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Application Portfolio Management from an Enterprise Architecture Perspective

Reducing the IT Landscape Complexity

Master's Thesis
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Abstract

In the past decades organizations have collected up to thousands of different applications supporting their business. This immense growth of the application landscape has been stimulated by advances in technology, mergers, acquisitions and organic growth of organizations. Organizations aim to reduce the complexity of the application portfolio and the related costs, but face a challenging time as their budgets for innovation is typically small. Application Portfolio Management (APM) is considered as the discipline to assess individual and application portfolios to justify their 'value', in order to make better decisions regarding the future state. APM is closely related to Enterprise Architecture (EA). EA can be used to unveil the relations between business processes, applications and underlying infrastructure. Moreover, EA can be used to effectively detect misalignments and redundancies in the application landscape.

This research aimed to create a new APM method and framework from an EA perspective. Method Engineering (ME) was used as technique to model existing APM approaches from literature, practice and Deloitte. In total, eight existing APM approaches were modeled using ME. A workshop with three experts was organized and functioned as construction instrument and resulted in a new APM method. The proposed APM method is clearly influenced by EA, both in activities as in the roles defined. More than twenty experts were interviewed and provide insight how APM is being applied in practice. Moreover, the interview results led to a set of lessons learned of applying APM. The proposed APM method includes the roles and responsibilities defined for each activity using a RACI model. The deliverables such as the lessons learned and the RACI model complement the proposed APM method and can be considered as the framework. Finally, the proposed APM method was evaluated by three experts and the majority of the method was considered credible.

Keywords: Application Portfolio Management, Enterprise Architecture, Method Engineering.

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1 Introduction

Over the past decades due to growth, mergers and acquisitions and fuelled by advances in technology, many companies have collected up to thousands different applications supporting their business. The collection of applications is often referred to as the IT landscape (Simon, Fischbach, & Schoder, 2010). Unfortunately, the process of selecting those applications is rarely undertaken through a planned approach (Lindström, Johnson, Johansson, Ekstedt, & Simonsson, 2006). As a consequence, the IT landscape is often poorly understood, which has led to the storage of redundant data and implementation of similar features (Lindström et al., 2006). Therefore, it is beneficiary for larger organizations to view and manage IT investments as a portfolio. By managing IT investments as a portfolio, organizations can make better decisions and achieve a better result rather than managing investments case by case. The core of IT Portfolio management is the optimization of IT investments in relation to their costs and benefits (Lankhorst, Quartel, & Steen, 2010). IT Portfolio management is the systematic management of elements such as applications, projects, services and infrastructure (Simon et al., 2010). IT Portfolio management can be further differentiated into application portfolio management (APM) and project portfolio management (PPM).

The relation between APM and PPM can be described as follows. APM considers the needs and value of the current portfolio of IT assets in order to further align IT assets with business goals or other drivers (Quartel, Steen, & Lankhorst, 2010).This can lead to decisions such as: to extend functionality, replace or eliminate a certain application. Second, this kind of decision making lead to a new proposal of a project or program, which needs to be assessed on its value and has to be fit within the project portfolio, for which PPM is used. Completed projects deliver a new IT landscape, representing the new application portfolio (Lankhorst, Quartel, & Steen, 2010).

In other words, APM is the discipline that tries to justify the 'value' of applications where usually benefits are compared with the costs of maintenance and ongoing operations (Lankhorst et al., 2010). Several definitions exist in literature and APM and Application Portfolio Rationalization (APR) are often used interchangeably. Two definitions for APM are presented below: Riempp & Gieffers-Ankel (2007) state that "APM comprises all models, methods and guidelines applied by IT decision-makers for the assessment, management and optimization of an Application Portfolio (AP). It requires the consideration and integration of different concerns and viewpoints such as IT strategy, business and application needs, IT architecture, IT operation, IT project management and IT investment".

Simon et al. (2010) state "Application Portfolio Management is the ongoing application of systematic and structured decision-making processes to evaluate an organization's applications along various dimensions (from a business and a technical viewpoint), weigh various actions for the purpose of optimization and implement appropriate actions to resolve identified issues and meet key enterprise objectives. The promise of Application Portfolio Management lies primarily in reducing the complexity of the application landscape, which is approached from a holistic viewpoint". In this research the latter definition is used because it is more complete, namely, it includes the main reason for APM and that it is approached from a holistic viewpoint.

As stated previously, the assessment of a current application portfolio can lead to a judgment such

as: keep, consolidate, redevelop, or eliminate an application. In order to make such judgments, not only costs and benefits should be taken into account, but strategic importance for example as well. Applications are linked to business functions and processes. This is combined in enterprise architecture (EA), therefore APM could be seen as part of EA. Lankhorst defines EA as ''a coherent whole of principles, methods and models that are used in the design and realization of an enterprise's organizational structure, business processes, information systems and infrastructure'' (Lankhorst, 2005). The Open Group (2011) defines an 'enterprise' in this context as "any collection of organizations that has a common set of goals and/or a single bottom line". Architecture frameworks like TOGAF or Zachman's framework can be used to map relevant aspects that, for example, help to resolve redundancies, spot missing integration links, or help detect misalignments. Those frameworks usually consist of different layers, such as a business layer, organization layer, application layer and infrastructure layer.

1.1 Research question and scope

The broader business and technical perspective of enterprise architecture can influence application portfolio decisions from a more holistic enterprise perspective and could therefor also enhance it. Therefore, it is interesting to research how application portfolio management is currently applied and how it can be strengthened by using or integrating it with enterprise architecture approaches. This resulted in the following main research question:

How can a framework and corresponding method be created to value an application portfolio from an enterprise architecture perspective?

The answer sought will be presented by creating a new framework and a corresponding method by combining current APM practices with enterprise architecture approaches. The word framework itself is used extensively in many different academic fields. Oxford Dictionary has the following two definitions: "an essential supporting structure of a building, vehicle, or object", for example a conservatory in a delicate framework of iron and (2): "a basic structure underlying a system, concept, or text", for example: the theoretical framework of political sociology. The MacMillan dictionary contains the following definition: "a set of principles, ideas etc. that you use when you are forming your decisions and judgments", e.g. a framework for the study of television's effect on society. A combination of these two definitions describes the intended output for this research most adequate, which leads to a basic structure composed of a set of principles, ideas etc., which can be used when decisions and judgments are formed. The framework envisioned for this research can best compared to the Business Canvas Model by Osterwalder & Pigneur (2010), in which different relevant elements describing the business model are listed under categories. The method will conceptualize and describe how the framework can be used.

To scope this research it is important to restate the difference between APM and PPM. The core of APM is to value current application portfolio(s), whereas PPM is about managing projects and mapping the risks involved with those (future) projects. This research is scoped at everything concerning the valuation of the application portfolio, which means that PPM is out of the scope.

In order to create a framework for APM and a corresponding method, elements or generalizable characteristics, will be collected. The focus lies on identifying processes and activities. For example: an activity to analyze source code. The activity itself will not be described in detail as this would require a too extensive research. Moreover, it is unnecessary to provide this much detail when for example a specific topic or technique is already covered extensively in other scientific work.

To come to such a framework and a method as described above, the following sub-questions have to be answered:

1. What methods exist to support APM in the context of enterprise architecture?

1.1 What are the processes in APM?
1.2 What characteristics of applications are to be considered in APM?
1.3 What is the relation between APM and EA?
1.4 How is APM used in EA and vice versa?

The answers to these sub-questions should give a clear overview of the current methods that exist to support APM and EA. From existing methods and literature, process phases will be identified along with the characteristics which have to be considered when evaluating the application portfolio. The relation between EA and APM in scientific literature will be subject to research. Finally, the way APM is used in EA and vice versa will be studied.

In addition to existing knowledge and theory, empirical research will be conducted to see how APM and EA are used in enterprises. Several interviews and case studies will be held from at least three different sectors. The Deloitte supervisor advised that the best chances for a 'best-practice' in combination with Deloitte's network would be in the Financial Services Industry, Consumer Business and Manufacturing. The supervisor suggested that it would be harder to obtain a relevant case in the Public Sector and therefore the Public Sector has been left out. Deloitte Consulting Netherlands distinguishes four main industries, namely: Consumer Industry, Manufacturing, Financial Services Industry and Public Sector. Each sector can be further divided in categories and segments. For example, Manufacturing includes a category Real Estate. This leads to the following sub-questions presented below.

2. How is application portfolio management executed in enterprises and how is enterprise architecture related to that?

2.1 What similarities and differences can be found in APM application in different sectors?
2.2 What are experiences from practice in APM and EA?
2.3 What are experiences from software tool vendors in the APM / EA field?

