whether this role will be occupied within this WS to perform the presented activities.

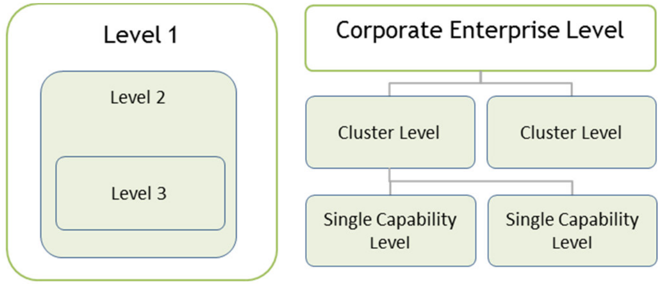
DOCUMENTATION

Content-related capabilities can be restructured, grouped or aggregated like illustrated in the following.



Functional oriented Capability grouping   Capabilities grouped by Management Tasks

Two Capability Grouping Examples



Hierarchy levels without additional significance   Hierarchy levels with additional significance

Examples Capability Aggregation Levels

Next to the given examples capabilities can be organized into the following categories as well:

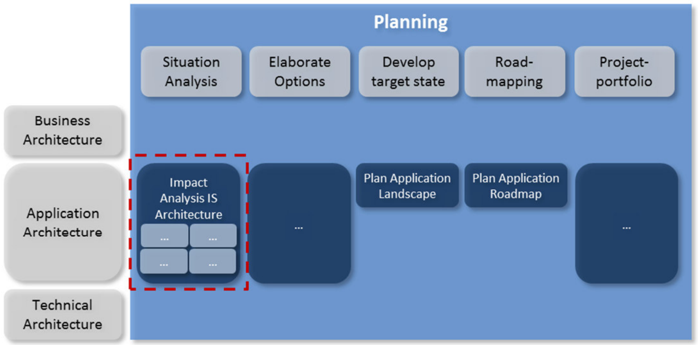
- Competitive & Support
- Importance
- Operative & Strategic
- Business & IT
- Available & Theoretical
- General & Specialized
- Enabling & Disable.

Moreover, the development of a capability hierarchy (in terms of an ordered and grouped collection) is needed to increase non-redundancy, transparency and conclusion, as well as to confirm the defined scope and to deliver a clear scope statement within.

Summarizations and new structures should be accepted by the involved Domain Experts, especially if capabilities are removed or modified to answer questions like: Does our new catalog structure represent our application area? There are two possibilities to answer the question above:

1. Yes: Everything is fine. The structuring process is finished. The next working step can be started.
2. No: More questions have to be asked and answered:
   (1) *How can we reach more acceptances?*
   (2) *Are there serious reasons for resistance?*

Questions and critical comments have to be documented in formal and informal. Moreover, in the course of several iterations, it is necessary to use suitable documents in order to implement a resistant and stable documentation process.



Documentation example for an aggregation of the Impact Analysis Application Architecture

Especially from here, we recommend a combination of the capability identification matrix (0) and a software tool. Next to identification purposes the matrix concept provides a structuring concept for this stage.

STATUS CAPABILITY CATALOG

The state of the art can be characterized as:

- *Review* of the first substantial results of the brainstorming activities
- *Pooling* of redundant elements with similar stating points
- *Missing* or basic relationships between capabilities

Further analysis and reorganizations are needed.

USEFUL APPROACHES

- *Protocols and Agreements*
- *Architecture Model*
- *Mind map*
- *Context Model*

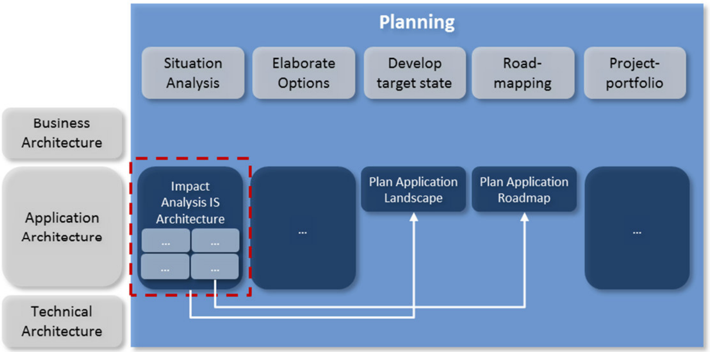
INPUT	*THROUGHPUT*	*OUTPUT*
Collection of EAM capability candidates	Classify capabilities, create a consistent structure, and fix capability names & prepare stable descriptions	Structured Capability Catalog

6.3 *WORKING STEP 3:* IDENTIFICATION OF RELATIONSHIPS

Since the collected improvement suggestions just provide content-related horizontal breadth and not particularly vertical a depth of a capability catalog, it is necessary to conduct further analyses and reorganizations. In addition to an improved level of detail that is achieved in *BB3*, dependencies among capabilities need to be identified and documented previously.

PROCEDURE & ROLES

During the step “relationships identification,” different relationships are documented and analyzed. As a result of identifying missing relationships, removing inconsistencies, and discovering gaps, there is an enhancement of both the knowledge represented by the catalog and the understanding of capabilities being available within an enterprise. Implicit, undesired, or overlapping relationships between capabilities have to be detected and adjusted.



Visualization example for relationships in the capability Identification matrix

The different types of relationships have to be documented and analyzed. Basically, it can be distinguished between the following relationship types:

- *Dependencies and correlations* – One capability needs another one. Informative dependencies are a subtype in term of information need.
- *Interdependencies* – Mutual reliance between (at least) two capabilities.
- *Independencies* – Capabilities exist side by side without any link.
- *Synergies* – The sum of capabilities has more value than the separate ones. The entire relation of them is in the interest.

The following subtypes of relationships are rated as useful within a capability catalog:

- *Supportive* – One capability is a precondition for another capability.
- *Conflicts* – One capability has a negative influence on another capability.

There are three main tasks fixing relationships:

1. *Find missing relationships*: gaps must be discovered and missing relationships identified and inserted
2. *Redundancies*: have to be removed
3. *Overlaps:* analyzed and aligned

The main activity is identifying and adjusting implicit, undesired and overlapping relationships.

Therefore, a process and corresponding Domain Experts have to be involved detecting relationships due to their practical experiences, knowledge about capability context elements and application area.

The indicative questions are:

- ✓ *What kinds of relationships exist between the capabilities?*
  - ○ *Informative, supportive, functional*
- ✓ *Are the relationships totally identified and defined?*
  - ○ *No: Where are the missing ones? How can we fill the gaps?*
- ✓ *Are there any wasted, inconsistent or unnecessary relationships?*
  - ○ *Yes: How can we eliminate them?*

✓ *Do the stakeholders agree to the identified relationships?*

Involved Roles to answer the questions: Project Lead (AS), EAM CM Team (S), Domain Experts (R), Moderator (R), Minute Taker (S), Small Workforces (R), 4EM Method & Tool Expert (R).

Small Workforces or single Domain experts have to be involved, detecting relationships within the current version of the capability catalog. Therefore, the 4EM Method and Tool Expert introduce first concepts of the 4EM Capability Model and the 4EM.Desk software tool. Also when using a different notation (E.g. EAM, ArchiMate 2.0) it is necessary to ensure that the parties understand the used formalization. In this context, the corresponding Method & Tool Expert must ensure that training and training materials are available for the method and software tool, and that the experts have sufficient skill to carry out training.

DOCUMENTATION

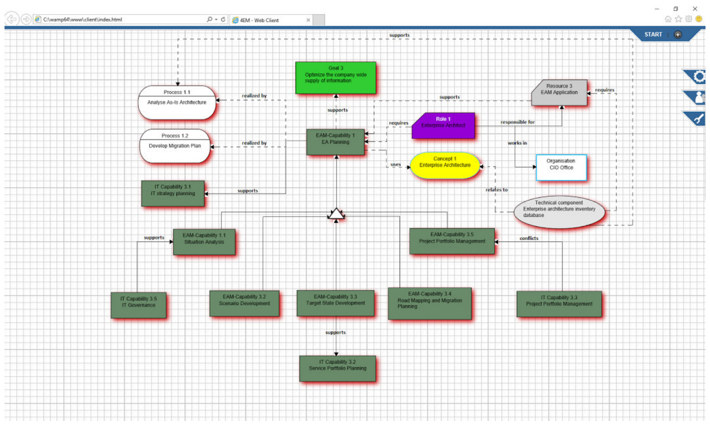
How do we want to fix and/or illustrate relationships?

Possibilities to answer the question are:

- Descriptions,
- Pure visualizations,
- Meta models,
- Modeling notations,
- Architectures.

A wide range of relationship models exist. The (Extended) Entity Relationship Model is one of the most popular ones. In case of *Entity Relationship Model (ERM)* standardized notations are, for instance, *Unified Modeling Language* , *IDEF1x* and *Bachman - Notation* .

Due to the composition of capabilities and its closeness to the elements of the enterprise architecture, however, appropriate visualization and notation forms are proven. In this context, the 4EM-Method and based thereon software tool 4EM.Desk is used. The 4EM Capability Model is based on the IECA and thus it is conceptually unchanged integrated into the software, which allows simultaneous collaborative work on different devices or on one device (E.g. multitouch tables). The software is available at the author.



An additional possibility is the further processing of the capability catalog within the CIM, which , however, should also be converted into an electronic form (eCIM). A template can be provided by the author.

STATUS CAPABILITY CATALOG

The state of the art can be characterized as:

- Representation of the first reduced and revised results of the process activities
- Detailed and accepted relationships between the capabilities

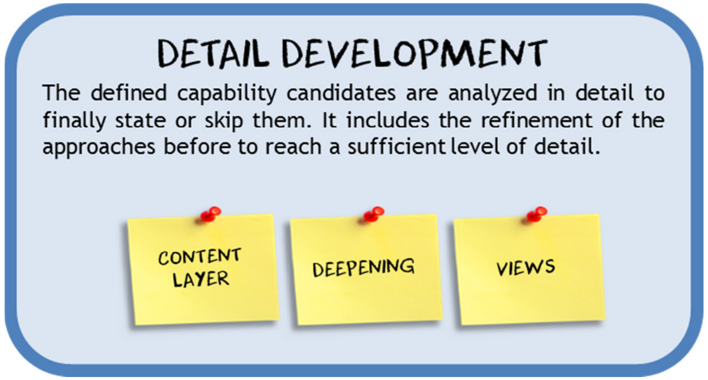
USEFUL CONCEPTS

- *Analyzing (Methods)*
- *Archimate 2.0*
- *Survey*
- *4EM Method Book & Website*
- *4EM.Desk Training Materials*
- *Document Analysis*
- *Workshops and Webinars*

INPUT	*THROUGHPUT*	*OUTPUT*
Structured Capability Catalog	Identification, differentiation & integration of capability relationships	Capability Catalog v1.0, (high granular structured and related elements)

7 Building Block 3: Detail Development

As described, capability management is typically an iterative process of identifying, defining, controlling and maintaining. Thus, it is completed once when every capability is described in a sufficient level of detail for supporting the specific strategy implementation of an enterprise. The third building block is responsible for the refinement and renewing of already achieved results by applying the following steps:



7.1 *WORKING STEP 1:* DEFINITION OF CONTENT LAYER

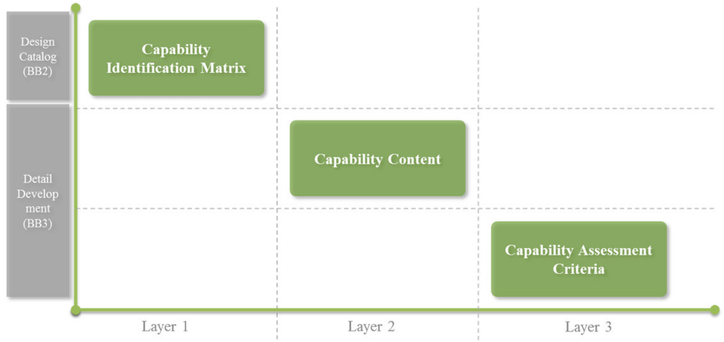
The initial step of the third building block, “catalog content layer definition,” addresses the definition of the content and associated depth in order to provide both a final structure and relations of the capability catalog details. This step is important in case the catalog needs to achieve a high level of detail in terms of content (e.g., by specifying descriptive elements and defining assessment criteria).

This WS can be combined with BB 2.WS1 and / or BB2.WS2. However, this combination is only recommended if the CMG is continuously carried out in a project and the Project Lead considers a combination of the abovementioned WS as necessary due to the given framework conditions (budget, time). If the BB is implemented with a time lag in different projects, merging is not recommended.

PROCEDURE & ROLES

Content layers are crucial to define content in an associated depth in order to provide both a final structure and a sequence of the catalog. Therefore, the descriptive elements, the content objects and other needed terms have to be specified in a high level of detail.

Which content layers can be distinguish?



Example for Content Layers

The example illustrates a three-level approach for the content layer definition. The capability identification matrix represents the first level and is used to identify contextual capabilities. At the content level the descriptive elements are precisely specified. Last but not least, different kinds of assessment criteria & procedures are defined at the third level.

Which degree of detail do we need?

Example - Weldon and Burton (2011) distinguish between the following three layers:

- *Level 0:* Contextual – identification and naming of context objects (e.g. sell, market, service, partner, procure)
- *Level 1:* Conceptual – identification and naming of related capabilities (e.g. for the context object "sell" there might be "sell miles to partners" and "sell miles to members")
- *Level 2:* Logical - further and more detailed sub-classification by chosen criteria (e.g. domestically sell or export to partners or members)

In particular the middle management might need more details in order to elaborate planning scenarios like level 1-2 from above, whereas the executive management is more focused on high-level capability content in order to receive global & complete overviews like level 0-1. First content layer depth impressions can be derived from assigned aggregation levels of BB2.WS2.

Questions, helping to identify and define content layers are:

- ✓ *Which degree of detail should be reached/ is required?*
- ✓ *Which layer differentiation should be used?*
  - *Foundation, groups, types, descriptive elements, KPIs*
  - *Contextual, conceptual, logical*
  - *Corporate, cluster, single capability, descriptive elements, KPIs*
- ✓ *How many content layers are practical and rather needed?*
- ✓ *How are the single layers connected?*
- ✓ *Which issues should be described in each layer?*

Involved Roles to answer the questions: Problem Owner (C), Project Lead (ARS), EAM CM Team (R), Domain Experts (C), Moderator (R), Minute Taker (S), Small Workforce (I), Stakeholder Group (C), 4EM Method & Tool Expert (R).

The vote on the content layer will determine the future depth of content of the catalog. The content depth must be derived from the various requirements of the roles involved and associated to the different levels. This assignment is performed by the EAM CM Team. In case of uncertainties the respective roles needs to be consulted.

DOCUMENTATION

Easy, clear and appropriate vocabulary is recommended to define the layer names and its content requirements. Due to the increasing content complexity, the more substantive documentation should be made within a software tool. Hence, both the previously identified relationships between capabilities as well as between descriptive elements can be taken into account.

For documentation purposes 4EM.Desk can still be used, but the current version 2.7a only supports content layer 1 and 2. Layer 3 can be identified, but not yet be evaluated. The eCim can already map all content layer and is an appropriate tool to identify, define descriptive elements and as well as appropriate KPIs.

Regarding the visualization of the layers, different possibilities could be used (beside the model view). Some of them are listed below:

- *Nested Cylinders and spheres*
- *Cubes*
- *3D Scatterplots*
- *Net layer models/ charts*
- *Tree layer models*
- *Parallel coordinates/ matrices*
- *Cluster maps*
- *Portfolios*

They have to be selected in relation to their respective addressees and degree of detail.

STATUS CAPABILITY CATALOG

The Catalog is extended by the defined content layer. Each layer is specified with regard to the containing information.

USEFUL CONCEPTS

- no additional concepts

INPUT	*THROUGHPUT*	*OUTPUT*
Capability Catalog (granular structured and related capabilities)	Content layer definition	Capability Catalog incl. content granularity concept

7.2 *WORKING STEP 2:* CAPABILITY CONTENT ENGINEERING

After specifying the number of content layers covered by the catalog, a systematic analysis of the identified capabilities as part of the "capability content engineering" step is advisable. Here, the capabilities are actually described in further detail.

During the engineering process, the entire capability catalog appearance may still be subject to substantial changes. The catalog's structures are depicted with the help of models that support a clear and consistent conception of the catalog.

PROCEDURE & ROLES

Within this step the descriptive elements, forming and resulting in the capability content, are specified regarding the results of systematic analysis of the identified capabilities.

Do the capabilities comply with the principles of content engineering?

Seven principles should help to state descriptive elements within the content engineering:

1. Descriptive elements describe and/or characterize the “How”.
2. Descriptive elements are material/tangible or immaterial/non-tangible.
3. Descriptive elements should have a differing nomenclature in comparison to capabilities. Hence, noun-verb declarations are recommended.
4. Descriptive elements are defined in terms of their application are (e.g. BPM syntax for processes).
5. Descriptive elements are combined in order to state capabilities. Hence, each element can occur several times within one capability.
6. Descriptive elements can be stable and enduring, but even instable and short-lived.
7. Descriptive elements have relationships to others.