The second sub-question will be answered by means of case studies and expert interviews to see how APM and EA are used within enterprises. The APM approaches used in practice will be described and modeled. Furthermore, sector differences and similarities will be described. Finally, the experiences of software tool vendors in the APM / EA field will be described. The main focus will be on APM aspects and to a lesser extent on EA. The main research question includes the question how a method and framework can be created. In order to create these, the following questions have

to be answered:

3. How can the method and framework be created?

> ***3.1 How can the experiences from practice be integrated in the framework plus method?***
> ***3.2 How can the framework plus method be evaluated?***

These questions consider which modeling technique can be used to support the creation of the method and framework. Furthermore, it will answer how the experiences from practice can be integrated in the method and framework. Finally, these questions will answer how the final framework including the method will be evaluated. The method engineering technique will be used for the creation of the methods. Method engineering can be used to engineer methods specifically for a project at hand, by re-using parts, referred to as method fragments, of existing established methods (Weerd & Brinkkemper, 2008). Chapter 2 describes the method engineering approach in detail and motivates the choice for it.

In order to be consistent throughout this project, important concepts and definitions have been defined and can be found in the Appendix 7.1.

1.2 About Deloitte

This research is being conducted at Deloitte Consulting Netherlands, at the Enterprise Architecture service line. Deloitte Consulting consists of several service lines, the service line which is most related to this research subject is Enterprise Architecture. Deloitte's network can be used to contact relevant experts.

The Enterprise Architecture service line is further divided into three different specialties namely, Enterprise Architecture, Enterprise Content Management and Business process management. Enterprise architecture is focused on establishing enterprise architecture within organizations or help organizations in the execution of it. Enterprise content management has more to do with organizing the content through an organization using IT. Finally, business process management focusses on helping organizations modeling their business processes, which can be used to improve business processes.

IT subjects often have a multidisciplinary nature, just like APM. APM is sometimes used at the IT Strategy and Programme Leadership service lines. IT Strategy is focused helping clients to (re)define their Business- IT strategy. Sometimes an assessment of the current IT landscape is necessary depending on the question of a customer client. Therefore, IT strategy related projects occasionally have an APM aspect as well. However, it is mostly used at a single point in time to provide a snapshot without implementing APM as a continuous process. One of the areas of Programme Leadership service line is portfolio management and is concerned with project portfolio management (PPM). In this role they are often dependent on adequate information about the application landscape. The relation between APM and PPM has been described earlier and will be further elaborated in chapter 3.

This research aims to be useful for service innovation for the Enterprise Architecture service line and combine overall knowledge of the other service lines IT strategy and program leadership on this matter. Finally, the results will be used for the improvement of the APM proposition.

1.3 Thesis structure

This thesis is structured as follows: in this chapter the research topic and research questions have been introduced. Furthermore, a short description of the host company for this research has been given and the context of this research topic within Deloitte has been explained. Chapter 2 describes the research approach, including the research phases, main deliverables and method engineering as modeling technique. Chapter 3 describes the literature study and is divided in four sections including APM, EA, the relation between APM and EA and presents the conclusions taken from literature. Chapter 4 presents the empirical results of explorative, case companies, software vendors and individual experts. The chapter ends with a conclusion of empirical research. Chapter 5 presents the creation of the APM method/framework during the APM workshop and presents the evaluation of the APM method/framework. Finally, chapter 6 presents the discussion, followed by the conclusions and potential future research.

2 Research Approach

2.1 Design research

This research combines several research methods, namely: literature study, case study, in-depth interviews and research design. As the APM method and framework will be the main deliverables of this research, this research can be classified as design research. Design research creates and evaluates IT artifacts intended to solve organizational problems (Hevner et al., 2004). In this context, design refers to a product (artifact) and a process (activities) (Walls, Widmeyer & El Sawy, 1992). This chapter is divided as follows: section 2.1 provides the general steps and motivations for the chosen research approach. Section 2.2 describes the main deliverables related to the research questions. Section 2.3 explains the empirical research approach. Section 2.4 explains the method engineering approach in detail and provides a short example.

This research consists of four main phases. The first step incorporates a literature study. The literature study results in a clear overview of APM and EA and the methods that are being used for those disciplines. Furthermore, it should provide the answer to what the relation between APM and EA is. Important characteristics of applications that are to be considered when performing APM will be identified and described. Candidate methods will be selected from literature and modeled using method engineering. This will lead to the construction of a process-deliverable diagram (PDD), using the method as proposed by Weerd et al. (2008).

Second, in-depth interviews (or unstructured interviews) will be held with both consultants at Deloitte and experts at (case) companies. These experts could have positions like architect or IT manager. Furthermore, interviews will be performed with experts from relevant software vendors in the APM/EA field. The results should give insights to how APM and EA are used in enterprises and describing differences and similarities between different sectors. Finally, the approaches/methods found in practice will be modeled in PDDs.

In the third phase the development of the framework and corresponding method takes place. In order to design and create a framework plus a corresponding method, the design cycle as proposed by Takeda (1990) will be followed. The design cycle is depicted in Figure 2-1 and consists of five activities. Awareness of problem entails the discovery of suggestions for a problem which are drawn through abduction from existing knowledge and theory. These suggestions lead to the development of the framework plus method, which are then through deduction improved. Finally, after iterations, the conclusion indicates the termination of a design project. The collected PPDs in phase 1 and 2 form the basis for the new APM method plus framework.

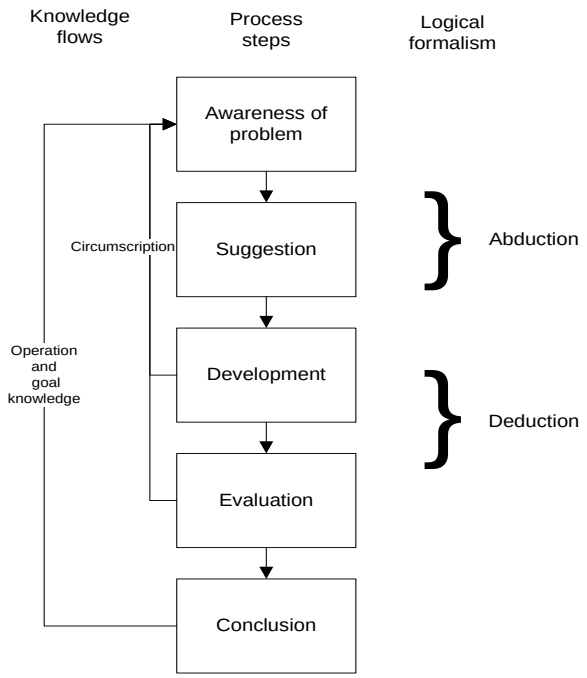

Figure 2-1: Design cycle in design research (Takeda et al., 1990).

Finally, in the last phase evaluation of the APM method and framework takes place. The APM framework and method will be evaluated by experts.

The whole research approach is modeled in a PDD and depicted in Figure 2-2.