Prior to any adjustment, a review of previous work is required. Hence, the refinement or renewing of descriptive elements can be initiated.

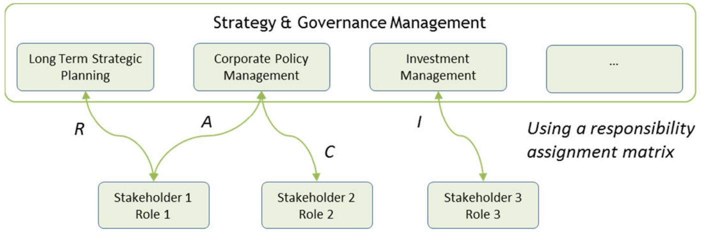
Therefore, the following questions should be answered for each specific capability:

- ✓ *Which are the related, underlying and/or linked roles, processes, departments and capabilities?*
- ✓ *Which information is needed as input?*
- ✓ *Which resources are needed as input?*
- ✓ *Which information and resources are needed?*
- ✓ *How can these sources be provided?*
- ✓ *What does the capability action in practice look like?*
- ✓ *Are there common accepted activities, business processes and responsible roles regarding each capability?*
- ✓ *Are there under-/over-performing and/or missing capabilities (gap analysis) based on performance targets derived from the strategy?*
- ✓ *Which relevant metrics and/or key performance indicators (derived from strategic objectives) can be identified?*
    - *How are they scored (e.g. in terms of properties of the EA to which the capability is linked)?*
- ✓ *How can we link capabilities to their motivation (strategic goals)?*
- ✓ *How can we link capabilities to their implementation (e.g. descriptive elements as represented by EA models)?*
- ✓ *Do we have to involve any experts and stakeholder? Which ones?*
- ✓ *Is there any estimation about the needed time and resources?*

Involved Roles to answer the questions: Problem Owner (C), Project Lead (AS), EAM CM Team (S), Domain Experts (R), Minute Taker (S), Small Workforce (R), Stakeholder Group (C), 4EM Method & Tool Expert (RS).

Domain experts & manager must be involved in order to give specific inputs. Depending on its expertise and organizational it is desirable and sometime necessary that these experts, work forces or single members of the stakeholder group are assigned to specific parts of the capability catalog in order to be further processed. To specify the assignment of tasks better in this WS, we use once more the responsibility assignment matrix again (RACI, PACSI, RASCI, RACIQ etc.).

Example - If a stakeholder provides activities that are required for a capability like informing, consulting, accountability or responsibility (RACI) for resources, information, processes or company specific descriptive elements, they pass over from its stakeholder position to a role element of the capability



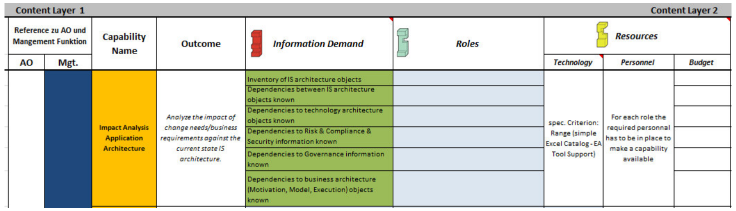
Example for a Capability Stakeholder-to-Role Map using RACI Assignment

DOCUMENTATION

During the engineering process, the entire catalog is subject of substantial changes of the structure, design and content. Additionally, the catalog´s structure is depicted by clear and visualized models to stress the consistent understanding.

From this WS on capabilities, its descriptive elements and KPIs can be described in more detail (depending on the selected content layer). Since these issues quickly become very complex, a modelling tool should be used at the latest. 4EM has been recommended for mapping relationships in BB2.WS3 and can be used accordingly by using the software 4EM.Desk. In particular, the support of Small Workforces, which allows collaborative and distributed work on Capability models, argues in favor of using 4EM.Desk. As described above, the only disadvantage of the latest version 2.7b is the fact that Content Layer 3, for the evaluation of KPIs, is not yet supported. The project lead has to take the decision with respect to the modeling tools under consideration of the respective project situation by weighing the pros and cons.

Nevertheless, the eCim can also be used at this point.



Documentation of content layer 1 and layer 2 within the eCIM

STATUS CAPABILITY CATALOG

During the engineering process, the entire catalog is subject to substantial changes of the structure, design and content.

Additionally, the catalog´s structure is depicted by clear and visualized models to stress the consistent understanding.

The state of the art can be characterized as:

- Representation of revised results of several iterative activities
- Detailed and accepted relationships between the capabilities
- High level of detail

USEFUL CONCEPTS

- Alternative Engineering (Tools)
    - e.g. Archimate 2.0 modeling software tools,
- Responsibility Assignment Matrix (RACI)

INPUT	*THROUGHPUT*	*OUTPUT*
Capability Catalog incl. content granularity concept	Detailing the descriptive elements & defined content layer	Capability Catalog enriched by current status content v3.0

7.3 *WORKING STEP 3:* DEVELOPMENT AND TEST OF STAKERHOLDER VIEWS

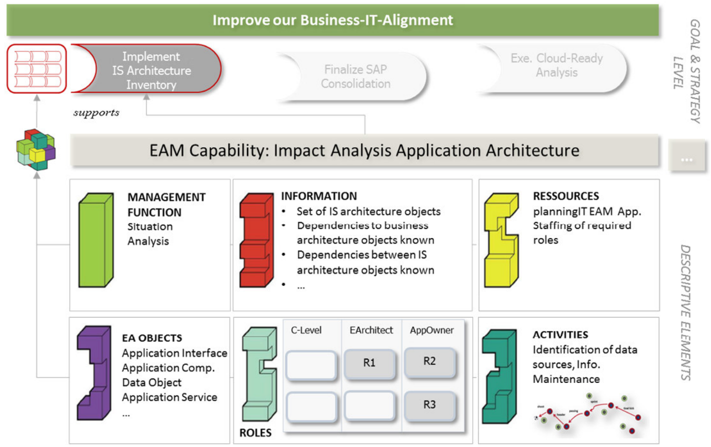
The third building block is completed by the "develop and test stakeholder views" step. When describing capabilities in detail, it is necessary to ensure that every capability is formulated in a general manner, i.e., there should not be any connections to objects such as particular applications or markets. However, capabilities may well be linked to logical elements. In general, views might be applied to present specific sets of capabilities to different kinds of stakeholder groups. In particular, one of the following sample views could be created:

- required maturity level vs. current maturity, level of a capability used for strategy implementation,
- costs of bringing a theoretical capability (some of the descriptive elements are described but non-existent in the enterprise) into real,
- dependencies between capabilities,
- Capabilities required for a particular strategy implementation
- financial aspects,
- just a capability overview map.

PROCEDURE & ROLES

For presentation purposes, different tools and technical measures may be used. Different kinds of evaluation criteria are developed in this working step. When describing capabilities in detail, it is necessary to ensure that every capability content layer & its defined elements are formulated and may be linked to other logical elements of the EA.

Example - The connection between goals, strategies, initiative and corresponding capabilities for realization could be captured in a view (figure).



Impact Analysis Application Architecture Capability

Views might be applied to present specific sets of capabilities as well as to different kind of stakeholder groups.

What kind of views should be defined?

Since the stakeholder group does not always have sufficient knowledge of methods to capture the requested information on the proper content layers, reporting must be adapted accordingly. Thus, in particular the knowledge of methods of the stakeholders must be estimated and considered. This is the only way to draw conclusions to the desired manner of the information presentation (different visualizations, lists, etc.). On the one side, results of BB1.WS1 & BB1.WS4 can be analyzed in more detail or an equivalent method may be used on the other side. In this connection IDA is used another time, which is conducted by an appropriate Method Expert (This is particularly recommended for larger projects).

The following questions can help to define views:

- ✓ *Which stakeholders need access to which catalog parts?*
- ✓ *Are the views appropriated?*

Involved Roles to answer the questions: Problem Owner (CI), Project Lead (AR), EAM CM Team (R), Domain Experts (RC), Minute Taker (S), Stakeholder Group (CI), 4EM Method & Tool Expert (S), IDA Method Expert (R).

The role of IDA-Method expert supports the development of appropriated stakeholder views based on previously (BB1.WS1, BB1.WS4) information demand and actually identified information needs.

DOCUMENTATION

Regarding the first building block of preparation, business language should be used to reach a common understanding decreasing the intellectual, behavioral and procedural differences between the stakeholders.

STATUS CAPABILITY CATALOG

The state of the art can be characterized as:

- Representation of revised results after several iterative process activities
- Detailed and accepted relationships between the capabilities
- High level of detail
- Completed

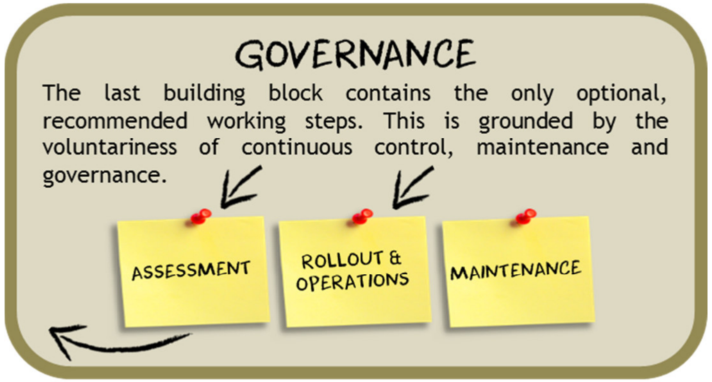
USEFUL APPROACHES

- *Layer/Level Model*
- *Chart/Graph*
- *Heat Maps*
- *Periodic table of visualization possibilities*
- *Best practices for promotion:*
  - *Business Capability Map*
  - *Business capability - focused performance communication*
  - *Business Capability Roadmap*

INPUT	***THROUGHPUT***	***OUTPUT***
Capability Catalog enriched by current status content	View Models Simple measurement methods and tools	Capability Catalog v4.0 incl. visualization for different stakeholders

8 Building Block 4: Governance

This last building block is very important due to introducing and keeping capabilities up-to-date. In fact, the governance process addresses the quality management of the created capability catalog. It thus includes activities referring to the assessment, deployment, and maintenance of a catalog illustrated in the following figure:



Even though there are a number of approaches dealing with quality criteria and valuation methods in the context of, for example, enterprise architectures (Sandkuhl et al. 2013). There is still little progress in the application area of evaluating capabilities, in which approaches most often build on ordinary methods for quality control or are impractical for the designated purpose. This might have originated from an omitted preparation phase, which is normally used to describe the quality criteria a catalog has to satisfy.

8.1 *WORKING STEP 1:* ASSESSMENT

In order to both counteract deficient quality and promote the functionality of a catalog, the optional step "assessment" can be used.

PROCEDURE & ROLES

The focus of the assessment concept can be the development process (the way the catalog is constructed), the designed result (the catalog itself), or both. Accordingly, the quality level and quality criteria have to be elaborated during this stage. Appropriate criteria can normally be derived from the goals predefined in BB1 or from the deeper content layers defined & formulated in BB3.

Who wants to evaluate which results?

In addition to conducting an overall review of general quality standards such as *completeness, accuracy, flexibility, linkage, simplicity, intelligibility, and usability*, it is recommended to apply comprehensive assessment approaches, e.g., capability maturity models or capability assessment matrices. From the process perspective after such an assessment phase, it is possible to revisit the second and third BB in order to integrate assessment results in a new iteration.

Moreover, if the assessment results are absolutely not satisfactory or primary goals are not achieved, the first BB has to be visited again in order to analyse critical points and re-define scope, definitions, stakeholder groups or development strategy.

There are three kinds of proposed subject:

- *Development process* - the way the catalog was constructed
- *Engineering result(s)* – the content of catalog itself
- *Both*

The indicative questions are:

- ✓ *What is the objective of the assessment?*
- ✓ *Should the catalog be verified (theory-oriented) or validated (practice-oriented)?*
- ✓ *What theoretical and existing capabilities need to be assessed?*
- ✓ *Are there any existing quality criteria (e.g. from BB 1 or BB3)?*
  - *No: What criteria should we use?*

Involved Roles to answer the questions: Problem Owner (R), Project Lead (AR), EAM CM Team (S), Minute Taker (S), Stakeholder Group (R), 4EM Method & Tool Expert (S).

The completed catalog needs to be formally approved by the *Problem owner* and evaluated by the *Stakeholder Group*.

The project team needs to be able to enhance the results of the capability catalog creation process, i.e., converting the final catalog version, descriptions, and illustrations into an appropriate form of presentation. Relevant stakeholders might, for example, obtain a copy of the document in order to prepare themselves for approval.

Therefore, catalog content in terms of deliverables, KPIs and the views are presented. In particular, not directly measurable quality criteria such as Improvement of communication can usually only be assessed by the Problem Owner, because this role ultimately accepts the deliverables of the CMG project.

Following, the catalog results have to be measured under specific conditions and issues. Probably, there is the need of modifying and revising the existing catalog totally.

Do we need to revisit BB1, 2 or 3 after the assessment?

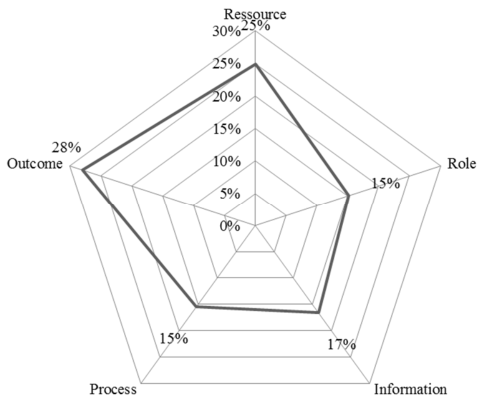
The feedback can be used as input for further iterations of catalog development, if it is necessary to run through.

There are several opportunities for assessment.

1st: If a maturity model is used. Maturity models are specific management instruments, which define various degrees of maturities in order to evaluate to what extent a particular competency fulfils the qualitative requirements that are defined for a set of competency objects (Wendler 2009) and the development processes in organisations (Back 2010). According to (Wißotzki at al. 2013) the utilization of maturity models in the capabilty context comprehends three different variants: descriptive, prescriptive or comparative. The descriptive maturity models could be applied to asses the current state (as-is) of a capability or a capability group. Prescriptive models do not only assess the as-is situation, but also recommend guidelines, best practices and roadmaps in order to reach higher degrees of capability maturity. A comparative maturity model can be applied for benchmarking across different capabilities. Following questions can guide the maturity assessment step:

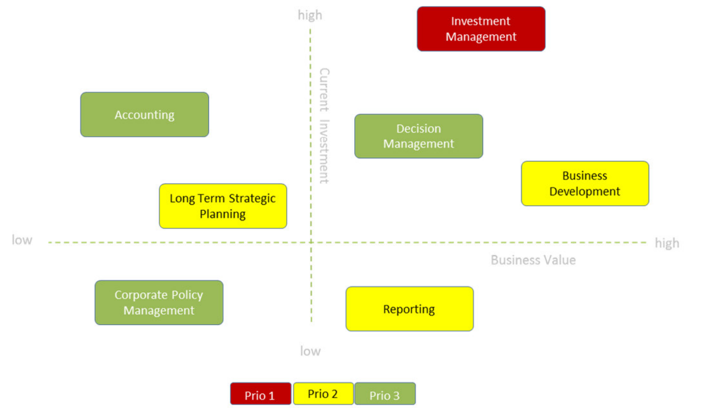
- ✓ *For each phase/maturity state:*
  - *Which kind of maturity approach do we need?*
  - *What criteria should they assess?*
  - *Which kind of maturity states/levels do we need?*
  - *How can we close gaps between current and desired states/levels?*

Example **-** The current data quality of capability can be illustrated by a spider chart. The chart shows significant gaps between the desired level (100%) and the current level of the required descriptive elements.



Descriptive Elements - Maturity Visualization

2nd: **Portfolios** are a good possibility to compare different assessment criteria like the mapping of investments to existing capabilities (e.g. internal and external distribution; human resource, IT and procure management) illustrated in the following illustration. Using highlights and/or priorities for a third criterion (e.g. their importance regarding the global enterprise goals) the same portfolio can offer gaps and misleading investments. Consequently, future measurements can be derived due to increased investment in capabilities of low strategic importance and the other way around.



Example for an Investment/Capability Portfolio

3rd: **Capability-based planning approach** (Aldea et al. 2015) is an approach to analyze and evaluate capabilities as well. It consists of three generic activities: mapping, planning and analyzing, which includes the definition of assessment metrics.

4th **Questionnaire** – Stakeholders can be questioned about changing requirements and capabilities, satisfaction regarding the current state of development, any other suggestions. It stresses the importance of their agreement towards the created catalog.

5th: *Utilization Model* - Utilization and financial models allow comparisons of enterprise states as well as analyses of the causal dependencies, quantifiable benefits and ongoing operation of capabilities. *Utilization models* offer the demand sources and what is needed. Gaps can be shown. Whereas financial models concentrate on (quantifiable) sources of benefits and costs as well as the cash flow statement.

However, there are no common accepted and proven approaches focusing on assessing capabilities yet. Most adoptable approaches concentrate on business processes or value chain and are often build on ordinary methods for quality control or are impractical for the designated purpose. Nonetheless, case studies, assessments and expert interviews are popular methods. The recommended method provides top-down ways to evaluate effectiveness and efficiency of descriptive elements. Comprehensive evaluation tools like capability maturity models are recommended in case of large capability catalogs.

However, the quality level of the assessment depends on appropriate chosen assessment criteria. We distinguish between general and specific criteria. General criteria are generally applicable for all capability type. Some examples:

- Completeness
- Accuracy
- Flexibility
- Linkage
- Simplicity
- Reasonability
- Intelligibility
- Usability
- Availability
- System Support

Specific criteria are capability specific quality indicators and have to be individually defined for each capability. In terms of our EAM Capability "Impact Analysis Application Architecture" driving questions for the quality of its descriptive element "information" could be: Inventory of AA architecture objects available? Are dependencies between AA architecture objects known? Are dependencies to business architecture objects known? Are dependencies to technology architecture objects known? These questions could be answered by a metric like in the following table.

Application	1			
Solution Bulding Block				4
Business Object		2		
Service (abgrenzen zu Appl.)			3	
Application Deployment	1			

This evaluation can be made for all descriptive element of a capability. The sum of results can, for example, reflect the level of maturity or taken as base for variance analysis.

DOCUMENTATION

Maturity models can be used to illustrate the past, current and striven degree of aim fulfillment. It's a base for further analysis, deriving measurements and trends.

Portfolios can be used to highlight gaps and derive measures. The focus of interest (e.g. costs) must be linked to the capabilities.

Example A portfolio can stress the mapping of investments to existing capabilities (e.g. internal and external distribution; human resource, IT and procure management)

Protocols can additionally note discussed issues and results, evaluation processes and feedback.

Example - The current data quality of capability can be illustrated by a spider chart. The chart shows significant gaps between the desired level (100%) and the current level of the required descriptive elements.

It is planned to integrate this analysis options into the 4EM.Desk software as a future development.

STATUS CAPABILITY CATALOG

The state of the art can be characterized as:

- Representation of revised results after several iterative process activities
- Detailed and accepted relationships between the capabilities
- High level of detail
- Completed
- Up-to-date
- Evaluated
- Including the views

USEFUL APPROACHES

- *Investment/ Financial Models*
- *Utilization Model*
- *Maturity Model*
- *Portfolio*

INPUT	THROUGHPUT	OUTPUT
Capability catalog incl. visualization for different stakeholders	Evaluation, indicators, measurements	Assessed content of the capability catalog

8.2 *WORKING STEP 2:* ROLLOUT & OPERATIONS

The way of integrating the results into an enterprise has a vital influence on the success of this catalog. To this end, the rollout step addresses the implementation/ rollout of a catalog in the organization.

PROCEDURE & ROLES

As specified earlier, creating a capability catalog is only reasonable in case the management approves and supports the process. Accordingly, both upper and middle management need to be convinced. That being said, the success of integrating a capability catalog depends on two major elements: quality and stakeholder satisfaction.

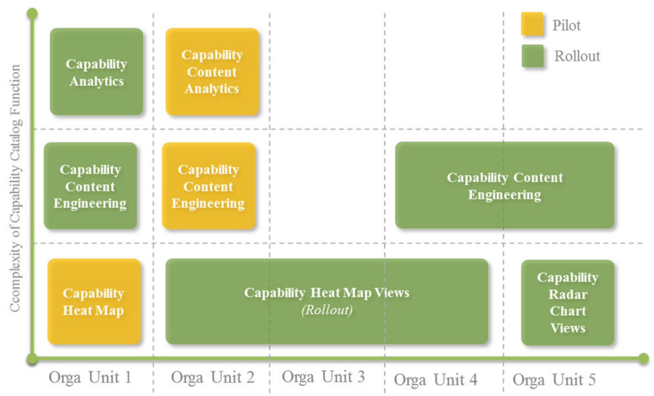
How to appropriately integrate the capability catalog and its findings into the organization?

Two major elements influence the integration significantly:

1. The capability catalog has a high-quality level
2. Potential users (e.g. board level, business developers, line managers) are convinced of the benefits of use.

To achieve both a successful rollout and an extensive use, accurate planning and preparation is required. Therefore, we recommend the following procedure.

The rollout process should start with a functionality (e.g. a viewer function to a capability map) as part of a pilot within a selected organizational unit. The pilot should provide evidence if the expected benefits for a specific functionality occur. After a successful pilot, this functionality can be rolled out across the enterprise. This procedure can then gradually be repeated for subsequent functionalities and organizational units. Additional functionalities (e.g. content maintenance) does not have to be always piloted with the same organizational unit. The following figure illustrates the approach.



In particular, the viewer functionality of specific content of the catalog shall bind both existing user to the catalog as well acquire new users. Interested user can automatically be notified of updates of certain catalog components (considering the respective risk classes) and, if necessary, functionality for requesting further access rights to information can be provided. In this context it is necessary that corresponding workflows are already present in the enterprise or the software of Catalog Management features corresponding functionalities.

Example – The eCIM is a sharepoint and authorized and appropriate roles are automatically notified when changes are implemented. In the context of future development of 4EM.Desk 2.7a so called alert functions and change requests are planned.

Even though an initial evaluation of the achieved state has been conducted in the preceding WS, it is unlikely that a single evaluation remains current for a long time. Thus, the second objective of this WS, even during the use of the catalog, is to continuously query and examine new requirements or change requests.

In this regard, it is recommended to perform internal surveys or workshops after a certain period of time. The way of integrating a catalog into an enterprise has a vital influence on the success of this activity. For instance, if a workflow system is available, electronical surveys (email, internet survey) could be directly integrated. Consequently, in order to support the rollout and the use of the developed catalog, the placement of the Capability Catalogs at central work-process contact points in enterprises is recommended (central access point setup) such as the already mentioned integration into existing workflows, as well as systems such as ERP, KMS, document management, or internal collaboration systems can support the use and acceptance.

Three subsequent aspects need to be considered in the context of catalog rollout and operations:

1. Obtain feedback from users, problem owner and stakeholder group.
2. Obtain suggestions about the maintenance of the catalog and the allocation of resources
3. Integrate the catalog into existing processes or collaboration systems.

All in all, the catalog rollout needs to pursue the goal of achieving an acceptance and usage of the achieved results and creating possibilities for future development by further development iterations.

The indicative questions regarding the capability catalog are:

- ✓ *Is it qualitative alright?*
- ✓ *How can they be visualized at its best?*
- ✓ *How can we get user and/or relevance feedback?*
- ✓ *Are the stakeholders satisfied? Do they accept?*
    - *No: Any ideas of improvement?*
    - *Yes: No further improvement needed.*

Involved Roles to answer the questions: Problem Owner (I), Project Lead (AR), EAM CM Team (S), Domain Experts (I), Minute Taker (S), Stakeholder Group (I), 4EM Method & Tool Expert (R).

In order to guarantee the abovementioned acceptance and the use of the catalog, trainings, organized by the Project Lead, have to be conducted through seminars and workshops within the rollout phase. In these trainings the benefits and the use of the Capability Catalog are explained as well as access rights are specified in more detail. Webinars and / or tutorials have to be created, which should be used as a supplement or for express entry.

DOCUMENTATION

To get user feedback, periodic (internal) surveys and training/workshops are recommended. The results are captured using standard protocols or survey systems.

Which presentation form is appropriated for generating new user?

Presenting and visualizing the benefits, contents and experiences are helpful e.g.:

- Progress reports of existing user,
- Examples of successful transformation projects,
- Survey results regarding the user satisfaction,
- Executive CMG version like a PitchDeck presentation.

The stakeholder satisfaction is the key consideration regarding the meaning of maintenance.

STATUS CAPABILITY CATALOG

The existing, proven capability catalog is deployed.

USEFUL APPROACHES

- *Training & Workshops*
- *Webinars*
- *Feedback and Survey techniques*
- *Pilot-based rollout approach*
- *Central Access Point Setup*

INPUT	*THROUGHPUT*	*OUTPUT*
Assessed content of the capability catalog.	Company rollout of the assed catalog.	Ready-to-use capability catalog

8.3 *WORKING STEP 3:* MAINTENANCE OF THE CATALOG

Feedback from the previous working step or especially from catalog utilization can result in a change in the structure and/or in the function of catalog elements. Besides, changes in the enterprise (e.g. governance, new orientation, management) and its branch can create the need for improvements in the catalog.

PROCEDURE & ROLES

For these reasons, and given that an enterprise may have to face new challenges over time and capabilities need to be modified accordingly, there is an ongoing "maintenance" process in addition to the aforementioned assessment methods applied to create a high-quality capability catalog over time.

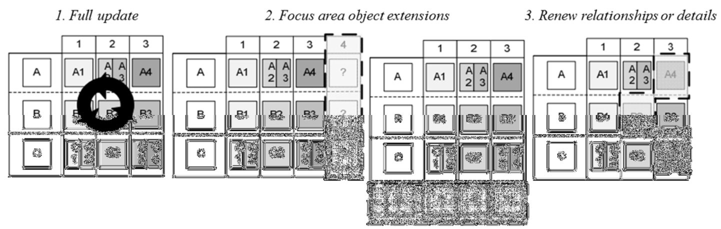
Consequently, an improvement of both quality and usage period of the catalog is addressed within the last step of this building block. Modifications in the catalog structure as well as slight changes may occur in this step.

Which measures and modifications improve the catalog quality?

At the latest, the definition, characterization and scope of "quality management" and "measurement" must be defined, which is not already done within the (optional) *BB4.WS1*. The including advantages are:

- Structure and comprehensibility are up to date,
- Ensured precise descriptions,
- Simplified modifications and reorganizations of the created catalog,
- Contributes to the organizational learning and securing of organizational knowledge,
- An improvement of both usage period and quality of the catalog is addressed.

From Lahrmann and Marx (2010), we adopted three of four extension patterns for the purpose of catalog maintenance.



Capability Catalog Maintenance Patterns, according to Lahrmann and Marx(2010)

A general update of capability catalog elements by adding new descriptive elements or updating the evaluation mechanism (e.g., maturity assessment procedure) may be examples of the first pattern. It is also possible to add new focus area objects or reorder their configurations, e.g., by changing attributes that might influence the identification process (*BB2*) or at least reconfigure the relationships between different capabilities. Although these extension patterns challenge the meta-structure of the capability catalog to some extent, they would not require passing the first building block and beginning the development process again by redefining the scope, as this would go beyond the scope of maintenance.

Is an update or upgrade necessary?

The differentiation between upgrade and update is in the point of interest.

(1) *Update*: adding new descriptive elements or content objects; updating the evaluation methods; any kind of modifications (BB2 – BB4)
(2) *Upgrade*: total renewing of the catalog starting with BB1

Example - When enterprise roles changed or processes are basically modified (e.g. by automatization), the existing catalog has to be updated by new iteration in terms of identifying additional or obsolete capabilities starting from *BB2* to *BB4*. An organizational restructuring or market change can lead to a capability catalog upgrade starting from re-scoping in BB1 to BB4.

What parts of the catalog have to be maintained?

The following driving questions help to identify the right maintenance pattern:

- ✓ *What is the precise extent of change about?*
  - ○ *Deletion, Modification, Insertion*
- ✓ *What is the kind of change?*
  - ○ *Structural, content-related or both*
- ✓ *What is more efficient?*
  - ○ *Upgrade or update*
- ✓ *Are there uniquely appearing or enduring changing reasons, which should receive more attention?*

Involved Roles to answer the questions: Problem Owner (I), EAM CM Team (AS), Domain Experts (R); Stakeholder Group (I), 4EM Method & Tool Expert (S).

All roles (problem owner, stakeholder groups etc.) have to be informed about catalog changes, whereas the maintenance activities should follow an all-do-some approach.

Capability maintenance is not just a task for the EAM CM Team without taking the expertise of the Domain Experts into account. In this context, the Know-how carrier must be integrated that the EAM CM Team only occupies a supporter function and Domain Experts support the maintenance of the content. Thus the capability maintenance has moved from being an ivory tower expert task to a cross-functional line activity that requires the participation of different departments and people. However, this is only possible if appropriate technological prerequisites have been already created in the rollout i.e. central access point setup (integration in workflows, collaboration system etc.).

Are the stakeholders still satisfied?

The authors recommend periodic consultations to discuss the state of the art as well as revisit WS1 and WS2.

DOCUMENTATION

There are two kinds of documenting changes in the visualizations:

1. Changes will be integrated into already established visualizations
2. Existing documents are dropped and new ones developed

The procedure depends on the number and extent of changes. Generally, they have to be documented and communicated in/by the catalog.

STATUS CAPABILITY CATALOG

The existing capability catalog has to be

- ***Modified*** regarding the steps of *BB2* till *BB4* and comply with the described state of the art
- ***Totally*** renewed from *BB1*. Then the existing capability catalog is rejected and a new one, corresponding to the single BB´s and working steps, is designed.

USEFUL APPROACHES

- *Maintenance Patterns,*
- *Formal and informal Protocols and Agreements*
- *Definition of Key Performance Indicators*

INPUT	THROUGHPUT	OUTPUT
Ready-to-use capability catalog v1.0	Maintenance activities following the capability extension patterns.	Full update, focus area object extension, renew relationships or details.

9 Conclusion

Enterprises reach their goals by implementing strategies. Successful strategy implementation is affected by challenges that an enterprise has to overcome. Enterprises require specific capabilities in order to be able to implement strategies efficiently and achieve a specific outcome. A demand for a systematic management approach to identify capabilities is growing.

We presented a generic approach that can be used to derive capabilities through a structured process and gather them in an enterprise-specific catalog for an effective operationalization of enterprise strategies. A capability here describes a certain combination of information, roles, activities/procedures, and resources to support issues like strategy implementation, planning purposes, or transformation processes.

Following a four-building-block approach, we described a straightforward and flexible process for capability catalog developers and designers, which allows to integrate descriptive elements for different capability types. In particular, our approach provides a building block covering the continuous evaluation and maintenance in order to maintain capability and catalog quality.

10 Glossary

Action Plan - detailed plan of activities to reach at least one specific goal

Agreement - Informal contracts defining obligations between different parties (at least 2) regarding a specific object

Analyzing (Methods) - Process of separating one global issue into several, smaller ones in order to answer specific questions or just reaching a better understanding. Methods define series of activities to get the knowledge required by an analysis.

Architecture Model – Regarding software, it is a rigorous diagram based on available standards, in which the primary concern is to illustrate a specific set of the structure and design of a system. It is a mean for communication and feedback.

Bachman - Notation – popular tool-diagram-language [Lassmann(2006)]

BM Canvas – It is a strategic management and entrepreneurial tool to describe, design, challenge, modify and invent a business model. [Osterwalder(2011)]

BM Creativity - It is a structured and easy to learn approach for experimental (re-)designing business models. It aims to increase or modify existing value and value propositions in both existing and new markets. [http://www.businessmodelcreativity.net/]

Brainstorming - Originally a creative technique for generating new and innovative ideas within a group, it is nowadays used by individuals as well.

(Business) Anchor Model - It is part of the development of the business context. It is a high-level view of organizations and the external entities they interact with. It aims to create a common language and vision across business and IT. [Burton(2012)]

Business capability - focused performance communication - kind of capability maturity model to communicate especially IT performances from time to time [CEB(2015)]

Business Capability Map - internalization of business capabilities through maps highlighting the value and maturity of all business capabilities on a single page (CEB(2015), p.20)

Business Capability Roadmap - linking of all (planned) technology projects to business capabilities

Business Context Modeling – Expression of a current business issue or even problem, aggregating relevant descriptive elements. It aims to evaluate projects regarding their effects and benefits.