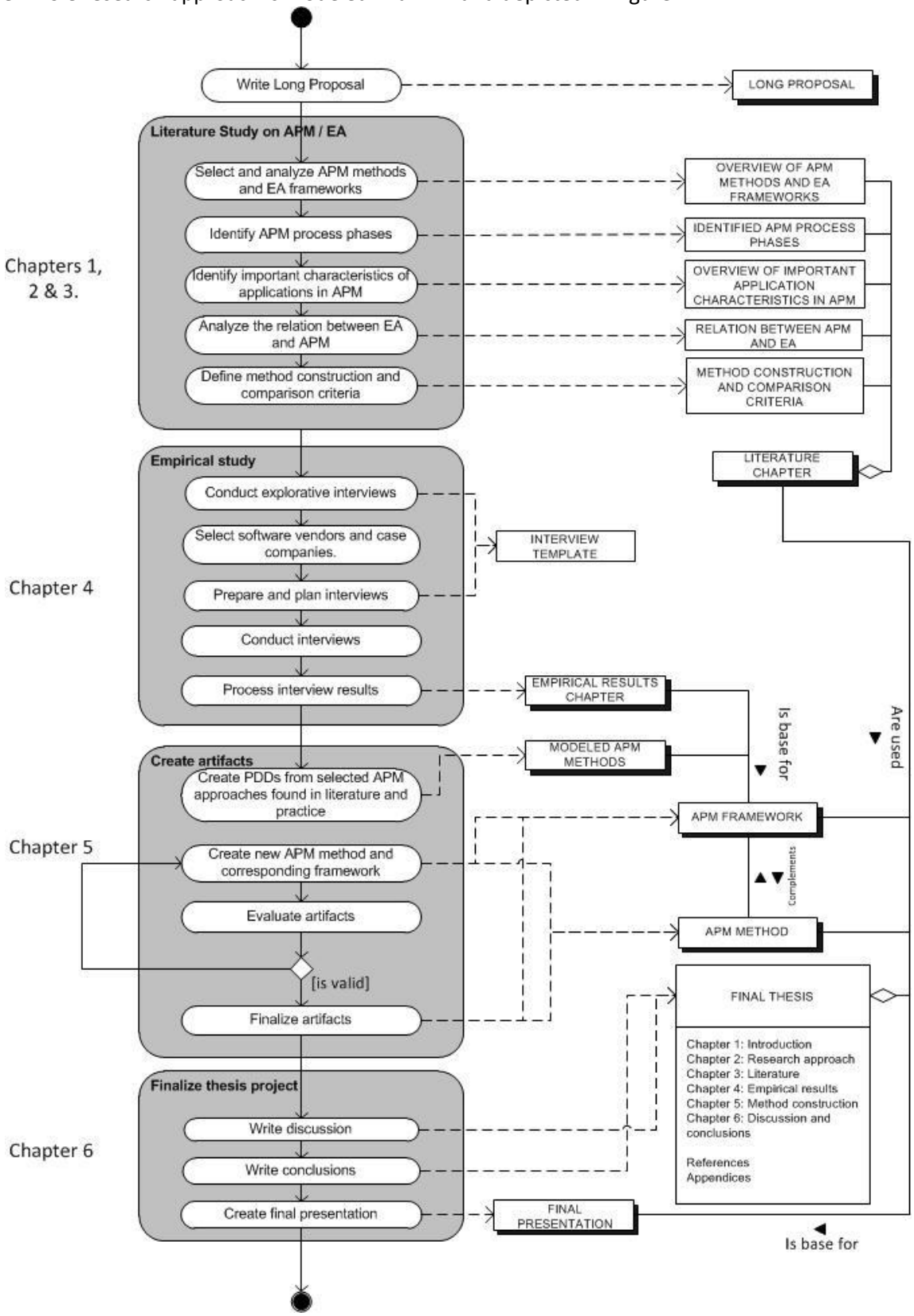

Figure 2-2: Research approach in PDD format.

Hevner et al. (2004) provide a detailed description of seven guiding principles when conducting design research. These guidelines will be used for the creation of artifacts and are shown in Table 2-1.

Guideline	Description
Guideline 1: Design as an Artifact	Design-science research must produce a viable artifact in the form of a construct, a model, a method, or an instantiation.
Guideline 2: Problem Relevance	The objective of design-science research is to develop technology-based solutions to important and relevant business problems.
Guideline 3: Design Evaluation	The utility, quality and efficacy of a design artifact must be rigorously demonstrated via well-executed evaluation methods.
Guideline 4: Research Contributions	Effective design-science research must provide clear and verifiable contributions in the areas of the design artifact, design foundations and/or design methodologies.
Guideline 5: Research Rigor	Design-science research relies upon the application of rigorous methods in both the construction and evaluation of the design artifact.
Guideline 6: Design as a Search Process	The search for an effective artifact requires utilizing available Process means to reach desired ends while satisfying laws in the problem environment.
Guideline 7: Communication of Research	Design-science research must be presented effectively both Research to technology-oriented as well as management-oriented audiences

Table 2-1: Design research: guiding principles (Hevner et al., 2004).

2.2 Main Deliverables

Research Question	Deliverable
Main Research Question ***How can a framework and corresponding method be created to value an application portfolio from an enterprise architecture perspective?*** **Sub-Questions:**	**An APM method which clarifies how the framework can be used, possibly with different situational sector specific sub-methods.** **An APM framework from an enterprise architecture perspective.** **Chapter 5 describes the proposed APM method / framework. Chapter 6 elaborates on the main results and concludes the research.**
1. What methods exist to support APM in the context of enterprise architecture	Literature chapters covering APM, EA, the relation between APM and EA and the conclusions. Found in chapter 3.
1.1 What are the processes in APM?	Description of APM process phases. Candidate methods will be selected and modeled in PDDs. Found in chapter 3.
1.2 What characteristics of applications are to be considered in APM?	Important characteristics of applications to consider based on literature. Found in chapter 3.
1.3 What is the relation between APM and EA?	Description the relation between APM and EA. Found in chapter 3.
1.4 How is APM used in EA and vice versa?	Description how APM is used in EA and vice versa. Found in chapter 3.
2. How is APM executed in enterprises and how is EA related to that?	Empirical research results chapter describing how APM and EA is applied in enterprises, in which the focus lies on APM aspects. Found in chapter 4.
2.1 What similarities and differences can be found in APM application in different sectors?	Description of the differences and similarities between of APM application in different sectors. Found in chapter 4.
2.2 What are experiences from practice in APM and EA?	Describing the APM/EA experiences in practice. Found in chapter 4.
2.3 What are the experiences from software tool vendors in the APM / EA field?	Interviews with software tool vendors to identify their experiences and describe what tools can offer. Found in chapter 4.
3. How can the method and framework be created?	Description of the motivation for method engineering as method construction and engineering technique. The selected APM approaches/methods found in literature and practice will be modeled in PDDs. Description of how the new APM method/framework will be created. Found in chapter 2 and 5.
3.1 How can the experiences from practice be integrated in the framework plus method?	Section description how the experiences from practice can be integrated. Answered in chapter 6.
3.2 How can the framework plus method be evaluated?	Section describing how the framework plus method can be validated and evaluated. Answered in chapter 5.

Table 2-2: Research questions and corresponding deliverables.

2.3 Empirical research

This section motivates the choice for in-depth expert interviewing as one of the used research methods. Furthermore, an interview protocol is provided.

There are several reasons why qualitative research by conducting expert interviews in combination with case studies are most useful to answer the research questions stated earlier. First, this research has a huge aspect of exploratory nature. Yin (2003) and Saunders, Lewis & Thornhill (2009) describe that in-depth (unstructured) interviews are most useful in that kind of situation. This is especially the case when motivations behind certain decisions have to be extracted. Both semi-structured and in-depth interviews provide the opportunity to obtain more detailed information on the participants' knowledge, which is highly valuable, because it allows the participants to explain or build on their previous given answers. The challenge lies in letting the participant lead the interview, instead of the other way around. According to Yin (2003) and Saunders, Lewis & Thornhill (2009) a combination of semi-structured and in-depth interviews is possible as well. This research uses a combination of both. However, it leans more to in-depth interviewing which is further explained in section 2.3.4. On the contrary, qualitative forms of empirical research are more useful when a hypothesis has to be proven (Saunders, Lewis & Thornhill, 2009).

2.3.1 Interview protocol

An interview protocol is intended to guide the researcher collecting data and is a major way of increasing the reliability of case study research (Yin, 2003). This protocol follows a similar structure provided by Yin (2003). This protocol has been written during the time of the interviews. Note that when the first interviews took place the protocol was not formally written. However, it represents all the steps that were followed during each interview. The next sections further explain the interview protocol.

2.3.2 Data collection procedures

The aim is to conduct all interviews in a face-to-face situation. Whenever this is not possible, an online communication service like Lync or Skype will be used. All interviews will be recorded, unless the participant objects.

2.3.3 Expert sampling

Three different 'stakeholders' are identified for this research. First, individual experts who can be consultant or researcher. Second, experts at case companies. Third, experts from software vendors. Experts at software vendors were specifically chosen because of the hypothesis that software vendors have a much closer relationship with customers than the academic field or possible other experts. The empirical research will initially start with explorative interviews to gain deeper knowledge of the topic and to improve the direction of this research. This will result in a base set of questions, as shown in appendix 7.2. The explorative interviews could be with any of the stakeholders.

The experts were contacted in different ways mostly depending to which expert group they belonged. Some experts were contacted via LinkedIn while others were contacted using Deloitte's or my personal network.

Selection criteria had to be made in order to select the software vendors. The selection procedure of software companies is described in the empirical results chapter, in section 4.4.

2.3.4 Interview outline and base set of questions

In general the interviews were unstructured and therefore require no-predefined questions to be asked. For each interview specific questions were prepared. However, both Yin (2003) and Saunders, Lewis & Thornhill (2009) advice to create a baseline of questions related to the research questions. Therefore, a base set of questions was developed and were asked almost at each interview. The topics could be divided into three areas namely: APM in general, relation between APM and EA and the methods/processes in APM. The full introduction outline and base set of questions can be found in Appendix 7.2.