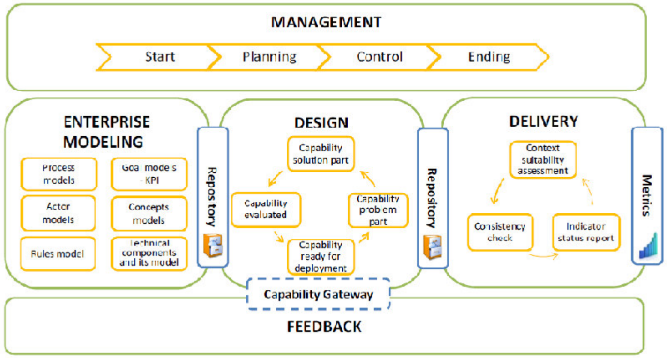
Business Object (BO) - A business object is the representation of an entity that is related to the enterprise's business like customer, product, order, invoice, or contract. These objects are processed by and exchanged between business processes. [Wißotzki(a)(2015)]

Business-oriented Knowledge Management - It aims to focus knowledge and its activities towards business processes. Therefore, it is based on *Business Process Model (BPM)* and appropriate application systems. [Nohr(2004)]

Business Process Model (BPM) - Graphical notation and modeling of (internal) business procedures in order to reach a common understanding and standardization to communicate in an easy way. Business Process Model Notation (BMPN) standardizes the syntax. [www.bpwm.org]

CAAS Capability Modeling – It is a modelling method to support capability-driven design and development (see also *Capability Design and Delivery (CDD)*). It includes several method components like *Enterprise Modeling* . [Espana et al.(2015)]

Capability Design and Delivery (CDD) - the approach is focused on development strategies for the management of developed and independent capabilities in subject to the organizational context. Hence, five method components and their relating approaches can be differed to illustrate the CDD methodology:



Espana et al.(2015), p.5

Capability Identification Matrix - It is a two dimensional identification matrix. The X-axis and Y-axis of the matrix contains the context objects.

CASE – computer-aided software engineering; names the intensive use of IT-based tools for the implementation of a software design. It aims to reach total automatization of (technical) descriptions to create software. [Lassmann(2006)]

Causal Chain - ordered sequence of events causing the next activity each

Chart/Graph - It is a graphical representation of data, whereby charts often contain a temporal component.

Context Model - It models the environment of the object of interest.

Design Thinking - It is a creative technique of brainstorming and refers to design-specific cognitive activities that designers apply during the process of designing. It aims to be close to the user. [https://hpi-academy.de/design-thinking/was-ist-design-thinking.html]

Document Analysis - Document analysis origins from social research and includes both information gathering as well as analyzing the structure and content of documents.

Dodd-Frank Wallstreet Reform – It is a federal law in the U.S.A., signed in 2010, also called Consumer Protection Act. The reform consists of 16 chapters resulting in stronger regulations of banks, reducing the risks for customers and improving financial security of institutions.

Engineering (Tools) - Approaches, tools and methods used in technical research and development.

Enterprise Architecture Framework – It provides principles and practices for designing and developing the architecture of a system. Basically, the view is differed into several layers/levels and a wide variety of appropriate tools for documenting.

Enterprise Modeling – Abstract description and representation of a business, including structure, processes, information, resources and other descriptive elements. It aims to improve organizational transparency, performance and understanding. Basically, it refers to several modeling types like business modeling, process modeling, and data modeling.

Entity Relationship Model (ERM) - It names data models describing information of a business domain and/or its process requirements in an abstract way. It is the basis of database implementation. The main concept of ERM´s are entities (artefacts of the real world) and their relationships. [http://bit.csc.lsu.edu/~chen/pdf/Chen_Pioneers.pdf]

Financial Model - They reflect issues and aspects of financial components after respective (IT-supported) analysis.

Feedback - States the back transfer of data/information from the receiver to the transmitter of a message.

4EM - "For Enterprise Modeling Method" was developed at the University of Rostock. It aims to model, analyze, plan and adopt enterprises. [Sandkuhl et al.(2014)]

Framework – Regarding ISO/IEC/IEEE 42010, architecture frameworks are "establish[es] a common practice for creating, interpreting, analyzing and using architecture descriptions within a particular domain of application or stakeholder community."

Glossary/Vocabulary - Names an alphabetical ordered list of terms and their definitions, within a specific domain.

Goal Model - Type of modeling, belonging to requirements engineering, mainly used for business analysis. Goals are business objectives, tried to reach by effective and efficient business working. Therefore, it relates to other descriptive elements like stakeholders, processes and context.

IDEF1x – de facto standard of the public authorities of the USA for many years [http://www.idef.com/idef1x.htm]

Information Flow Diagram – Illustration of (at least) one information flow within an organization. Additionally, it offers relationships between internal and external information flows, as well as enterprise units and environment entities.

Investment Model – Specific financial model, concentrated on business investments as one examined object.

*I** - Modeling language allowing to develop current and future state models in order to reason about enterprise decision.. It covers actor-oriented and Goal Modeling in order to answering the questions: *Who?* And *Why?*. This is grounded in the characterization of an enterprise: A system containing various actors and their specific goals, which have to be reached, but often are in competition with another. [http://www.cs.toronto.edu/km/istar/]

Key Performance Indicators – They evaluate the success of an entire organization or a specific, particular activity in which it engages. Therefore, its specification and measuring depends on the focus of importance. Success can be defined in relation to the fulfilment of strategic goals or by relating to reach specified (goal) levels.

Knowledge modeling by Probst, Raub and Romhardt – The approach provides a method of 8 blocks to manage knowledge. Two of them (knowledge aims and knowledge rating) are names as orienting and supporting ones. The main elements are: 1. Identification, 2. Acquisition, 3. Development, 4. Distribution, 5. Usage and 6. Storage of knowledge. [Probst et al.(2006)]

Layer/Level Model – It is a popular visualization of hierarchical structured components. Each layer/level specifies one component, e.g. entire or partial functions. It aims to reduce complexity of systems.

Map – It is a symbolic representation of objects and their relationships.

Maturity Model – It is a specific management instrument for the definition of various degrees of maturities. Therefore, evaluations (e.g. the degree of fulfillment a particular competency for specific objects and regarding requirements) and further development (in form of actions) can be derived. Maturity models measure the current state by means of assessment methods.

Mind map – Is a type of diagram, organizing information in a visual way. It is often created as a landscape page, where related terms and definitions are centered around a main issue.

Organizational Chart/Organigram – It is an chart/diagram visualizing the structure of an organization, the existing relationships and roles.

Overview – Names the generalized visualization of a topic.

(Design) Pattern – Design pattern summarize the formal way of documenting a problem solution in a specific research topic.

Portfolio – The term summarizes the organized collection of objects of a specific type.

Project Management – Management disciplines (planning, organizing, controlling and maintaining) regarding a specific temporary task, typically producing benefit and/or value.

Project Scoping – Identifies and defines the delivery of a project in detail. Recommendation: before project beginning.

Protocol – Protocols aim to document at what time and in which order what happened by which person. It can be differed between formal protocols, according to specific, predefined rules, and informal protocols, which are freely documented.

Responsibility Assignment Matrix (RACI) - Depending on its expertise it is desirable and certainly possible that stakeholders pass over to a role relation using a *Responsibility Assignment Matrix (RACI)* to give input. For instance, if a stakeholder provides activities that are required for a capability like Responsibility, Accountability, Consulting and Informing (RACI) for specific descriptive elements, they pass over from its stakeholder position to a role of the capability.

Sarbanes-Oxley Act – The reform was signed in 2002 and aims to regulate financial practice and corporate governance regarding every enterprise size. It consists of 11 chapters. [http://www.soxlaw.com/]

SECI-Model by Nonaka and Takeuchi – Approach helping to generate knowledge. It differs between 4 types of knowledge conversion: Socialization, Externalization, Combination and Internalization. Knowledge is understood as a two-dimensional phenomenon that is produced only by individuals, but expanded and integrated into systems afterwards. There is a change from implicit to explicit knowledge. [Nonaka et al.(1997)]

Survey - Represents the main technique for gathering information in the context of descriptive capability elements. In particular, these elements are used to either describe the context or improve the comprehensibility of a subject by creating a uniform language. [Wißotzki(a)(2015)]

Strategy models - Type of modeling, which illustrates a strategic plan. It aims to improve a business process, their general operations and meet their goals.

The Open Group Architecture Framework - specific *Enterprise Architecture Framework* by The Open Group. It provides an approach for designing, planning, implementing, and governing enterprise information. [http://www.opengroup.org/subjectareas/enterprise/togaf]

Training - It summarizes all tasks of teaching someone (even oneself) in specific skills, competencies and knowledge.

Unified Modeling Language – It is a notation standard for *Entity Relationship Model (ERM)* , even referenced by ISO. [http://www.uml.org/]

Utilization Model - Type of modeling, visualizing the demand and/or existing sources.

Value Chain – It is a concept of the business management, summarizing a set of business activities in order to deliver a valuable product or service. It contains of primary (e.g. internal logistics, operations, external logistics, marketing & sales, service) and supporting (e.g. infrastructure, human resource management, technology, procurement) activities. [Lassmann(2006)]

Workshop - It names a time-limited event in which a smaller group is working on a specific topic. It is characterized by cooperation and moderation aspects, reaching a common goal.

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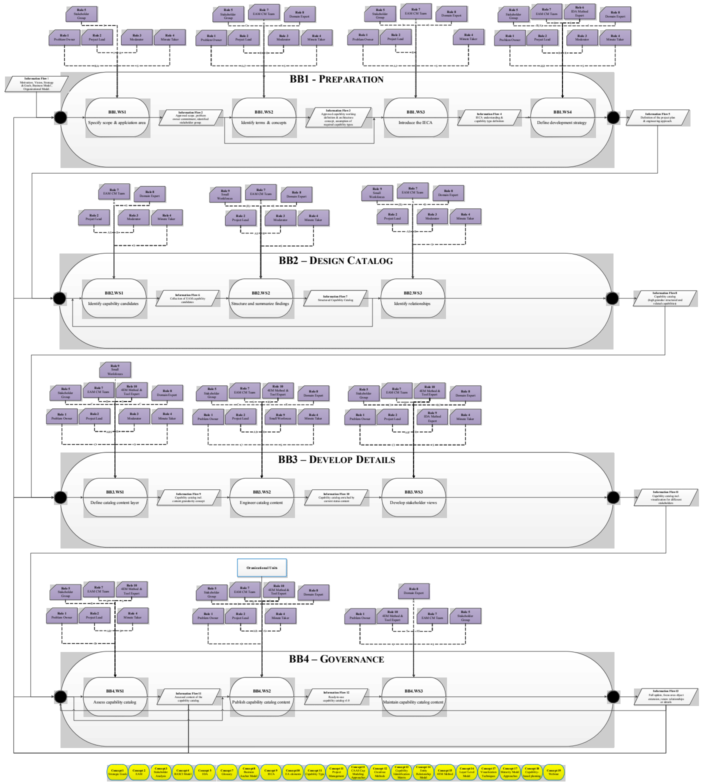
Wißotzki M, Köpp C, Stelzer P. *Rollenkonzepte im Enterprise Architecture Management*. In: European Dialogue on Internet Governance, 2015.

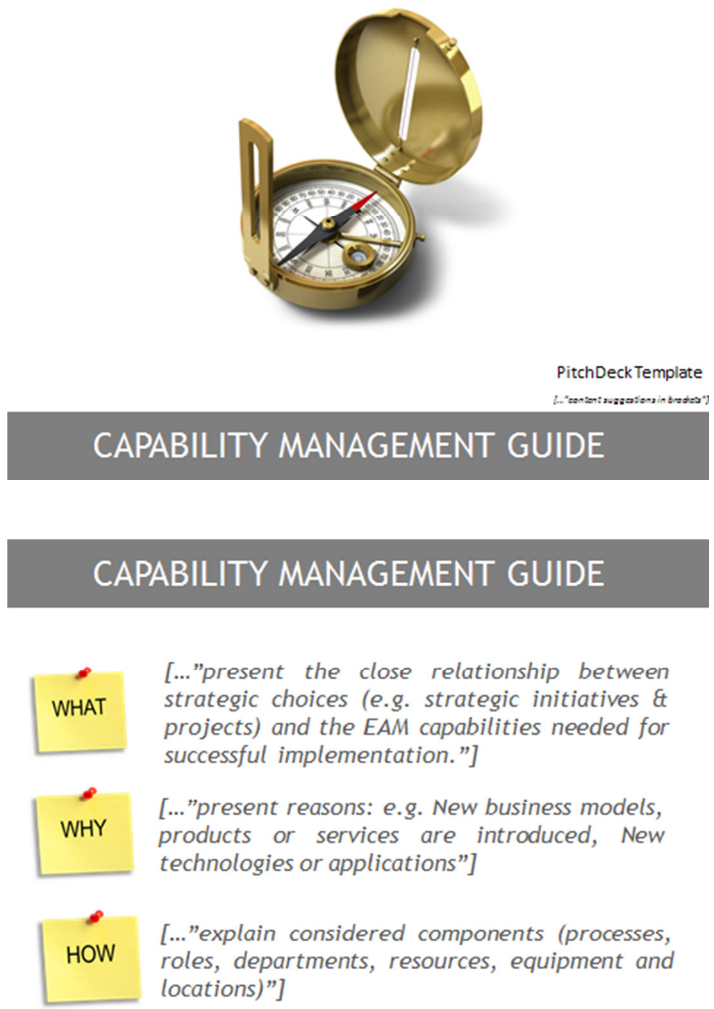
Wißotzki M, Sandkuhl. (2015). *Elements and Characteristics of Enterprise Architecture Capabilities*. In: Perspectives in Business Informatics Research. Pages 82 - 96. Springer International Publishing, 2015.

Winograd T. *Architectures for Context*. In: Human-Computer Interaction, Vol. 16 No. 2. Pages 401 – 419. 2001.

12 Appendix

Process Template
PitchDeck Template

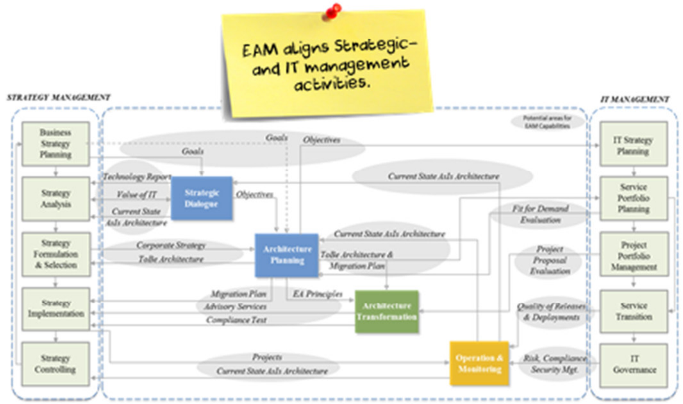




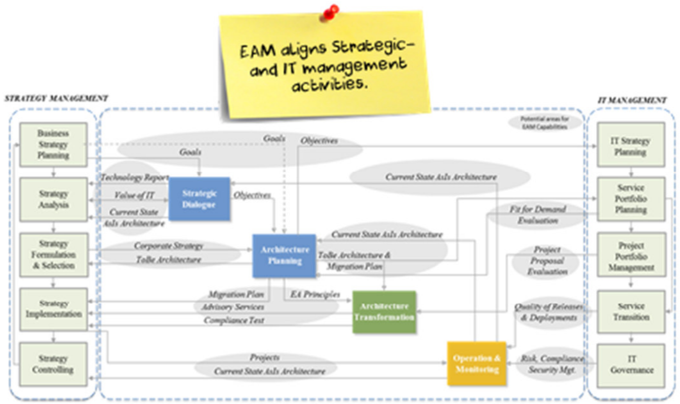
CAPABILITY MANAGEMENT GUIDE

[…"Define objectives"…]

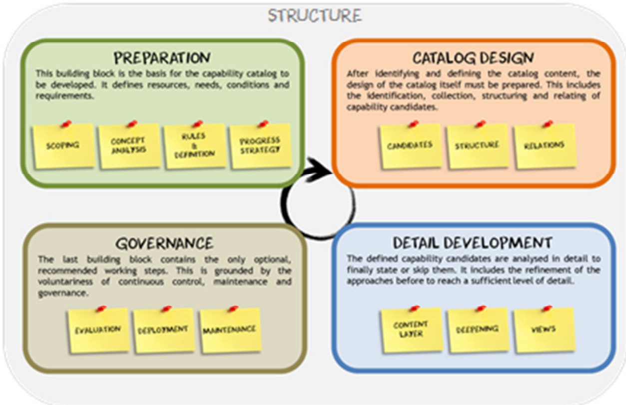
CAPABILITY MANAGEMENT GUIDE



CAPABILITY MANAGEMENT GUIDE



CAPABILITY MANAGEMENT GUIDE



CAPABILITY MANAGEMENT GUIDE

PREPARATION

This building block is the basis for the capability catalog to be developed. It defines resources, needs, responsibilities conditions and requirements.

[..."The following aspects summarize the most important points of the preparation phase:

1. *Define and agree on goals and the application area by all stakeholders*
2. *Ensure to have consent and support of the upper management*
   a) *Involve all relevant organizational units*
   b) *Arrange an adequate period of time and sufficient resources*
   c) *Admit access to already existing documents*
3. *Consider affected individuals at an early stage*
   a) *Inform about the purpose of the capability catalog that is to be created*
   b) *Make the schedule and planned activities available*
   c) *Communicate who currently is or will be involved for what specific purpose*
4. *Creation of a consistent and accepted vocabulary, including terms and concepts*

The quality of a developed capability catalog depends on precise scoping and if compliance with guidelines for quality management is achieved. These guidelines represent another important component of this phase, as they contribute to quality improvement of the development process and allow an evaluation of the achievement of objectives."]