2.3.5 Interview data processing

The interviews will be transcribed. However, not every word spoken will be written out. Only the relevant matters will be written down with regards to the research questions. This will result in a much smaller data set, which is better manageable and understandable for further analysis (Auerbach & Silverstein, 2003). Another popular way of processing interview data is coding (Yin, 2003; Auerbach & Silverstein, 2003; Saunders, Lewis & Thornhill, 2009). However, it is not necessary for this research, because the most important data is process based (APM processes) and important application characteristics to consider. Furthermore, the methods will be modeled using PDDs. Finally, every transcript will include a summary with key findings.

2.4 Method engineering for method construction

For the creation of the methods from both literature and empirical research the method engineering technique will be used. This section describes the motivations for choosing method engineering as technique and some of the main concepts and constructs will be explained. Method engineering is defined by Brinkkemper (1996): “Method engineering is the engineering discipline to design, construct and adapt methods, techniques and tools for the development of information systems”. Method engineering can be used to create methods specifically for a project at hand, by re-using parts, the so called method fragments, of existing established methods (Weerd & Brinkkemper, 2008). This is referred to as situational method engineering and has been defined earlier by Harmsen, Brinkkemper & Oei (1994) as “an information systems development method tuned to the situation at hand”. However, method engineering is not intended to be exclusively used for IS development methods, but for other area’s as well (Weerd, Brinkkemper, Souer & Versendaal 2006; Weerd & Brinkkemper, 2008). De Weerd et al. (2006) identified the following steps in in the creation of (new) methods in method engineering:

1. Analyze implementation situations and identify needs;
2. Select candidate methods that meet one or more aspects of the identified needs;
3. Analyze candidate methods and store relevant method fragments in a method base;
4. Select useful method fragments and assemble them in a situational method by using route map configuration to obtain situational methods.

Weerd et al. (2006) developed a meta-modeling technique to support the last two steps; in this technique PDDs are created. The meta-modeling technique proved to be very useful in the creation, analysis, comparison and combination of methods (Weerd et al., 2006). Therefore, this technique is chosen to model methods to be found in existing literature and practice and for the creation of a new APM method.

2.4.1 Method modeling technique

The next page contains an example PDD in Figure 2-3. The left side of the diagram presents the activities and the right side of the diagram represents its deliverables. The concepts are defined by Weerd & Brinkkemper (2008) and presented below. The full description and rules can be accessed in the paper by Weerd & Brinkkemper (2008).

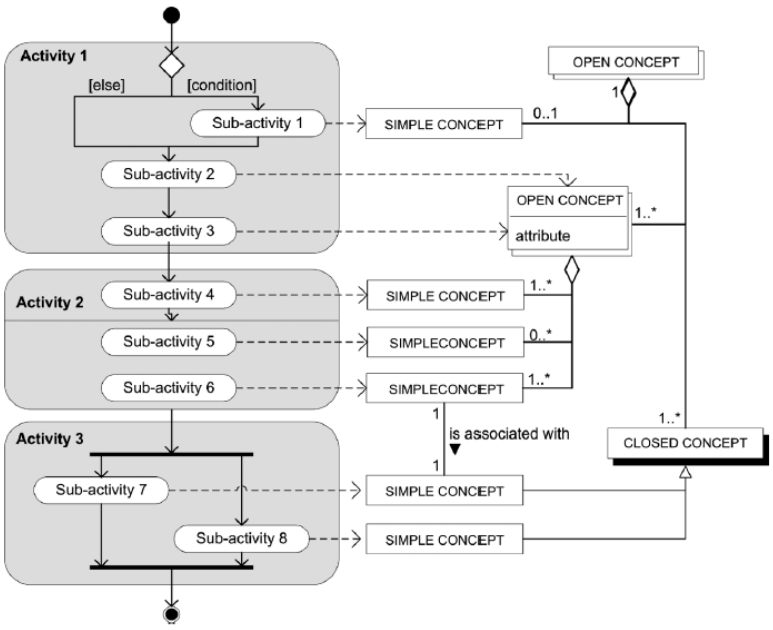

Figure 2-3: Example of a process deliverable diagram and its concepts (Weerd & Brinkkemper, 2008).

The left side:

- Standard activity: An activity that contains no further (sub) activities. A standard activity is illustrated with a rounded rectangle.
- Complex activity: An activity that consists of a collection of (sub) activities. They are divided into:
    - Open activity: A complex activity whose (sub) activities are expanded. This expansion can be done with: a rounded rectangle, containing two or more sub activities or a rounded rectangle with a white shadow, to indicate that the activities are depicted elsewhere.
    - Closed activity: A complex activity whose (sub) activities are not expanded since it is not known or not relevant in the specific context.

Activities can be sequential, but can be required to be executed in order as well. Furthermore, roles

can be assigned to activities. Finally, conditional activities are possible as well.

The right side:

- STANDARD CONCEPT: A concept that contains no further concepts. A standard concept is visualized with a rectangle.
- COMPLEX CONCEPT: A concept that consists of an aggregate of other concepts. Complex concepts are divided into:
    - OPEN CONCEPT: A complex concept whose sub concepts are expanded. An open concept is visualized with a white shadow border. The aggregate structure may be shown in the same diagram or in a separate diagram.
    - CLOSED CONCEPT: A complex concept whose sub concepts are not expanded since it is not relevant in the specific context. A closed concept is visualized with a black shadow border.

3 Literature: Overview of APM and EA

3.1 Application Portfolio Management

In 2009, some organizations spend up to 90% of their IT budget on continuing the existing IT landscape, leaving little room for innovation (Lankhorst et al., 2010). In the worst case scenario, organizations do not have any budget left for innovation and are therefore unable to perform crucial maintenance tasks. Fabriek, Brinkkemper, & Van Dullemen (2007) found that APM is named different in literature: 'Enterprise IT portfolio management', 'Redesign of the IS portfolio' and other examples, but they all refer to the following elements: Applications, Portfolio and Rationalization. Rationalization concerns the reduction of portfolio complexity. Figure 3-1 visualizes this. For organizations it is more beneficial to look at the real value of applications taken into account their business goals, instead of looking at associated costs only (Lankhorst et al., 2010). This can lead to a better budget in which there is both room for maintenance and innovation (Lankhorst at al., 2010). Ensuring a good process for application portfolio management will help organizations achieve this.

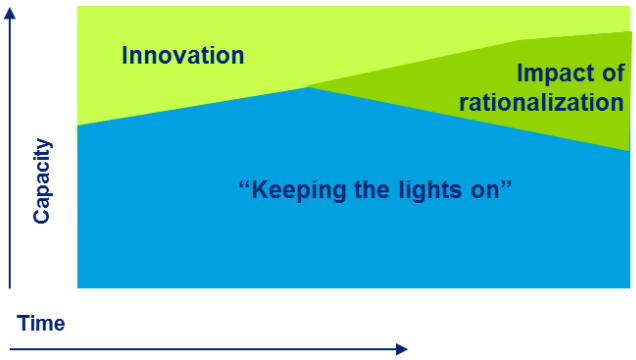

Figure 3-1: Innovation versus "keeping the lights on". An expanding IT landscape requires more and more resources and money, just to keep the lights on. When IT budgets don't increase anymore, the resources available for innovation shrink (Deloitte, 2013).

According to Gartner (2009) 25% of the Global 1000 (the top 1000 world's biggest enterprises) would initiate an application overhaul project in 2012. Main reasons for such a project would be: (1) enterprises are losing IT flexibility; (2) there is little or no budget for new projects (3) and Software as a Service (SaaS) allows enterprises to outsource applications (ibid.). Therefore, it is not only important to have a sound application portfolio management; it also shows that this is a recent topic. The requirements for change are increasing and therefore the capacity available for change is decreasing. This is demonstrated in Figure 3-2.

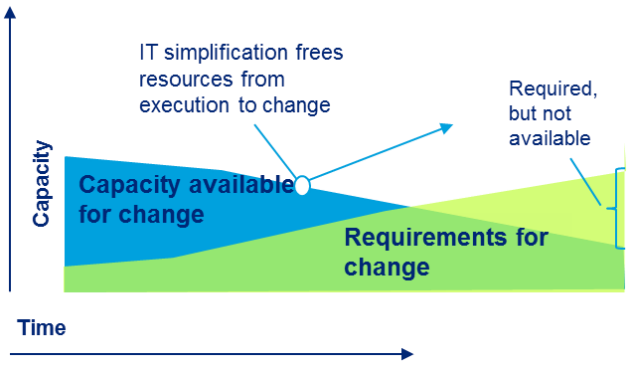

Figure 3-2: A changing business environment, changing legislation and changing business requirements, require an increasing capacity to change from IT. Shifting resources away from execution to innovation is one way to address this challenge, but this requires simplification of the IT landscape (Deloitte, 2013).