CAPABILITY MANAGEMENT GUIDE

DETAIL DEVELOPMENT

The defined capability candidates are analyzed in detail to finally state or skip them. It includes the refinement of the approaches before to reach a sufficient level of detail.

[..."The following aspects summarize the most important points of the detail development phase:

1. *Definition of content layers as consensus of all stakeholders*
   1. *Min. 2, max. 5 layers*
2. *Specification of descriptive elements in terms of capabilities*
   1. *Appropriate visualizations*
3. *Development of views applied to specific sets of capabilities to different kinds of stakeholder groups*

Therefore, this building block is crucial for defining the final structure and relations of the created catalog. A high level of content detail is important. As a result, the unique and clear naming of content and layers is necessary."]

CAPABILITY MANAGEMENT GUIDE

CATALOG DESIGN

After identifying and defining the catalog content, the design of the catalog itself must be prepared. This includes the identification, structuring & relating of capability candidates.

[..."The following aspects summarize the most important points of the catalog design phase:

1. *Identification of the first capabilities in terms of the application area*
   a) *Determination of content and concepts*
   b) *Selection of an appropriate analyzing method*
   c) *Capability Identification Matrix & Cube*
2. *Creation of a development core team*
   a) *Enlargement during the continuing process*
   b) *Connection of know-how and knowledge*
3. *Restructuring of capability candidates regarding their context*
   1) *Removing, modification or aggregation*
4. *Grouping of the remaining capabilities*
5. *Identification of relationships*
   a) *Removing redundancies*
   b) *Detecting and fixing gaps*
   c) *Removing overlaps*

The quality of this building block depends on precise analyses and resulting measures. Principles to aim are transparency, consistency and accepted understanding."]

CAPABILITY MANAGEMENT GUIDE

GOVERNANCE

The last building block contains the only optional, recommended working steps. This is grounded by the voluntariness of continuous control, maintenance and governance.

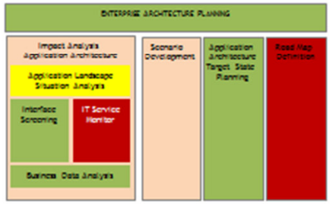
[..."The following aspects summarize the most important points of the governance phase:

1. *Optional: Assessment of ...*
   a) *Development Process*
   b) *Catalog*
   c) *Both*
2. *Selection of appropriate assessment tools*
3. *Implementation/Roll-out of the catalog*
   a) *Earning support by middle and upper management*
   b) *Derivation of activities (Pilot/Full-Rollout)*
   c) *Evaluation in terms of the achieved state and/or stakeholder satisfaction*
4. *Implementation of derived measures*
   a) *Upgrade*
   b) *Update*

This last building block is very important to keep capabilities up-to-date. In fact, the governance process addresses the quality management of the created capability catalog."]

CAPABILITY MANAGEMENT GUIDE

SUMMARY

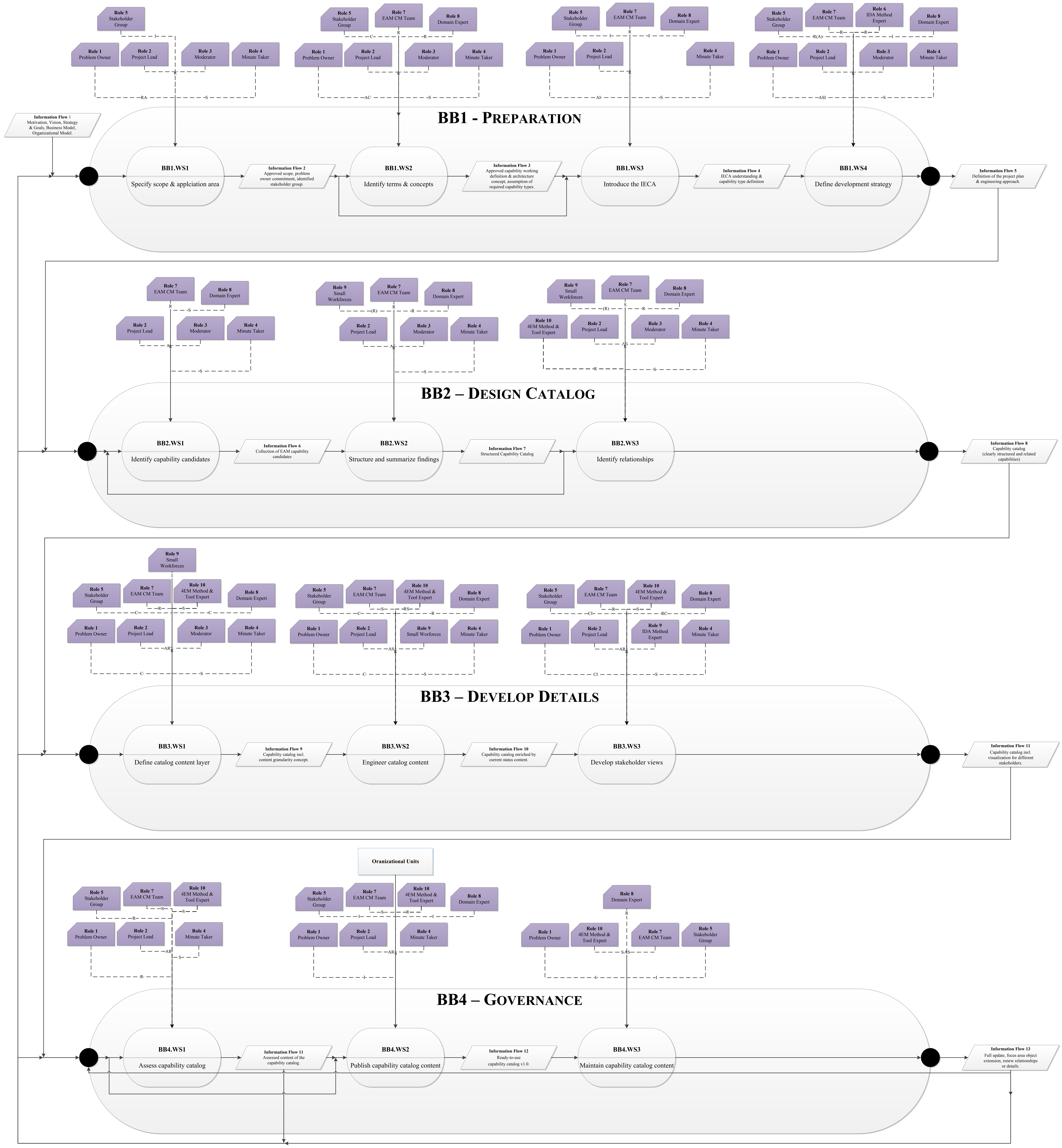


[…"Enterprises reach their goals by implementing strategies. Successful strategy implementation is affected by challenges that an enterprise has to overcome. Enterprises require specific capabilities in order to be able to implement strategies efficiently and achieve a specific outcome. The demand for a systematic management approach to identify capabilities is growing.

We presented a generic approach that can be used to derive capabilities through a structured process and gather them in an enterprise-specific catalog for an effective operationalization of enterprise strategies. A capability describes a certain combination of information, roles, activities/procedures, and resources to support issues like strategy implementation, planning purposes, or transformation processes.

Following a four-building-block approach, we described a straightforward and flexible process for capability catalog developers and designers, which allows the integration of descriptive elements for different capability types. In particular, our approach provides a building block covering the continuous evaluation and maintenance in order to maintain capability and catalog quality."]

A2: CMG V3.0 – 4EM PROCESS & ROLE MODEL



Information Flow 1
Motivation, Vision, Strategy & Goals, Business Model, Organizational Model.
BB1 - Preparation
BB1.WS1
Specify scope & applciation area
Information Flow 2
Approved scope, problem owner commitment, identified stakeholder group.
BB1.WS2
Identify terms & concepts
Information Flow 3
Approved capability working definition & architecture concept, assumption of required capability types.
BB1.WS3
Introduce the IECA
Information Flow 4
IECA understanding & capability type definition
BB1.WS4
Define development strategy
Information Flow 5
Definition of the project plan & engineering approach.
BB2 – Design Catalog
BB2.WS1
Identify capability candidates
Information Flow 6
Collection of EAM capability candidates
BB2.WS2
Structure and summarize findings
Information Flow 7
Structured Capability Catalog
BB2.WS3
Identify relationships
Information Flow 8
Capability catalog (clearly structured and related capabilities)
BB3 – Develop Details
BB3.WS1
Define catalog content layer
Information Flow 9
Capability catalog incl. content granularity concept.
BB3.WS2
Engineer catalog content
Information Flow 10
Capability catalog enriched by current status content.
BB3.WS3
Develop stakeholder views
Information Flow 11
Capability catalog incl. visualization for different stakeholders.
BB4 – Governance
Oranizational Units
BB4.WS1
Assess capability catalog
Information Flow 11
Assessed content of the capability catalog.
BB4.WS2
Publish capability catalog content
Information Flow 12
Ready-to-use capability catalog v1.0.
BB4.WS3
Maintain capability catalog content
Information Flow 13
Full update, focus area object extension, renew relationships or details.
Role 1 Problem Owner
Role 2 Project Lead
Role 3 Moderator
Role 4 Minute Taker
Role 5 Stakeholder Group
Role 6 IDA Method Expert
Role 7 EAM CM Team
Role 8 Domain Expert
Role 9 Small Workforces
Role 9 IDA Method Expert
Role 10 4EM Method & Tool Expert

APPENDIX B: ANALYZED TECHNOLOGY AND IT TREND SURVEY

B1: SIM IT TREND SURVEY ANALYSIS

SIM IT Trend Surveys – Analysis of most important organizational IT Management concerns 2015 – 1980 [335].

ITM goals	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005	2004	2003	1994	1990	1986	1985	1983	1980
Alignment of IT with the business	1	1	1	2	1	3	2	1	2	1	1	1	1	9	7	5	2	7	9
Security/Privacy (b)	2	2	7	9	8	9	9	8	6	3	2	3	3	-	19	18	6	14	12
Business Agility/ Flexibility (c) (d)	9	3	2	3	2	2	3	13	17	7	-	5	7						
Business Productivity	5	4	3	1	4	1	1	7	4										
IT Time-to-Market/Speed of IT Delivery	3	5	(d) New; was with “Velocity” in 2013, and “Agility” through 2012.																
IT Value Proposition in the Business	6	6	New																
Velocity of Change in the Business	-	7	(d) New; was with “Time to Market” in 2013, and “Agility” through 2012.																
Innovation	4	8	New																
Business Cost Reduction/Controls	10	9	4	Combined with “Business Productivity” through 2012.															
Revenue Generating IT Projects	-	10	10	4	9	6	8	17											

(a) Blank cells, unless otherwise noted, indicate that the issue was not asked in that year of the Study.
(b) “Security” and “Privacy” were recombined this year. Separated in 2013, “Privacy” was not selected by any respondent.
(c) “Flexibility” was added this year.
(d) In 2013, “Business Agility and Speed to Market” became “Time to Market/Velocity of Change” and “Business Agility.” This year, “Time-toMarket/Velocity of Change” was separated and became three selections: “Velocity of Change in the Business,” “Velocity of Change in IT,” and “IT Time-to-Market/IT Speed of Delivery.”

B2: GARTNER TECHNOLOGY TRENDS 2011-2016

Gartner Technology Trends Summary 2011 – 2016 [355].

	Gartner Technologietrends					
#	2016	2015	2014	2013	2012	2011
1	The Device Mesh	Computing Everywhere	Mobile Device Diversity and Management	Mobile Device Battles	Media Tablets and Beyond	Cloud Computing
2	Ambient User Experience	The Internet of Things	Mobile Apps and Applications	Mobile Applications and HTML5	Mobile-Centric Applications and Interfaces	Mobile Applications and Media Tablets
3	3D Printing Materials	3D Printing	The Internet of Everything	Personal Cloud	Contextual and Social User Experience	Social Communications and Collaboration
4	Information of Everything	Advanced, Pervasive and Invisible Analytics	Hybrid Cloud and IT as Service Broker	Enterprise App Stores	Internet of Things	Video
5	Advanced Machine Learning	Context-Rich Systems	Cloud/Client Architecture	The Internet of Things	App Stores and Marketplaces	Next Generation Analytics

6	Autonomous Agents and Things	Smart Machines	The Era of Personal Cloud	Hybrid IT and Cloud Computing	Next-Generation Analytics	Social Analytics
7	Adaptive Security Architecture	Cloud/Client Computing	Software Defined Anything	Strategic Big Data	Big Data	Context-Aware Compu-ting
8	Advanced System Architecture	Software-Defined Applica-tions and Infra-structure	Web-Scale IT	Actionable Analyt-ics	In-Memory Computing	Storage Class Memory
9	Mesh App and Service Architec-ture	Web-Scale IT	Smart Machines	In Memory Compu-ting	Extreme Low-Energy Servers	Ubiquitous Computing
10	Internet of Things Platforms	Risk-Based Security and Self-Protection	3-D Printing	Integrated Ecosys-tems	Cloud Computing	Fabric-Based Infrastruc-ture and Computers

APPENDIX C: FRAMEWORKS AND METHODS

C1: EA FRAMEWORKS

Table: Extract of popular EA(M) frameworks, according to [92]

Acronym	**Full Name**
AGATE	The France DGA Architecture Framework
AM	Agile Enterprise Architecture – Agile Modeling
ARCON	A Reference Architecture for Collaborative Networks
CLEAR	Atos Origin's Enterprise Architecture Framework
Deloitte EAF	Deloitte Consulting Enterprise Architecture Framework
DNDAF	The DND/CF Architecture Framework (of Canada)
DoDAF	The US Department of Defense Architecture Framework
FDIC-EAF	FDIC Enterprise Architecture Framework (of the US)
FEAF	Federal Enterprise Architecture Framework (US)
GEA	Government Enterprise Architecture – Queensland Government
GERAM	Generalized Enterprise Reference Architecture and Methodology
IAF	Capgemini Integrated Architecture Framework
IFW	Information Framework (IFW) – by Roger Evernden
MEGAF	Architecture Framework that conforms to ISO/IEC 42010 standard
MODAF	The UK Ministry of Defense Architecture Framework
NAF	The NATO Architecture Framework
NIST EA	NIST Enterprise Architecture framework (of the US)
NORA	Nederlandse Overheid Referentie Architectuur (The Netherlands)
OBASHI	The OBASHI Business & IT methodology and framework
OEAF	Oracle Enterprise Architecture Framework

Acronym	Full Name
PEAF	Pragmatic Enterprise Architecture Framework
PERA	Purdue Enterprise Reference Architecture framework
Praxeme/EST	Open Enterprise Methodology, with Enterprise System Topology (EST)
RM-ODP	Reference Model of Open Distributed Processing
SAM	Solution Architecting Mechanism
SAP-EAF	SAP Software – Enterprise Architecture Framework
TEAF	Treasury Enterprise Architecture Framework (of the US)
TEF	The Enterprise Framework – by Sam Holcman, EACOE
TOGAF	The Open Group Architecture Framework
TRAK	Systems-oriented framework based on MODAF 1.2
ZIFA	Zachman Framework

C2: CAPABILITY FRAMEWORKS

Table: Extract of popular capability frameworks.

Business Capabilities and Exchanges Framework Goran Goldkuhl and Mikael Lind: Developing eInteractions - A Framework for Business Capabilities and Exchanges. In: ECIS 2004 Proceedings (Paper 72)
Business Capabilities Modeling Framework Jean-Pierre Brits, Gerrit Botha, Marlien Herselman (2007): Conceptual Framework for Modeling Business Capabilities. Available: http://proceedings.informingscience.org/InSITE2007/InSITE07p151-170Brits297.pdf
Dynamic Capabilities and Strategic Management Teece, David J., Gary Pisano, and Amy Shuen. "Dynamic capabilities and strategic management." Strategic management journal 18.7 (1997): 509-533.
Capability Assessment Framework for the Adoption of B2B Integration Systems Spyros Mouzakitis, Dimitris Askounis (2008), published in Emerging Technologies and Information Systems for the Knowledge Society, p. 451 - 459
Capability Based Framework for Business Intelligence Olszak, Celina M.: Towards an Understanding Business Intelligence. A Dynamic Capability-Based Framework for Business Intelligence, p. 1103–1110. Available: http://ieeexplore.ieee.org/ielx7/6923033/6932982/06933142.pdf?tp=&arnumber=6933142&isnumber=6932982
Capability Maturity Model Integration Team, CMMI Product. "CMMI for Development, version 1.2." (2006), http://www.sei.cmu.edu/cmmi/, CMMI Institute, http://cmmiinstitute.com/
Capability Maturity Framework for eGovernment Marcelo Iribarren et al. (2008), Capability Maturity Framework for eGovernment: A Multi-dimensional Model and Assessing Tool; published in Electronic Government, p. 136 - 147
Dynamic Capabilities Framework for Context-Aware Mobile Services Chin-Chih Chang (2008), published in 2008 10th IEEE Conference on E-Commerce Technology and the Fifth IEEE Conference on Enterprise Computing, E-Commerce and E-Services, p. 183 - 189
Enhancing IT- Capabilities Framework James D. McKeen, Heather A. Smith, and Satyendra Singh (2005): Developments in Practice XVI: A Frame-work for Enhancing IT Capabilities. In: Communications of the Association for Information Systems Vol. 15 (Article 36),
Framework for Positioning and Assessing Innovation Capability Rodriguez, Lilibeth; Diaz, Jessica; Garbajosa, Juan; Perez, Jennifer; Yague, Agustin: A Framework for Positioning and Assessing Innovation Capability from an Organizational Perspective, p. 3564–3573. Available: http://ieeexplore.ieee.org/ielx7/6751593/6758592/06759046.pdf?tp=&arnumber=6759046&isnumber=6758592

Framework of Alliance Capability Sheng-Hua Zheng: Research on the Fundamental Framework of Alliance Capability and Its Mechanism of Promoting Alliance Performance, S. 963–969. Available: http://ieeexplore.ieee.org/ielx5/4094461/4037319/04105034.pdf?tp=&arnumber=4105034&isnumber=4037319
Green IT Capability Framework Rabiah Eladwiah Abdul Rahim and Azizah Abdul Rahman (2013): Resource-based Framework of Green IT Capability Toward Firm's Competitive Advantage. In: PACIS 2013 Proceedings (Paper 280)
Innovation Capability Maturity Framework Esterhuizen, Denéle; Schutte, Corne; Du Toit, Adeline (2012): A knowledge management framework to grow innovation capability maturity. In: South African IM 14 (1). DOI: 10.4102/sajim.v14i1.495
IS Vendors Capabilities Framework Prashant C. Palvia, Ruth C. King, Weidong Xia, Shaiendra C. Jain Palvia (2010): Capability, Quality, and Performance of Offshore IS Vendors: A Theoretical Framework and Empirical Investigation. In: Decision Science (41), p. 231–270. Available: http://onlinelibrary.wiley.com/store/10.1111/j.1540-5915.2010.00268.x/asset/j.1540-5915.2010.00268.x.pdf?v=1&t=i68fi7eb&s=3a829626ff40bdc25fe8a5316bee8a9ade1f2dda
IS/ICT Management Capability Maturity Framework Jaco Renken (2004) Developing an IS/ICT management capability maturity framework, University of Stellenbosch, South Africa; http://dl.acm.org/citation.cfm?id=1035060
IT Capability Maturity Framework Martin Curley: Introducing an IT Capability Maturity Framework, S. 63–78. Available: http://download.springer.com/static/pdf/301/chp%253A10.1007%252F978-3-540-88710-2_6.pdf?auth66=1423414790_ce82039d9f3a9776a064a12452ac7dbc&ext=.pd
IT Classification Framework Mulligan, Paul (2002): Specification of a capability-based IT classification framework. In: Information & Management 39 (8), p. 647–658. DOI: 10.1016/S0378-7206(01)00117-3
Life Cycle Management Capability Framework Swarr, Thomas; Fava, James; Jensen, Allan Astrup; Valdivia, Sonia; Vigon, Bruce: Life Cycle Management Capability: An Alternative Approach to Sustainability Assessment, p. 35–42. Available: http://download.springer.com/static/pdf/73/chp%253A10.1007%252F978-94
Organizational Capabilities Framework Fabrice Roghe, Andrew Toma, Julie Kilmann, Ralf Dicke, Rainer Strack: Organizational Capabilities Matter. Available: http://www.jma.or.jp/keikakusin/pdf/english_report.pdf
Process Innovation Capability Framework Frishammar, Johan; Kurkkio, Monika; Abrahamsson, Lena; Lichtenthaler, Ulrich (2012): Antecedents and Consequences of Firms' Process Innovation Capability: A Literature Review and a Conceptual Framework. In: IEEE Trans. Eng. Manage. 59 (4), p. 519–529. DOI: 10.1109/TEM.2012.2187660
Product Lifecycle Management Maturity Models Framework Enrico Vezzetti, Maria Grazia Violante, Federica Marcolin (2013). A benchmarking framework for product lifecycle management (PLM) maturity models. In: INTERNATIONAL JOURNAL,ADVANCED MANUFACTURING TECHNOLOGY. - ISSN 0268-3768
Service Innovation Capability Framework Jens Pöppelbuß, Ralf Plattfaut, Kevin Ortbach, Andrea Malsbender, Matthias Voigt, Björn Niehaves, Jörg Becker: Service Innovation Capability: Proposing a New Framework, p. 545–551. Available: http://ieeexplore.ieee.org/ielx5/6068195/6078170/06078176.pdf?tp=&arnumber=6078176&isnumber=6078170
VRIO Framework Barnety, J.B. (1991) "Firm resources and sustained competitive advantage." Journal of Management, 19, p. 99-120.

APPENDIX D: DOCUMENTS & VISUALIZATIONS TECHNIQUES

D1: STANDARD MEETING PROTOCOL

Minutes of Meeting: *(Date) + (Topic)*

Participants:

Name	Required / Optional	Participation	Minutes author
	R		
	R		
	R		
	R		
	R		
	R		
	R		
	R		
	R		
	O		
	R	On vacation	

Agenda

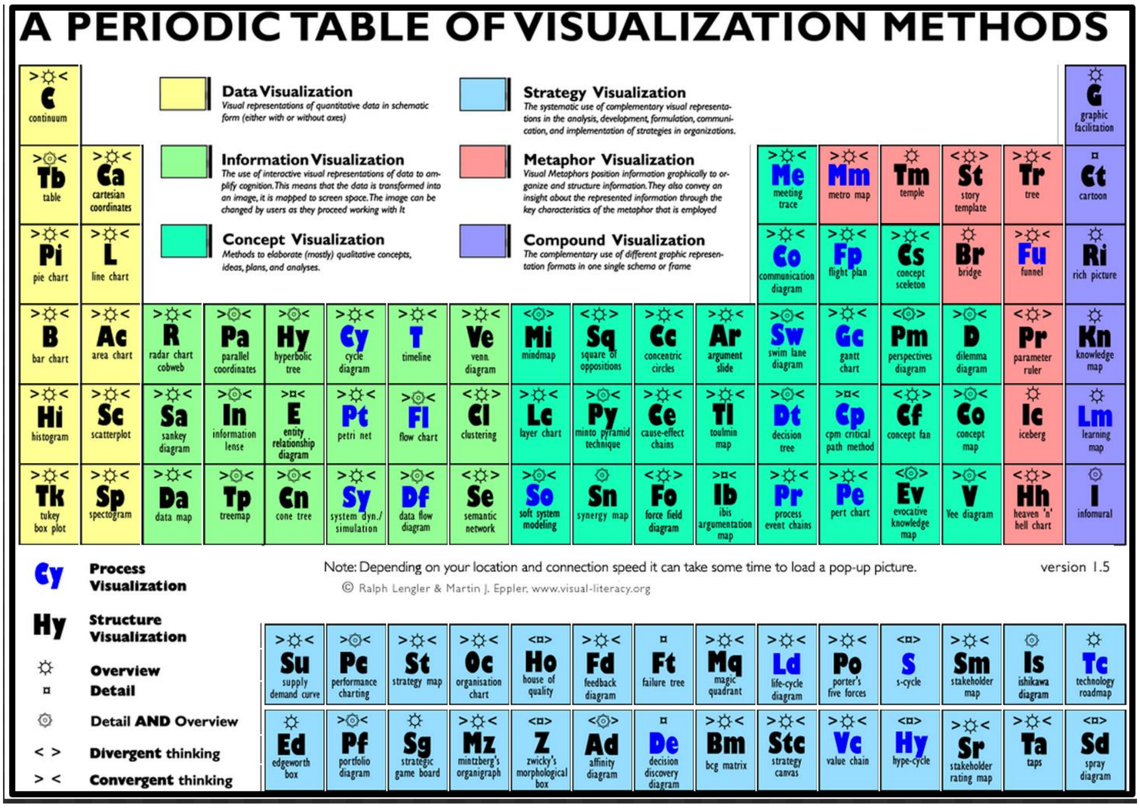
Title	Speaker Responsibility	Time Need (minutes)	Requirements / Content
Check of Action Items		5	
Back Office (Status / Issues)		10	
Status update		15	
Feedback Reporting		10	Optional!
…			

New Action Items

No.	T.	Pr.	Description	Due Date	Responsibility

Type indicators (T):	T	Task	D	Decision	C	Clarification needed	I	Information
Priorities (with T & C):	1	High	2	Normal	3	Low		

D2: VISUALIZATION TECHNIQUES



Perodic table of visualizations [390]

D3: COMMUNICATION PLAN

Example

Report types	Responsible	Recipient	When?
1. Project Status Report	Project lead EAM CM team	Problem owner Stakeholder group EAM CM team	monthly (last Friday in a month)
2. Status Report Sub-activities	Small Workforces	Project lead	monthly
3. Status Report Action Item	AP-Verantwortlicher	Project lead	Project lead specification
4. Report Mile Stones	Project lead EAM CM team	Problem owner Stakeholder group EAM CM team	Mile stone specification
5. Urgent Report	Project lead EAM CM team	Problem owner Stakeholder group EAM CM team	Escalations
6. Delivery Report	Project lead EAM CM team	Problem owner Stakeholder group	Commitment project deliverables
7. Final Report	Project lead EAM CM team	Problem owner Stakeholder group	Project closure
8. Presentation Mile Stones	Project lead EAM CM team	Problem owner Stakeholder group	Project phase closure
9. Final Presentation	Project lead	Problem owner Stakeholder group	Project closure

D4: ELECTRONIC CAPABILITY IDENTIFICATION MATRIX (ECIM)

Example Content Layer 1

Layer	Meta Objects	Archimate 2.0 Ojbects & BSVC Extentsion* & Motivation Extension**	Planning lifecycle: Situation Analysis	Elaborate options	Develop target state	Road mapping & migration planning
Application Architecture	Application	Application Component / Collaboration	Impact Analysis Application Architecture	?	Plan Application Landscape	Plan Application Roadmap
	Information Flow	Application Interface			Plan Information Flow	
	Solution Bulding Block				Plan Solution Building Block	
	Business Object	Business Object			*Plan Business Object	
	Service (abgrenzen zu Appl.)	Application Fuction / Application Servic				
	Application Deployment	Data Object (hier geht es weiter)				
Technology Architecture	Component	Application Component	Impact Analysis Technology Architecture	Elaborate technology options	Plan Component Landscape	Plan Component Roadmap?
	Component Deployment	?? Infrastructure Interface				
	Device	?? Node				
	non-corporate Device (Cloud, BYOD)	?? Communication Path				
	Technical Service (eher SOA Sicht)	?? Network				
		?? Device				
		?? Software System				
		?? Infrastructure Service				
		?? Infrastructure Function				
		?? Artifact				

Example Content Layer 2

CAPABILITY CONTENT

Content Layer 1: ID	Reference zu AO und Mangement Funktion: AO	Mgt.	Capability Name	Outcome	Content Layer 2: Information Demand	Roles	Resources: Technology	Personnel	Budget	Activity / Task
		Planning lifecycle	Impact Analysis Application Architecture	*Analyze the impact of change needs/business requirements against the current state IS architecture.*	Inventory of IS architecture objects		spec. Criterion: Range (simple Excel Catalog - EA Tool Support)	For each role the required personnal has to be in place to make a capability available		
					Dependencies between IS architecture objects known					
					Dependencies to technology architecture objects known					
					Dependencies to Risk & Compliance & Security information known					
					Dependencies to Governance information known					
					Dependencies to business architecture (Motivation, Model, Execution) objects known					
			n Application Landsc	*Developing and documenting target application landscape and detailed analysis of implications & consequences. Plan introduction of new applications, retirement or enhancement of existing applications.*	Inventory of applications					
					Dependencies to legal requirements and other compliance requirements					
					Dependencies between IS architecture objects known					
					Dependencies to technology architecture objects known					
					Dependencies to business architecture objects known					
					Budget information					
					Contract information					
					Strategy alignment					
					BluePrints available					
			n Application Roadn	*Translate target state of application landscape into feasible tactical plans (roadmaps). Ensure that roadmaps reflect the relevant dependencies and requirements at different architecture layers. The application roadmap functions as an*	Gaps between ASIS and TOBE					
					Migration Plan (1..n migrations)					
					Migration Pattern					
					Dependencies to legal requirements and other compliance requirements					
					Dependencies to technology architecture objects known					
					Functions/ Services relevant for migration scope					
					Using organizational units					
					Supported processes					

Example Content Layer 3

SPECIFIC CRITERIA

t Objects Mgt.	Cap Name	Descriptive Element	Assessment Question	Values
	Impact Analysis IS Architecture	Information	Inventory of AA architecture objects available?	see table 1
			Are dependencies between AA architecture objects known?	see table 2
			Are dependencies to business architecture objects known?	see table 3

Application	1			
Solution Bulding Block				4
Business Object		2		
Service (abgrenzen zu Appl.)			3	
Application Deployment	1			

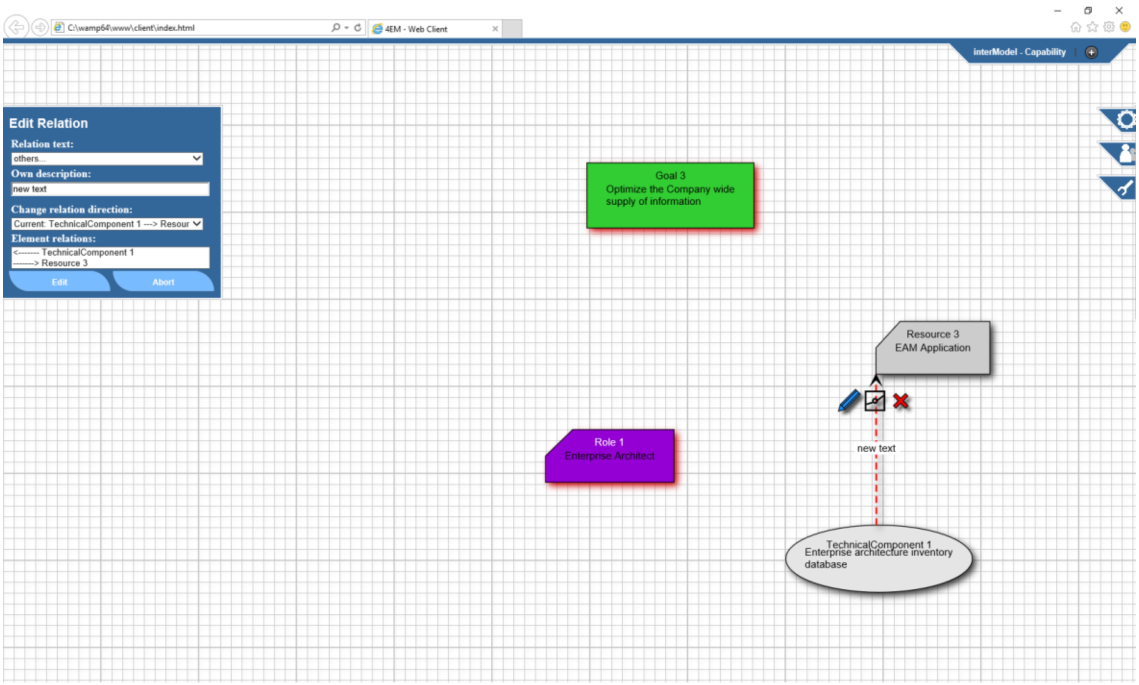
	Application	Information Flow	Solution Bulding Block	Business Object	Service (abgrenzen zu Appl.)	Application Deployment
Application	1		4	2	3	1
Information Flow				3	3	
Solution Bulding Block			2	2	2	
Business Object					3	
Service (abgrenzen zu Appl.)					?	
Application Deployment						

	Process	OrgaUnit	Business Capability	Channel	Stakeholder	Location/ Placement
Application	1	1	4	2	3	1
Information Flow				3	3	
Solution Bulding Block			2	2	2	
Business Object					3	
Service (abgrenzen zu Appl.)					?	
Application Deployment						