As mentioned in the introduction, companies collected up to thousands of different applications over time supporting their business. However, many applications are redundant, too expensive to maintain or do not align with a company's strategy. The ability to keep, consolidate, redevelop or eliminate an application depends on key dependencies, support and constraints with other applications, which are often unknown (Maizlish & Handler, 2005). Different architecture views like business, technical and infrastructure are typically outdated or nonexistent (ibid.). The lack of good IT architecture, misalignment between IT and strategic intent and a poorly documented or undocumented as-is architecture will result in high operations and maintenance costs (ibid.). This causes the inability to quickly respond to a new situation and prioritize and reprioritize investments (ibid.). Therefore, IT portfolio management is becoming an increasingly critical capability (ibid.). However, less than 20% of the companies maintain an active IT portfolio management framework (ibid.).

3.1.1 Matrix-based approaches

The concept of APM originated from matrix-based approaches to derive appropriate management action and allocation of resources (investments) for applications (Simon, Fischbach & Schoder, 2010). McFarlan (1981; 1984) introduced the first application portfolio approach and is therefore valuable to describe. The first paper of McFarlan (1981) is focused on PPM and associated risks and will therefore not be elaborated in this research. The second paper (McFarlan, 1984) has a clear application portfolio management perspective and is depicted in Figure 3-3.

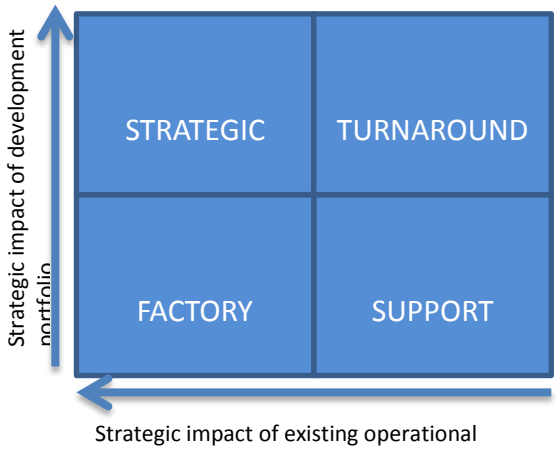

Figure 3-3: Position of an Information system within a company (McFarlan, 1984). Note that the X-axis has increases as it moves to the 'zero' point, whereas nowadays both the X and Y axis usually turn towards 'endless'.

In this approach the strategic impact of existing operational systems is compared to the strategic impact of the development portfolio. The strategic impact of existing operation systems implies the

current strategic value of those systems. The strategic impact of development portfolio implies the potential value if the application would be further developed. Applications can be placed in one of the four grids shown below. Applications placed in the strategic grid are candidates for further investment. They have a strong strategic impact on the current business and provide increased strategic value if further development efforts are made. Applications which are considered turnaround candidates provide low strategic value to the business, but might be able to provide a high strategic value if investments would be made. 'Factory' applications provide a high strategic value but do not require any further investments, for example very mature applications. Finally 'support' applications provide low strategic value and investments will not influence its position. Those applications should receive no or minimal investments at its best.

McFarlan (1984) provides us with another exhibit, the reason for IS expenditure. McFarlan argues that for a company it is essential to analyze the true competitive impact of those expenditures involved. Table 3-1 can be used to allocate resources to areas with the most grow potential. The numbers correspond with the relative attractiveness of the investment with 1 having the highest priority.

Goal of IS expenditure	Growing, highly competitive industry	Relative stable industry known ground rules	Static or declining industry
Rehabilitate and maintain system	1	1	1
Experiment with new technology	2	3	3
Attain Competitive advantage	2	2	3*
Maintain or regain competitive parity	2	3	4
Defined return on investment**	3	3	4

Table 3-1: Resource allocation priorities (McFarlan, 1984).

*Assuming the change is not so dramatic as to revolutionize the industry's overall performance.
** In an intensely cost competitive environment, defined ROI is the same as gaining competitive advantage.

Ward (1988) analyzed six different matrix-based approaches for application management from eight sources (Mc Farlan, 1984; Porter & Millar, 1985; Munro & Huff, 1985; Sullivan, 1985; Ives & Learmonth, 1984; Galliers, 1987; Hirschheim, 1982; Galliers, 1987). Those approaches were combined into a new matrix. Ward argues that there is a need for different generic strategies in each segment. The IS/IT competence or capability of an organization is a key factor of option for future IS/IT ambitions. Some other important conclusions of this work are the fact that an application has business life cycles and therefore its value changes overtime. This supports the idea that APM should be an ongoing process.

So what do these matrix-based approaches tell? They all share certain characteristics: they try to value applications in two dimensions. One dimension is usually related to the (future) technical value of an application. The other dimension is usually related to the (future) strategic value. However, an axis can also be related to, for example, costs or risks as well. Furthermore, applications are mapped in grids, resulting in four 'strategies' which can be executed for each application. Although most models use different names, a pattern can be recognized. Ward (1988) used to same grid names as McFarlan (1984), although the names coined to the axis' were extended. The matrix is depicted in Figure 3-4.

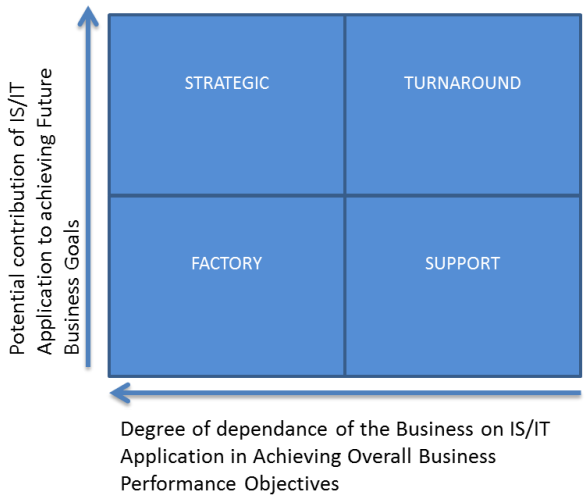

Figure 3-4: Matrix based IT portfolio approach (Ward, 1988). Note that the X-axis has increases as it moves to the 'zero' point, whereas nowadays both the X and Y axis usually turn towards 'endless'.

The benefits of such matrix-based approaches are that they are easy to understand and provide visualization which can be used to rate applications against each other. However, the simplicity of many of these matrix-based approaches remains a problem. None of the matrix-based approaches developed in the eighties state precisely what the necessary requirements are to assess the applications. Furthermore, one can imagine that not all things can be plotted against the 'same' axis terminology. For example, a certain application might have a high value by supporting a certain process, but there can be another application doing exactly the same. However, in such matrix-based approaches there is no room to compare functional redundancies. Another example is an application with a high business value, low costs, but runs on a very old technology. This forms a potential risk in the future, when its support may become very expensive (e.g. due to lack of knowledge regarding older technology).

3.1.2 What is an application?

The term application can have different meanings in companies. It is important to point out the different viewpoints in literature concerning applications, because it is the subject in application portfolio management. Riempp & Gieffers-Ankel (2007) define application as a specific class of IS that supports business directly. According to Maizlish & Handler (2005) an application is "an aggregation of software code impounding business logic and rules, transforming users or systems input into data output, for the purpose of automating and optimizing business functions, processes, tasks and activities therein". This definition seems far more complete than the definition of Riempp & Gieffers-Ankel (2007). The interesting part in this definition lies in the part 'aggregation' of software. Imagine an ERP package with different modules. They typically contain dozens of software modules bound together into a system, an aggregation of software right? However, from a functional perspective these modules probably have no similarity at all. From technical perspective, they can be seen as separate applications, because each module is an aggregation of software itself. Applications can also be assessed from a contractual perspective with the corresponding software vendor. These examples are not exclusive but clearly show difficulties with the definition of Maizlish & Handler (2005). Therefore, it is important to realize that applications can be viewed from different

perspectives.

3.1.3 Application migration options

In order to make decisions regarding an application portfolio, it has to be known what kind of application strategies exist. In research different opinions exists in what the main strategies are and what alternatives within those options exist. Some research name it “Application Portfolio Migration Patterns” (Maizlish & Handler, 2005), others name it “Optimization Options” (Simon et al., 2010), while in practice C2 (Case Company #2, see chapter 4) mentioned it as “Transformation Models’, while in this research it is named “application transformation options”. The word transformation itself implies that the applications are subject to change and that they are several options to choose from.