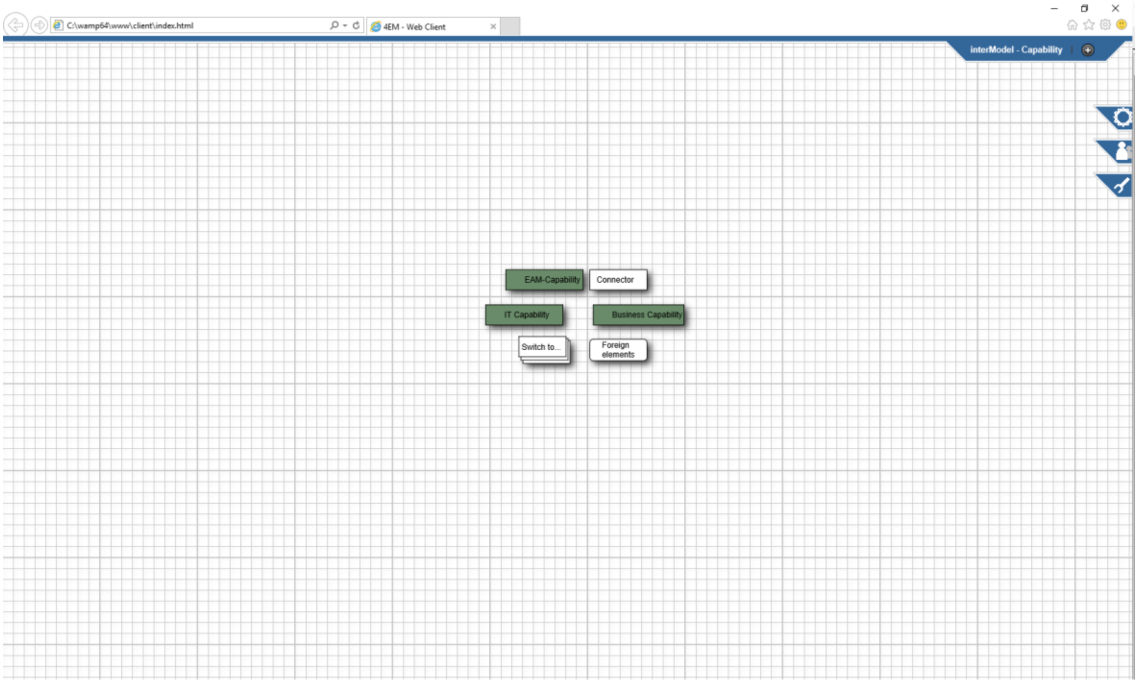
More examples are available at the author

D5: 4EM.DESK 2.7A

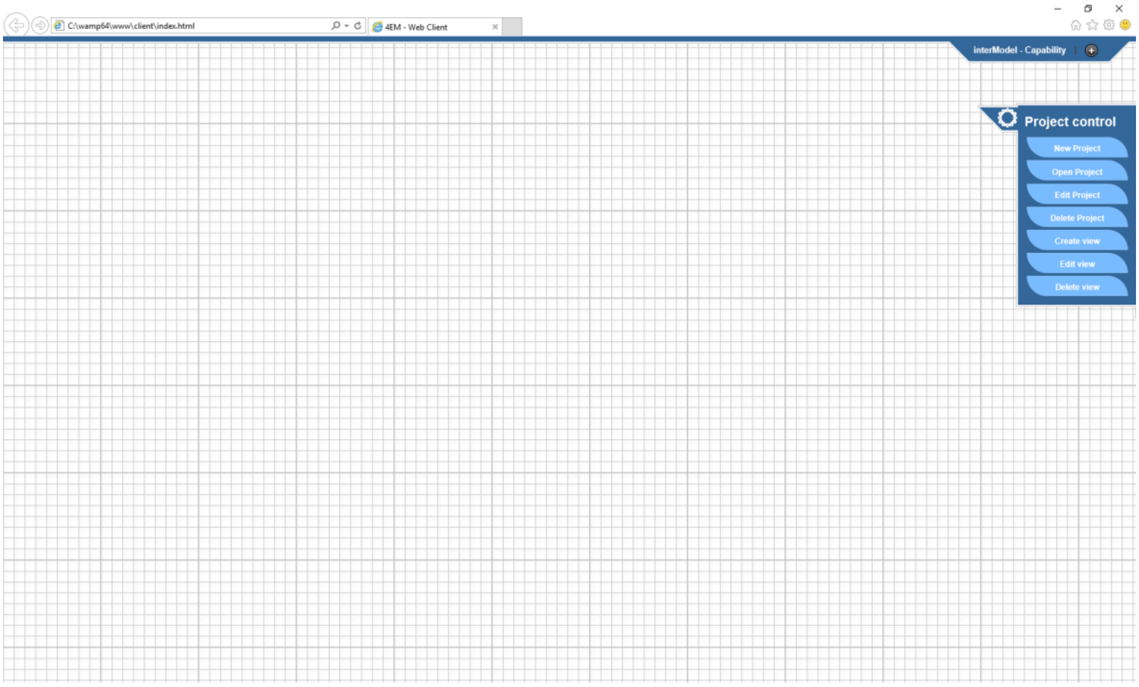
Example for editing EAM capability relationships



Example for editing EAM capability type.



Example for EAM capability catalog control



More examples are available at the author.

APPENDIX E: INTERVIEW GUIDE & QUESTIONNAIRES

E1: EVALUATION QUESTIONNAIRE

Table: Quality evaluation questions.

Quality Questions		
Question	Description	Requirement
Q1. Do you believe that this guide was useful for your use case(s)? Why?	An overall estimation of usability and assistance by this guide is in terms of its value is desirable. With a bigger sample base, the rating can illustrate whether further research and communication is necessary. *Ordinal scale:* Yes >Partly >No *Text field:* Why statements. *Text field:* Suggestions for improvement or reference to in-document comments created by the MS Word "*comment*" function. Answers: R1: Partly: I probably will not have the time/budget to go through all steps of the CMG. However, capturing the capabilities helps to identify all things involved a certain process and provides an additional view on things. R2:Yes: Einhaltung einer sequentiellen Form, so dass keine Schritte vergessen werden können. Erklärung der zu stellenden Fragen für die Erreichung der jeweiligen WS. Kurzversion für kleinere Projekte und Unternehmen. Bündelung von Schritten. Translated: Compliance with a sequential form that no steps can be forgotten. Explanation of questions to be asked for the achievement of each WS. Short version for smaller projects and enterprises. Bundling of steps.	R_{Q11}
Q2. Does the CMG and corresponding capabilities improve your cross-divisional communication in terms of strategy implementation purposes? *Can you tell us more about the background and decisive CMG contribution?*	The CMG was developed to support cross-divisional communication in terms of a high-level communication medium for EAM capabilities and its relation to goals and strategies implementing them. *Ordinal scale:* Yes > Partly > No *Text field:* Background and CMG contribution. *Text field:* Suggestions for improvement or reference to in-document comments created by the MS Word "*comment*" function. Answers: R1: Yes: Identifying and further elaborating on capabilities provides you with a better understanding of everyone elses involvement. R2: Partly: Auf Ebene des Projektmanagements nimmt die Kommunikation zu. Dies ist notwendig, um alle notwendigen Informationen zu erhalten. Auf C-Level kann ich das nicht mit Bestimmtheit sagen. Es könnte sein, dass Informationen auch vorausgesetzt werden. Translated: On the project management level communication increases. This is necessary in order to obtain all necessary information. On the C-level I cannot confirm it with certainty. It could be possible that information is also provided.	R_{Q13},CR_8
Q3. Are the proposed capability assessment concepts appropriate in terms of measuring current and desired future states?	The integrated capability approach and its layered specification should provide possibilities of integrating indicators for measuring capability qualities. *Ordinal scale:* Optimal > Sufficient > Insufficient	R_{Q12}

	Text field: Suggestions for improvement or reference to in-document comments created by the MS Word "*comment*" function. <u>Answers:</u> R1: Sufficient: Cannot really answer this question. Maybe we can discuss in the interview. R2: Optimal: Schwierig zu beurteilen, da wir keine eigene Messung durchgeführt haben. Konzepte wie Maturity Models hören sich jedoch praktikabel und plausibel an. Translated: It is difficult to judge, since we have not performed measurements. However, concepts such as Maturity Models sound practical and plausible.	
Q4. How do you rate design and visualization of the guide?	It is assumed that an appealing design increases the interest and frequency of use studying the guide. The author decided for a discreet and modern design using blue as the only additional color for highlighting specific elements and/or phrases of content. To further contrast the guide from normal books, it has been layout out in landscape format. *Ordinal scale:* Optimal > Sufficient > Insufficient *Text field:* Suggestions for improvement or reference to in-document comments created by the MS Word "*comment*" function. <u>Answers:</u> R1: Optimal: Clear structure, good reading recommendations, easy to follow flow. R2: Optimal: Grafiken waren selbsterklärend. Aufbereitung und Abfolge der Schritte waren logisch und nachvollziehbar. Translated: Graphics were self-explanatory. Preparation and sequence of steps were logical and comprehensible.	R_{Q21}, R_{Q22}, CR_{15}, CR_{23}
Q5. How do you rate the wording and way of expressions?	In order to make the CMG adoptable to a variety of stakeholder (EAM capability newcomers and experts), the guide has to be written in a common, practice-oriented business-style language, merging theoretical knowledge and examples from real-life settings. At the moment, the guide is provided only in the English language. It is assumed that leading positions in medium to large enterprises are used to the international language. Therefore, the rating of the language is important for showing weaknesses of expressions and understanding for external persons. *Ordinal scale:* Intuitive > Suitable > Unsuitable ; Cannot name it. *Text field:* Suggestions for improvement or reference to in-document comments created by the MS Word "*comment*" function. <u>Answers:</u> R1: Intuitive: no comments. R2: Intuitive: no comments.	R_{Q22}, CR_6, CR_7,
Q6. How do you rate the general structure of the guide in terms its procedures and documentation proposals?	Appropriate structuring is assumed to facilitate the understanding and implementation of the CMG in a standardized and repeatable manner. *Ordinal scale:* Intuitive > Suitable > Unsuitable ; I don't know. *Text field:* Suggestions for improvement or reference to in-document comments created by the MS Word "*comment*" function. <u>Answers:</u> R1: Intuitive: no comments. R2: Intuitive: no comments.	R_{Q23}, CR_{13}
Q7. Were the single WS suitable for adaption and/or integration of additional aspects of your project? *Could you give examples!*	In order to provide a certain degree of flexibility the CMG method components should be suitable for adaption and integration of additional enterprise related aspect. *Ordinal scale:* Optimal > Sufficient > Insufficient; Cannot name it. *Text field:* Examples for adaption or integration of project related aspects. *Text field:* Suggestions for improvement or reference to in-document comments created by the MS Word "*comment*" function. <u>Answers:</u>	R_{Q32}

	R1: Optimal: no comments. R2: Sufficient: Nicht alle Schritte passen auf unser Unternehmen und auch nicht auf jedes Projekt. Einzelne Schritte können bei verschiedenen Projekten weg gelassen werden. Das müssen aber nicht immer die gleichen Schritte sein. Möglichkeit Schritte zu komprimieren. Translated: Not all steps apply to our company and to each project. Individual steps can be excluded in various projects. It is not necessary to perform the same steps. Possibility to compress steps.	
Q8. How do you rate the assignment of responsibilities accountable for WS executions? Is something missing?	The ease with which an actor can be made accountable for the workings within the CMG execution. *Ordinal scale:* Complete > Adequate > Fragmentary > Incomplete; Cannot name it. *Text field:* Missing responsibilities. *Text field:* Suggestions for improvement or reference to in-document comments created by the MS Word "*comment*" function. <u>Answers:</u> R1: Adequate: no comments. R2: Complete: no comments.	R_{Q33}
Q9. To what extent the method includes all aspects required for managing your EAM capabilities?	The degree to what extent the CMG includes all desired components in order to support the experts use case. *Ordinal scale:* Complete>Adequate>Fragmentary>Incomplete; Cannot name it. *Text field:* Suggestions for improvement or reference to in-document comments created by the MS Word "*comment*" function. <u>Answers:</u> R1: Adequate: My use case is an external use case. The guide contains more steps that I can potentially implement because of budget restrictions. R2: Complete: no comment.	R_{Q34}

The following specific questions are aimed at particular CMG implementation of concept-related requirements as well as experiences from its execution. The set of specific questions is summarized in the following table.

Concept-related evaluation questions

Conceptual Questions		
Question	Description	Requirement
Q10. Do you rate the integrated capability approach of BB1.WS3 comprehensive and easy to adapt to your business context? Why?	A comprehensible and reusable capability approach was required that is easy to integrate into existing architectures as well as described by a standardized set of descriptive elements. *Ordinal scale:* Yes > Partly > No; Cannot name it. *Text field:* Why statements *Text field:* Suggestions for improvement or reference to in-document comments created by the MS Word "*comment*" function. <u>Answers:</u> R1: *Cannot name it: Not sure what you mean. Let's discuss in the interview.* R2*: Partly: Die Beschreibung der einzelnen Fähigkeiten ist nicht immer eindeutig. Bzw. die Fähigkeiten zu erkennen ist teilweise schwierig. Hier sind vielfältige Beispiele wichtig.* Translated The description of the individual capabilities is not always clear or the identification of capabilities can be difficult sometimes. Here, various examples are important.	R_{C11}
Q11. Are you satisfied with the capability type differentiation concept? Why not?	In order to provide a flexible capability approach, we introduced a capability type differentiation concept based on the combination of descriptive elements. *Ordinal scale:* Yes > Partly > No *Text field:* Why not statements.	R_{C12}, R_{C23}

	Text field: Suggestions for improvement or reference to in-document comments created by the MS Word "*comment*" function. Answers: R1: Yes: no comments. R2: Yes: no comments.	
Q12. Are used terms, concepts and/or approaches of BB1.WS2 appropriately defined and explained? Do you miss anything?	A common understanding between different stakeholders with differing languages (not in the understanding of spoken language, but rather the specific working vocabulary) must be found. Thus, we provide recommendations for the identification of terms and procedure in order to specify a common understanding of respective preconditions. *Ordinal scale:* Complete > Adequate > Incomplete; Cannot name it. *Text field:* Missing aspects. *Text field:* Suggestions for improvement or reference to in-document comments created by the MS Word "*comment*" function. Answers: R1: Complete: no comments. R2: Complete: no comments.	R_{C22}
Q13. Could you identify required stakeholder (groups) using the recommended approaches of BB1.WS1? *Did you use additional approaches*	As better the governance structure of an organization or project including clearly defined roles and tasks, as better works the identification of stakeholders and their agreement on development conditions. Thus, we recommend stakeholder groups that could come into consideration. *Ordinal scale:* Yes > Partly > No *Text field:* Additional approaches. *Text field:* Suggestions for improvement or reference to in-document comments created by the MS Word "*comment*" function. Answers: R1: *Yes:* Strategies for dealing with conflicts would have been nice. R2: Partly: Konnte ich heraus finden. Die Gefahr besteht trotzdem immer, dass Gruppen oder Personen übersehen werden. Auflistung von Beispielen könnte hilfreich sein. Translated: I figured it out. Nevertheless, the danger of ignoring groups or individuals always exists. List of examples may be helpful.	R_{C21}
Q14. Does the systematic capability identification matrix support your identification activities? *Describe your experiences!*	Based on integrated capability approach the capability identification matrix is intended to support the identification of specific capability candidates. *Ordinal scale:* Yes > Partly > No *Text field:* Experience description *Text field:* Suggestions for improvement or reference to in-document comments created by the MS Word "*comment*" function. Answers: R1: *Partly: Yes, it can support it. However, it already presses you into a specific thinking. Brainstorming by itself leaves everything open and the matrix may restrict that thinking by a bit. I would probably use this step later during the summarization as a guide.* R2: *Yes: siehe Kommentare* Translated: Compare with comments.	R_{C25}
Q15. How did you rate the maintenance concept for the capability catalog? Do you miss anything e.g. responsibilities?	The method provides mechanisms that support the recognition of faults, their causes and its correction as well as integrate new requirements occurring from enterprises' changing environments. *Ordinal scale:* Complete > Adequate > Incomplete; I Cannot name it. *Text field:* Missing aspects.	R_{C26}, R_{Q31}, CR_{27}

	Text field: Suggestions for improvement or reference to in-document comments created by the MS Word "*comment*" function. Answers: R1: *Adequate:* Important concept. Not sure if it is complete but it feels like it has all the items required. R2: *Adequate:* Es fehlt nichts. Teilweise ist es aber schwierig Änderungen immer nachzuhalten im Konzept, wenn es nebenbei passieren muss. Translated: Nothing is missing. Sometimes it is difficult to always keep track of changes in the concept, if it has to happen casually.	
Q16. Were the recommended notation concepts suitable for documenting your EAM capabilities? *What kind of notations did you use?*	In order to document e.g. decisions, modelling results and share that information in a standardized way, the CMG provides a set of possible notations for different purposes like protocols for decisions or 4EM capability extension for modeling capabilities. *Ordinal scale:* Yes > Partly > No; Cannot name it. *Text field:* used notations, what do you like, what not? *Text field:* Suggestions for improvement or reference to in-document comments created by the MS Word "*comment*" function. Answers: R1: *No:* Content Layer provides a lot of information and can be very helpful. I probably would not use it because of time/budget restrictions. R2: Partly: Bei kleineren Projekten keine komplette Nutzung. Translated: In smaller projects, it is not used completely.	R_{C27}, CR_{16}
Q17. Did you use the suggested content layer for structuring your capabilities on an appropriate level of detail? *If not, please describe your structuring approach!*	The content layer concept addresses the definition of the content and associated depth in order to provide both a final structure and relations of the capability catalog details. *Ordinal scale:* Yes > Partly > No; Cannot name it. *Text field:* Description of used structuring approaches. *Text field:* Suggestions for improvement or reference to in-document comments created by the MS Word "*comment*" function. Answers: R1: *No:*Content Layer provides a lot of information and can be very helpful. I probably would not use it because of time/budget restrictions. R2: *Partly:* Bei kleineren Projekten keine komplette Nutzung. Translated: In smaller projects, it is not used completely.	R_{C28}

Table: Method architecture related evaluation questions.