Application transformation options can be categorized generally in “Create”, “Modify” and “Delete” (Simon et al., 2010). These optimization strategies can effect a single application, several applications, or even an entire portfolio. “Phase out/replace”, “Reevaluate/reposition”, “Reengineer/modernize” and “Maintain/evolve” are alternatives provided by Maizlish & Handler (2005). Gartner (2010) propose the so-called TIME model, which includes “Tolerate”, “Invest/Innovate”, “Migrate” and “Eliminate”. More interestingly is the identification of the underlying options that reside in each of the main options. The ASL BiSL Foundation provides more detail. ASL stands for Application Services Library and is a framework of best practices that can help organizations maintaining and controlling their application management processes. This framework provides a lot of detail on the topic of APM. In addition, the ASL BiSL foundation has identified eight different migration strategies for applications and is illustrated in Figure 3-5.

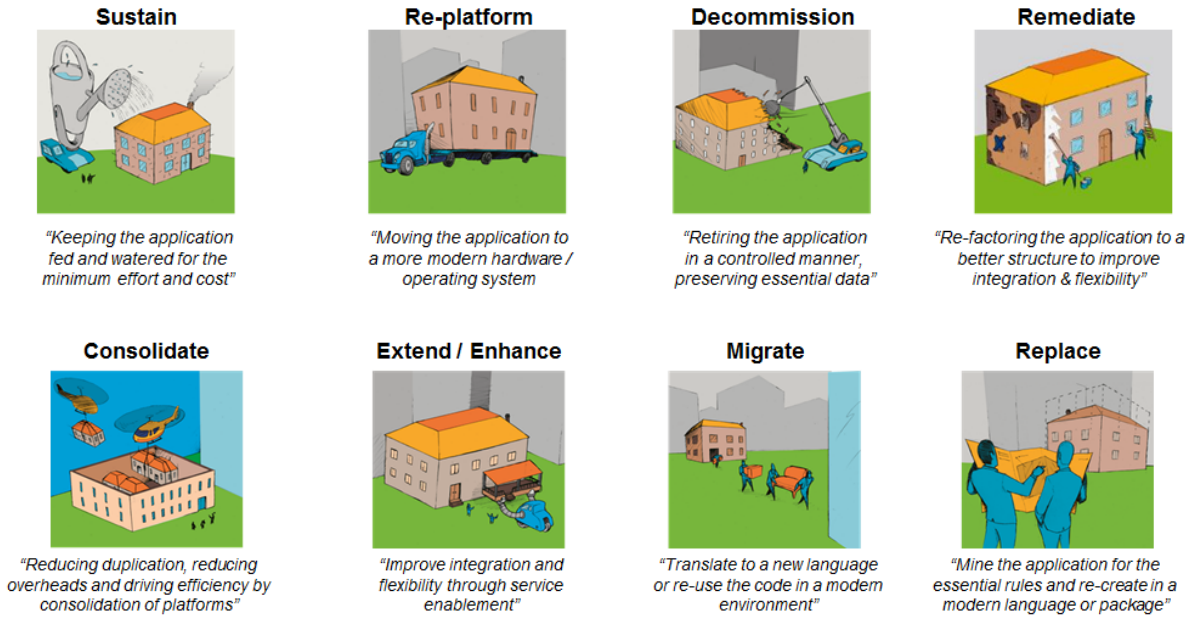

Figure 3-5: Migration strategies for applications (ASL BiSL Foundation).

3.1.4 Assessing the health of an application portfolio

Weil & Vitale (1999) start their paper introducing a topic which has been a subject for debate for a long time, namely: the value of IS investments versus the performance of an organization. Weil & Vitale (1999) argue that although many studies have investigated the relation between expenditure and performance of an organization, these studies generally do not address the context of the organization. According to Weil & Vitale (1999), understanding the 'health' of an organization's application portfolio may well explain the mixed findings found in research so far. The aim of research by Weil & Vitale was to create a model for assessing the application portfolio. In order to demonstrate the state of each application "Health Grids" are used. Health grids are matrices and in this case they use distinguish between Upgrade, Nurture, Consolidate or Eliminate and Question. The four grids can be shortly explained as follows:

Nurture: Applications that provide high management value and have a good technical quality. *Upgrade:* Applications that provide a high management value, but have a low technical quality. *Consolidate or Eliminate:* Applications with low management value and low technical quality. *Question:* Applications with a good technical quality, but rated low for management value. The health grid used by Weil & Vitale (1999) is depicted in Figure 3-6.

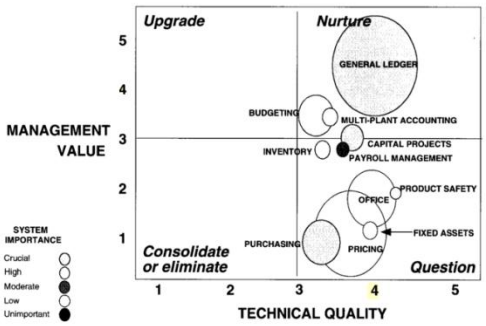

Figure 3-6: Health Grid used by Weil & Vitale (1999).

Weil & Vitale (1999) identified five interrelated attributes considered key for assessing the health of an IS. They used those five key attributes in a case study and showed how the attributes could be operationalized. The case itself is not described in this section, just the five key attributes and the approach used in the case study, further case details can be found in Weil & Vitale (1999). The five key attributes related to the health of an IS are as follows (Weil & Vitale, 1999):

1) **Importance of the system to the business unit**: the alignment between an application and the business goals (of a business unit). It can be assessed by providing a questionnaire using a five point scale for example.
2) **Investment in the system:** the investments related to an application, which consists of provision, operation and maintenance. Information was retrieved in reports from the information department.
3) **Technical quality of the system:** six aspects regarding the technical quality were identified to be useful this kind of analysis. Source code quality, data quality and reliability, system reliability, ease of use, output quality and finally portability.
4) **Level of use of the system:** says something about the usage or amount of users of an application. The level was determined by how often a particular application was accessed.

5) **Perceived management value of the system:** says something about how useful a particular application was for executives in performing their job as managers. Again a five scale questionnaire was used.

The approach used for their research is depicted in Figure 3-7 and consists of four steps:

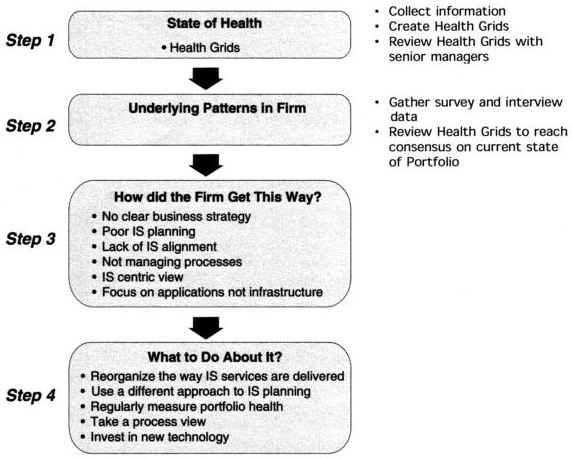

Figure 3-7: APM approach by Weil & Vitale (1999).

1) State of health:
   The creation of health grids. First, information has to be collected, then the health grids are created and finally, the health grids are reviewed with senior managers.
2) Underlying patterns in firm: Analyze the interview data and review the current state of the application portfolio.
3) How did the firm get this way?
   In this phase an analysis has to be conducted to understand the organization, more specifically, to understand how the organization influenced the evolution of the current application portfolio.
4) What to do about it?
   In this phase some activities related to IT governance are suggested, for example reorganize the delivery of IS services. Furthermore, the authors' urge to regularly measure the application portfolio health.

Weil & Vitale (1999) summarized the strengths and weaknesses of their approach. Health Grids (matrix) are a very good way to communicate to higher management, some of the senior managers and line managers in the case study intuitively understood the portfolio, but the matrices provided a clear case for action. In their case study, the health grids were seen as objective, for they were prepared by a third party.

Some of the weaknesses encountered during the case study: Health matrices are a snapshot in time. Weil & Vitale (1999) argue that you should re-perform the analysis at significant transition points (e.g. new CEO, CIO, major technology changes etc.). Health grids do not take into account the health or flexibility of underlying infrastructure. Authors argue that one could add questions to a questionnaire that identify the costs and time required related to enhance applications, or build new application on existing infrastructure for example.

3.1.5 'Picture' approach

Groot, Smits, & Kuipers (2005) provide a method to redesign the IS portfolio in large organizations. The method was used in three different case studies and the case organizations involved wanted to reduce complexity and increase transparency, maintainability, effectiveness and efficiency (Groot, Smits & Kuipers, 2005). Groot, Smits & Kuipers (2005) start with an interesting discussion about

complexity, which is briefly described below.