Method Architecture Questions		
Question	Description	Requirement
Q18. Did you use the process in sequence or did you recombine single Building Blocks? *What components did you use?*	Modularity is represented by the CMGs BB design in order to its flexibility by recombining respective elements. *Nominal scale:* In sequence; Recombination; I don't know. *Text field:* Description of used components and necessary adjustments. *Text field:* Suggestions for improvement or reference to in-document comments created by the MS Word "*comment*" function. Answers: R1: *In sequence:The flow makes sense.* R2: *Recombination:*Ich habe teilweise auf mehrere iterative Schritte verzichtet und einzelne Punkte kombiniert. Translated: I did it partly without iterative steps and recombinated certain steps.	R_{M21}, R_{Q32}
Q19. Were the relationships between the individual components (Building Bocks & Working Steps)	The method should provide a logically ordered and consistent structure. *Ordinal scale:* Yes > Partly > No; Cannot name it.	R_{M22}

logically, orderly and consistently comprehensible?	*Text field:* Suggestions for improvement or reference to in-document comments created by the MS Word "*comment*" function. Answers: R1: Yes: no comment. R2: Yes: no comment.	
Q20. Did you find an adequate granularity layers for your stakeholders within the CMG under consideration of its information demands? *What concepts did you use?*	Adequate granularity layer of the CMG should be used for communication purposes in terms of providing desired sets of information to various stakeholders. *Ordinal scale:* Yes > Partly > No; Cannot name it. *Text field:* Description of used structuring approach *Text field:* Suggestions for improvement or reference to in-document comments created by the MS Word "*comment*" function. Answers: R1: Yes: no comment. R2: Yes: no comment.	R_{M23}

E2: EVALUATION INTERVIEW GUIDE

Table: Evaluation – Interview Guide

Welcome & Person	**R_x/ CR_Y Reference**
Good day. Thank you in advance for taking time for us. As discussed, I am conducting an interview with you for my dissertation at the institute of business informatics at the University of Rostock. The interview deals with CMG, about your corresponding experience, possible improvements and expansion suggestions. I would like to point out that this is an anonymous survey that is used exclusively for research purposes. Conclusions cannot be drawn to the interviewee from the data. If you mention a name during the interview, it is going to be made unrecognizable in the evaluation. If you do not mind, I would like to record the conversation, because the exact wording is very important for the evaluation later. Do you have any further questions? [Start recording!]	*n/a*
First, I would like to ask you a few questions about yourself, your company and your work. • For how long do you work for your current company? • What is your position in the company? • In what context / project do you use CMG? [Let them speak freely!]	*n/a*
The Capability Management Process aims to identify, structure and maintain EAM capabilities of a company. It means to get an overview of the capabilities, which a certain company has in relation to a particular destination and in a defined area of application (at this point: EAM). It consists of 4 phases (so called building blocks), which will be divided further into sub-steps. I will discuss this structure in more detail in the following part.	
BB1: Preparation The first BB deals with the preparation of catalog development and basic project management activities	
WS1: Scope & Application Area *Determination of responsible roles / stakeholder (Who has to be involved?)* *Defining the scope of application (e.g. business capabilities, informatics capabilities or similar)* *What is the objective to develop the capabilities catalogt?* **Application**: • In which field of application are we? • Who was involved in the development (roles) and who delivered what kind of input? • Who specified which persons have to be involved in the development? • Which stakeholder wants to use the results later? • For what purpose did you define capabilities? • What goals / strategy shall be supported? • Were there any industry-specific capabilities that should be taken into account? • What are the advantages / benefits for the stakeholder? • Who is available for certain working packages? • Stakeholder analysis/ pick-up-points: o What was the attitude towards the project?	R_{C21}, R_{Q33}, CR_1,CR_2,CR_3

◦ Who had what impact on the project? ◦ What did you expect? ◦ Who did initiate the project and why? ◦ Which stakeholders were essential to start the project? ◦ How did you document the results of these questions? • Are the proposed concepts practicable or do they include unimportant aspects from your point of view? • *(CR_1):* Has the importance of WS been sufficiently described? • *(CR_2):* Have you or can you identify all EAM capabilities in your company, if possible? • *(CR_3):* Has the concept of pick-up-points been sufficiently described?	
WS2: Identification of terms & concepts *Clear definition of terms used and concepts for consistent understanding of all parties involved (it is important to document the results), possible compilation of already existing capability concepts.* **Application**: • Did you already apply the concept „capability"? • How do you define capabilities so far? • Are there already capability maps/catalogs/projects/approaches in your company? ◦ What level of detail do these approaches have? ◦ In what field of application have you carried out the project? ◦ How satisfied are the stakeholders with the results up to now? • What definitions of capabilities have been included for the project? • How important do you think is the determination of common basic views? • How did you document results and how did you make them available? • *(CR_4): Is it evident that this working package takes some more time and coordination?* • *(CR_5):* Do you think an overarching modeling concept and a KMS are suitable for documenting results and make them accessible?	*R_{C22}, R_{Q11}, CR_4,CR_5*
WS3: Description of the integrated capability approach *Capability context arises from the previously defined application scope of the catalog* *Distinction between three types of capabilities* **Application**: • Did you and all parties involved understand the approach? • Which elements/objects/functions were important for you? • What type of capability do you use? • How did you document the information / results? • *(CR_7):* Has the approach been sufficiently described? • *Q3. Are the proposed capability assessment concepts appropriate in terms of measuring current and desired future states?* • *Q10. Do you rate the integrated capability approach of BB1.WS3 comprehensive and easy to adapt to your busi-ness context? Why?*	*R_{C11}, R_{C12}, R_{C13}, R_{Q13}, CR_7, Q3, Q10*
WS4: Definition of the developed strategy *Traditional development planning: resource planning (financial, staff) scheduling, securing management assistance, provision / availability of documentation / records* **Application**: • Who was the financial decision-maker? • Who had to contribute which resource and when? • How did you control the accessibility of documents? • How did you inform stakeholders? (as per mail, meeting etc.) • How did you analyze the cost-benefit-ratio? • Which methods did you use for expense planning and scheduling? • *(CR_8):* Did you develop a communication plan? • Were the stakeholders already interested at this time? • Could all parties provide enough time for the project without neglecting the operational business?	*CR_8*
BB2: Catalog Design Within the second BB, capability candidates are identified, collected, structured as well as their relationships identified	
WS1: Identification of Capability Candidates *Defining initial capabilities (e.g. by using brainstorming, surveys, document analysis etc.)*	*R_{C23}, R_{C24}, CR_9,CR_{10},CR_{11},*

Application: • Did you understand the CIM approach? • Has CIM sufficiently been explained? • How difficult was it to work with CIM? • Did you have to adjust the concept of CIM? • *(CR_{10})*: Did you have sufficient examples? • *(CR_{11}):* Was it possible to adjust CIM according to the requirements? • What additional methods did you use for generating initial steps of development? (in addition to the proposed) • Which method did you prefer? How much time would you plan for using this method? • (CR_9): Was it possible to adjust the proposed workshop method flexibly and accurately? • *Q11. Are you satisfied with the capability type differentiation concept? Why not?*	*Q11*
WS2: Structuring and Summarization *Concretization of previous broadly defined capabilities, removing redundancies, aggregation/categorization of similar capabilities for better clarity and understanding, hierarchies* **Application**: • How did you review the first results / CIM • Has a pooling of redundant elements with similar content been conducted? • Have capabilities been removed, combined or extended? • How have changes been documented? • *(CR_{12}):* Have small teams been used for the revision? • *(CR_{13}):* Have BB2.WS1 & WS2 been conducted iteratively? • *Q14. Does the systemat-ic capability identifica-tion matrix support your identification activities? Describe your experiences!*	*R_{C25}, CR_{12}, CR_{13}, Q14*
WS3: Identification of Relationships *Determination of dependencies between capabilities, information demand, causal dependence.* **Application**: • *(CR_{14}): Could you identify relationships / dependencies relating to capabilities, which support the same objective?* • *(CR_{15}): Did you understand the visualization?* • *(CR_{16}): Was 4EM Capability Extension a suitable notation to document dependencies?* • *(CR_{17}): Was 4EM.Dev Software a suitable modeling tool?* • Which method would you use for identifying relationships? • Do you know other types of relationships or did you use other types?	*R_{C14}, R_{C27}, CR_{14}, CR_{15}, CR_{16}, CR_{17}*
BB3: Catalog Design The third building block is responsible for the refinement and renewing of already achieved results.	
WS1: Content Layer Definition *The final structure of the capability catalog shall be developed via the content layer definition, e.g. description elements and evaluation criteria.* **Application**: • How detailed did you describe the EAM capabilities? • *(CR_{18}):* Has the layer concept clearly and sufficiently been described? • Were the proposed 3 layers sufficient for the application? • Do you think this step is necessary? • *Q17. Did you use the suggested content layer for structuring your capabilities on an appropriate level of detail? If not, please describe your structuring approach!*	*R_{C28}, CR_{18}, Q17*
WS2: Capability Content Engineering *Content-related and detailed description of EAM capabilities.* **Application examples**: • What kind of information was necessary? • What resources were necessary? • Who did provide the required information? • Who was the decision-maker? • Have the intended outputs been achieved? • Did you follow a clearly defined procedure for detailing the concepts/steps/processes?	*R_{Q12}, CR_{19}, CR_{20}, CR_{21}*

• *(CR_{19}):* Was the provided description to create a content layer sufficient in detail? • *(CR_{20}):* Did you use smaller workshops to describe specific capabilities in more detail? • (CR_{21}): Did you use the proposed modeling tool to document the described capabilities? • Did you miss components to describe capabilities?	
WS3: Development of Stakeholder Views *When describing capabilities in detail, it is necessary to ensure that every capability is formulated in a general manner, i.e., there should not be any connections to objects such as particular applications or markets. In general, views might be applied to present specific sets of capabilities to different kinds of stakeholder groups.* **Application**: • Who had to access which catalog information? • Have restrictions been implemented with regard to certain views for certain stakeholders? • Was the relationship between capability and strategy of particular importance? • *(CR_{22}):* Did you use one of the proposed methods for information needs analysis? • *(CR_{23}):* Were the examples and concepts sufficient?	R_{Q13}, R_{Q22} CR_{22}, CR_{23}
BB4: Catalog Governance The governance process addresses the quality management of the created capability catalog. It thus includes activities referring to the assessment, deployment, and maintenance of a catalog.	
WS1: Assessment *The focus of the assessment concept can be the development process (the way the catalog is constructed), the designed result (the catalog itself), or both* **Application**: • How did you check the general quality of the generated capabilities or the catalog? • Did you use defined criteria of BB1 & BB3? • Which criteria did you choose? • Did you use a maturity model to assess the entire catalog? • Did you achieve the desired quality? • How did you document the results? • *(CR_{25}):* Did you present the quality assessment to already involved stakeholder? • Are you satisfied with the results as a project manager? • Is the catalog of satisfactory quality? (see previous steps)	R_{Q11}, R_{Q12}, CR_{25}
WS2: Rollout *The way of integrating a catalog into an enterprise has a vital influence on the success of this catalog.* **Application examples**: • Have all stakeholders agreed with the results? • Who had to be convinced? • Who decided on the introduction? • Who was holding the presentations? • Whose feedback was of utmost importance? • What had to be done? • How has the catalog been provided? • How has the catalog been used? • Has CMG been introduced as a standardized method? • *(CR_{26}):* Have trainings on handling the catalog been carried out? • Were there specific techniques to document problems, critique, user feedbacks and user questions during and after the presentation?	R_{Q23}, R_{Q24}, CR_{26}
WS3: Maintenance *The following WS shall ensure the high quality and a lasting operating life of the catalog, which means that necessary changes must be recognized and implemented by updates, context extensions or an entire renewal.* **Application**: • Who was appointed for this task? • Are there statements about the operating life of the catalog? • Who has to approve potential changes? • Who has to provide the input? • Are there sufficient resources (time/finance) in the long term? • Would you use external help in the long term? • *(CR_{27}):* Have the proposed roles for maintenance been sufficiently described? • *(CR_{28}):* Do you use the „all-do-some“ or the „some-do-all“ approach? • What internal measures would you take and how often would you perform these measures?	R_{C26}, R_{Q31}, CR_{27}, CR_{28}

General questions	
• *(R_{Q21}):* How do you evaluate the general process regarding the practicability and applicability? • *(R_{Q22}):* Were the proposed approaches, recommendations and visualizations generally compre-hensible? • *(R_{Q31}):* Is there something that you missed in the process? • *(R_{M21}):* Did/ Could you combine different BB and/or WS? • *(R_{Q32}):* Was it possible to adjust and integrate additional components? • *(R_{M22}):* Was CMG structured logically, orderly and consistently enough? • *(R_{M23}):* Did you find an adequate granularity layers for your stake-holders within the CMG under consideration of its information demands? • *Q7. Were the single WS suitable for adaption and/or integration of additional aspects of your project? Could you give examples!* • *($R_{Q34,}$ Q9): To what extent the method includes all aspects required for managing your EAM capabilities?* • *Q18. Did you use the process in sequence or did you recombine single Building Blocks? What components did you use?* • Do you have further comments or feedback?	*R_{Q21}, R_{Q22}, R_{Q31}, R_{Q32}, R_{M21}, R_{M22}, R_{M23}* *Q7, Q9, Q18*
Completion / end	
As we are at the end of the interview, I would like to thank you sincerely for taking your time to conduct the interview. You helped me a lot and if you are interested in the evaluation, I will gladly send them to you. • Is there anything else I did not ask, but you would like to add due to the importance with regard to the subject matter? Thank you once again for your time. I wish you and your company all the best!	

THESES

1. *Enterprise Architecture Management* (EAM) is becoming increasingly important for the systematic support of strategy implementation considering the Business- and IT Alignment. Therefore, enterprises require specific capabilities to optimize enterprises' economic impacts of EAM supporting business- and IT alignment.
2. Due to the global digitalization, fast shifting business models and short technology lifecycles, modern enterprises need strategies to deal quickly with unpredictable changes to stay competitive. Capability-based approaches support such required strategies.
3. Enterprises interact with different environments, which involve different challenges and opportunities. These circumstances also have impact on the flexible composition of EAM capabilities in general i.e. different circumstances require different capability types, new capabilities are needed, existing capabilities need to be adapted or are no longer needed.
4. The concept of capabilities is applied and interpreted in a variety of different ways. The *Integrated Enterprise Capability Approach (IECA)* helps to precisely describe EAM capabilities by specifying its elements and characteristics.
5. While existing capability approaches already provide good assistance regarding modeling and evaluation, a holistic and structured management process, which continuously supports enterprises in management, adjustment and application of EAM capabilities in a catalog represents a suitable completion to these approaches.
6. Capability catalog development projects require an understanding of the preconditions for capability management. A preparation phase helps to perform the guided analysis of enterprises existing concepts and mapping them to the IECA.
7. An initial capability catalog can be set up by the identification, structuring and defining relationships of EAM capabilities. The *Capability Identification Matrix (CIM)* represents a concept to assist the design process of the catalog.
8. Different levels of detail are required for EAM capabilities. For content engineering with regard to the desired level of detail, the *capability content layer approach* is suitable for a flexible adjustment.
9. Capabilities have three states: *operational, theoretical, planned status*. The operational status implies that the descriptive elements of an EAM capability are available and ready for use. The theoretical status indicates that the descriptive elements of an EAM capability are available, but not ready to use. The planned status implies that the descriptive elements of an EAM capability are neither available nor ready for use.
10. An *all-do-some maintenance approach* helps to keep capabilities up-to-date by integrating instruments to consider feedback of the entire enterprise.
11. EAM capabilities within a strategic dialogue support decision-making of the strategy management through the ability to reflect the impact of changes to the current enterprise architecture.
12. The *Capability Management Guide (CMG)* is a suitable instrument for Business- IT alignment by managing all relevant EAM capabilities in a continuous and structured process.

VITA

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