Changes in the business environment caused IS to become highly complex in information-intensive organizations (Groot, Smits & Kuipers, 2005). However, according to Groot, Smits & Kuipers (2005) the complexity of a set of information systems is of a different nature than that of a single information system, which is often expressed in the total lines of code. Groot, Smits & Kuipers (2005) introduce the term 'system complex', which is the complexity of a set of information systems. Groot, Smits & Kuipers (2005) continue by emphasizing that no universal definition of complexity exists. An observer will find an object complex if he or she is unable to understand the concept and its relations in a certain amount of time. This makes complexity a subjective concept. Furthermore, a concept can be complex for one person, while it may not be complex for someone else. Complexity can be objective as well. There can be quantitative characteristics, for example, the amount of relations, the amount of names used, amount of objects within an object etc. According to Groot, Smits & Kuipers (2005) decisions such as the migration to a new system can only happen if decision making and migration options become transparent. Furthermore, it has to be presented in a way that all actors can understand it and relate it to their own objectives (Groot, Smits & Kuipers, 2005).

Groot, Smits & Kuipers (2005) argue that a system complex is viewed in different layers of relations between business processes and information systems. However, due to the lack of an appropriate method to combine business process modeling (BPM) and information systems modeling, Groot, Smits & Kuipers (2005) introduced the 'picture approach'. The picture approach aims to reduce subjective complexity (by enabling better communication), followed by a reduction in the objective complexity of system complexes. By using the picture approach the relations between business processes and systems can be made much transparent and could improve communication.

3.1.6 Selected candidate methods for the APM method

Three methods from literature were selected as candidates for the APM method.

1) Maizlish & Handler (2005).
2) Fabriek, Brinkkemper & Dullemen (2007).
3) Simon et al. (2010).

The methods were primarily chosen because of the completeness of processes and/or type of characteristics needed for the application of APM.

1) IT portfolio management process by Maizlish & Handler (2005):

Maizlish & Handler (2005) define that IT Portfolio consists of three sub-portfolios namely: IT discovery portfolio, IT project portfolio and IT asset portfolio. IT discovery portfolio consists of longer-term investment. IT project portfolio consists of medium-to short-term investments and is represented in new product development. Finally, IT asset portfolio is comprised of existing investments. The IT discovery and IT project portfolio are more related to PPM for they consist of future and current projects. The IT asset portfolio is closely related to APM as it consists of the current IT landscape. Maizlish & Handler (2005) introduce the IT portfolio management method, which is a proven process for IT portfolio management. The IT portfolio management method is a combination of APM and PPM and it contains eight phases. The approach of Maizlish & Handler

(2005) has been modeled in a PDD and because its size it can be found in appendix 7.3 in Figure 7 4. The original method (of which the PDD is abstracted) is shown in Figure 7 5. The names in the method have been slightly adjusted in order to be content with the PDD annotation. The eight phases are described below.

1) Create game plan: in the game plan the objectives for the IT portfolio management initiative are determined.
2) Plan portfolio structure: in this phase the investment strategy is determined.
3) Create as-is portfolio: in this phase the current and planned projects are identified. Furthermore, each potential IT investment has to be described in a business case and stored centrally. The method suggests that a company has to define its own metrics to compare investments against each other. In addition, the current IT asset portfolio (the current IT landscape, including all applications) has to be assessed on several dimensions: technical condition, business value, and risks. Matrices can be used to rank current IT assets. As part of the assessment, the method urges to conduct a stakeholder analysis, architectural views and create a detailed application inventory. The application inventory should be made available to key employees so that IT investments can easily be linked to applications (and other IT assets)
4) Assess portfolio: in this phase the key is to reassess the portfolio on a continuous basis. It is advised to conduct these assessments at least on a quarterly basis. The portfolio is compared to the targets set earlier taking into account internal and external trigger events.
5) Re-balance portfolio: in this phase a committee of senior management determines the optimal allocation of investments. It results in re-balanced IT portfolios.
6) Communicate actions: in this phase the planned changes related to IT portfolios have to be communicated clearly to target stakeholders.
7) Improve governance & organization: in this phase roles and responsibilities for the IT portfolio management processes are defined.
8) Monitor execution: in the last phase the execution of projects is evaluated and compared with the goals defined in the game plan (phase 1).

2) APR Method by Fabriek et al. (2007):

Fabriek, Brinkkemper, & Van Dullemen (2007) combined the methods from Weill & Vitale (1999) and Sarissamlis (2006) into one method, which has been named Application Portfolio Rationalization method. The method is shown in Figure 3-8. The method consists of three main phases, namely: assessment current situation, evaluate assessment and plan actions. The method describes that one should look on both the individual applications and the complete set of applications, the application portfolio.

Fabriek, Brinkkemper, & Van Dullemen (2007) provide some key characteristics of APR:

- **Evolutionary process:** Creating an application inventory is an iterative process and it requires both resources and time.
- **Continual:** APR should be conducted continuously to keep the portfolio structured and up-to-date.

- **Application Assessment:** The gathering of application information is the *core* of APR.
- **Respond to business process changes:** APR is a process which should be conducted jointly by business and IT organization.
- **Improve application usability:** APR aims to improve the usability for all applications.
- **Reduce the total cost of ownership:** The long-term call goal of APR is the reduction of the total cost of ownership.

Assess current situation: Fabriek, Brinkkemper, & Van Dullemen (2007) describe that the first step is to determine the scope. In order to determine the scope, the applications can be plotted on business processes. Fabriek, Brinkkemper, & Van Dullemen (2007) mention the picture approach presented by (Groot et al., 2005) as an alternative, which is referred to as a more technical approach. Fabriek, Brinkkemper, & Van Dullemen (2007) argue that an organization has to choose between a more process-based approach and a more technical approach. Although the 'technical' approach includes more details, it becomes more difficult to communicate it to higher management. To assess the applications, Fabriek, Brinkkemper, & Van Dullemen (2007) suggest score applications based on five different 'value' factors defined by Weill & Vitale (1999), as discussed earlier. To categorize the applications Fabriek, Brinkkemper, & Van Dullemen (2007) suggest to use "matrixes" or "health grids", and provide several examples. The matrices and health grids have been discussed already in a section 3.1.1.

Evaluate assessment: The assessment and categorization of applications need to be reviewed with managers of the different departments involved. This prevents a potential bias from the (IT-) employees whom perform the APM project (Fabriek et al., 2007). Furthermore, an organization should investigate/evaluate the underlying patterns. In this phase, an evaluation has to be conducted on how the current problems were raised in the past in order to prevent future application portfolio complexity. An organization should analyze its business strategy, IT strategy, EA, culture and organization patterns. EA can help organizations to align the processes with applications. The evaluation of the applications should be performed with managers from different departments. However, it is not clear which stakeholders or which type of departments should be involved.

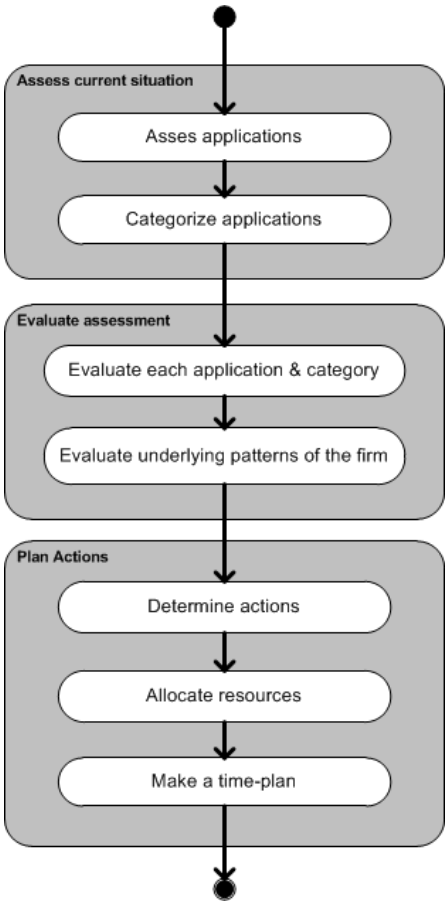

Figure 3-8: APM method by Fabriek et al. (2007).

Plan actions: In the last phase a planning need to be made in order to reduce the assessed and evaluated application portfolio. It should include actions, resources and time (Fabriek et al., 2007). Application migration options discussed in section 3.1.3 can be used to determine actions. Fabriek et al. (2007) mentions that from a governance perspective an organization should regularly execute the APR process in order to prevent a fallback. The investments made should deliver value both in present as in the future. Finally, the planned actions should be included in a time-plan.

3) APM Method by Simon et al. (2010):

The method of Simon et al. (2010) is depicted in Figure 3-9. It consists of four phases each described below. These four phases form the basis of the APM framework and their original framework is shown in Figure 7-10 in appendix 7.4.

Create application inventory: The application inventory is created in the first step. Simon et al. (2010) provide examples of application characteristics such as: "application name, release version, implementation date and application owner". The application inventory consists of three levels of understanding. What applications does an organization have? What are the general characteristics of those applications? What are the key attributes of these applications? The application inventory can be filled by using three types of data collection methods, namely: automatic data collection, semi-automatic data collection and manual data collection. However, the data collection procedures are only briefly described by Simon et al. (2010).

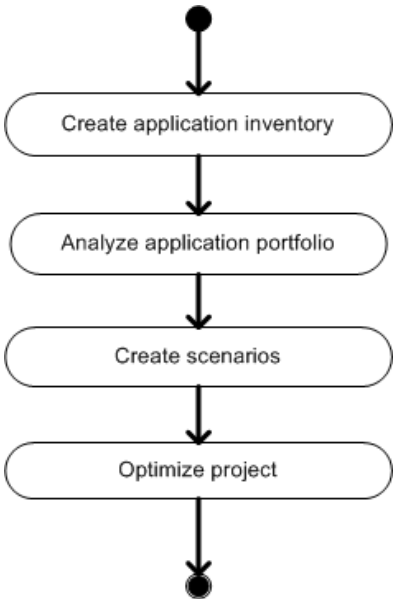

Figure 3-9: APM method by Simon et al. (2010).

Analyze application portfolio: In this phase the as-is portfolio is subject to analysis and the application inventory provides a major input. For the analysis of the application portfolio Simon et al. (2010) suggest analysis along the following dimensions: "Business Process Support, Strategic Fit, Value/Benefits, Costs, Risks, Lifecycle, Regulatory Compliance, Functional Wealth, Technical Health, Operational Performance, Relations and Dependencies and Vendor Information". Simon et al. (2010) present some examples on how to rank applications in each of those dimensions. For example to analyze 'business process support' applications can be plotted in matrices against business processes. To analyze the costs of an application Simon et al. (2010) suggest the usage of Total Cost Ownership (TCO) concept or Activity Based Costing and provide references for each of these approaches.

Create scenarios: The third phase involves decision making, which consists of planning and shaping the to-be portfolio (Simon et al., 2010). Simon et al. (2010) mention the application migration options and categorize them into 'create', 'modify' and 'delete'. For each of those migration options several specific options are given. For example, "investment" (in new applications) and "replacement" fall into the 'create' category. However, Simon et al. (2010) argue that portfolio matrices are limited in scope to only a few dimensions, as discussed earlier. Therefore, it is important to combine portfolio matrices with a holistic perspective by creating a level overview picture. This can be achieved by using the approach of Riempp & Gieffers-Ankel (2007) which is discussed in section 3.3. According to Simon et al. (2010) it is important to analyze how current problems were raised in the past (Fabriek et al., 2007). Planned applications and other initiatives need to be considered as well, to avoid duplicate efforts (Simon et al., 2010). The outcome of this process results in a road map, which consists of the planned actions including the business case(s)

and a model of the future landscape.

Optimize project: In the optimization phase the planned actions can be prioritized and more concrete solutions have to be made more. For example, when it has been decided that an application will be replaced there might be a selection software vendors for a new product. Simon et al. (2010) note that this phase is closely related to PPM efforts, as planned actions may result in huge projects. Finally, Simon et al. (2010) mention that after a project the application portfolio is modified, it may unveil new opportunities in the application portfolio.

The approach of Simon et al. (2010) can be found in PDD format in the appendix in Figure 7-3 and the original framework is shown in Figure 7-10.

3.2 Enterprise Architecture

The goal of enterprise architecture is to optimize the legacy of processes (both manual and automated) into an integrated environment that supports change and supports the business strategy (TOGAF 9 Foundation, 2010). Enterprise architecture provides the strategic context for the evolution of IS in response to the constantly changing needs of the business environment (TOGAF 9 Foundation, 2010). Therefore, enterprise architecture puts a lot of emphasis on the evolvement of information systems, of which a major part are the applications.

This chapter describes some of the most well-known EA frameworks and describes how APM aspects are currently integrated in those models. Four frameworks have been selected for analyses and are depicted in Table 3-2.

Method / Framework	Author(s)	Year	Section
Zachman Framework	Zachman, IBM	1987 - present	3.2.1
TOGAF	The Open Group	1995 - present	3.2.2
Federal Enterprise Architecture (FEA)	U.S. Federal Government	1999 - present	3.2.3
DYA	Wagter et al. (2005), Sogeti	2005 - present	3.2.4

Table 3-2: The EA frameworks selected for this research.

3.2.1 Zachman Framework

In 1987 Zachman introduced a framework called the Zachman framework (1987), which is regarded as the first enterprise architecture framework. Back then, Zachman named it the 'Framework for Information Systems Architecture'. The framework can be seen as a logical structure to create descriptive representations of an enterprise, which are both relevant for the management of the enterprise and the development of information systems (Lankhorst et al., 2005). The framework is shown in Table 3-3.

	DATA *What*	**FUNCTION** *How*	**NETWORK** *Where*	**PEOPLE** *Who*	**TIME** *When*	**MOTIVATION** *Why*
SCOPE (Contextual) *Planner*	List of important things to the business	List of Processes the business performs	List of locations in which the Business Operates	List of organizations Important to the Business	List of Events/Cycles Significant to the business	List of Business Goals/Strategies
BUSINESS MODEL (Conceptual) *Owner*	Semantic Model	Business Process Model	Business Logistics System	Work Flow Model	Master Schedule	Business Plan
SYSTEM MODEL (Logical) *Designer*	Logical Data Model	Application Architecture	Distributed System Architecture	Human Interface Architecture	Processing Structure	Business Rule Model
TECHNOLOGY MODEL (Physical) *Builder*	Physical Data Model	System Design	Technology Architecture	Presentation Architecture	Control Structure	Rule Design

DETAILED REPRESEN-TATIONS (Out-of-context) *Sub-contractor*	Data Definition	Program	Network Architecture	Security Architecture	Timing Definition	Rule Specificatio n
FUNCTIONING ENTERPRISE	DATA	FUNCTION	NETWORK	ORGANIZATIO N	SCHEDULE	STRATEGY

Table 3-3: Zachman Framework (Zachman, 1987).

From classical architecture, Zachman extracted generic perspectives that apply for architecture in general, namely: Planner, Owner, Designer, Builder and Out-of-context representations, or perspectives.
The *planner* defines the organization's purpose and direction (SCOPE).
The (business) *owner* defines the nature of the organization, including structure and processes (BUSINESS MODEL).
The designer defines a more detailed version of the business model, including information systems (SYSTEM MODEL).
The *builder* defines the technology used to support the needs addressed above in a (TECHNOLOGY MODEL).
The subcontractor defines a detailed design and enterprise components, e.g. implementation language and middleware components (DETAILED REPRESENTATIONS).

For each of the perspectives the following product abstractions are present namely: What, How, Where, Who, When and Why. For each of the perspectives the six 'W' questions are related to how they perceive the enterprise or system. The genE1 words related to the six 'W' questions are as follows:

- ***What*** is related to the **DATA** (describing the content).
- ***How*** is related to the **FUNCTION** (describing the function).
- ***Where*** is related to the **PEOPLE** involved (describing the actors).
- ***When*** is related to the **TIME** (describing how time is related).
- ***Why*** is related to the **MOTIVATION** (describing the 'reason').

Each cell names a potential example of a deliverable (related to a specific 'W' question) and its corresponding perspective (Table 3-3). For example, a *designer* can create an 'Application Architecture' to answer ***how*** the current or envisioned information system ***functions.***

The Zachman framework has the advantage being very easy to understand. Furthermore, it is independent from tools or methodologies and takes a holistic perspective of the enterprise (Lankhorst et al., 2005).

A major disadvantage is the lack of detail. The Zachman framework defines the deliverables in each cell, however the details for each deliverable are not described. For example, a 'business process model' and 'application architecture' are mentioned, but it is not specified to which extend they are included and how they relate to each other. The framework tries to organize all the aspects of an enterprise. However, no guidelines, let alone specification, are given of the development and implementation process. Finally, Sowa & Zachman state that their framework was not based on

scientific research, but rather on observations of some natural rules for segmenting the enterprise into logical parts without losing the holistic perspective of its whole (Sowa & Zachman, 1992).

3.2.2 The Open Group Architecture Framework (TOGAF)

The Open Group Architecture Framework (TOGAF) originated as a framework and methodology for development of technical architectures, but from version 8 onwards it is dedicated to enterprise architectures (Lankhorst et al., 2005). The TOGAF framework is depicted in Figure 3-10. TOGAF 9 covers the development of four architecture domains, which are commonly accepted as subsets of enterprise architecture. These are business architecture, data architecture, application architecture and technology architecture.

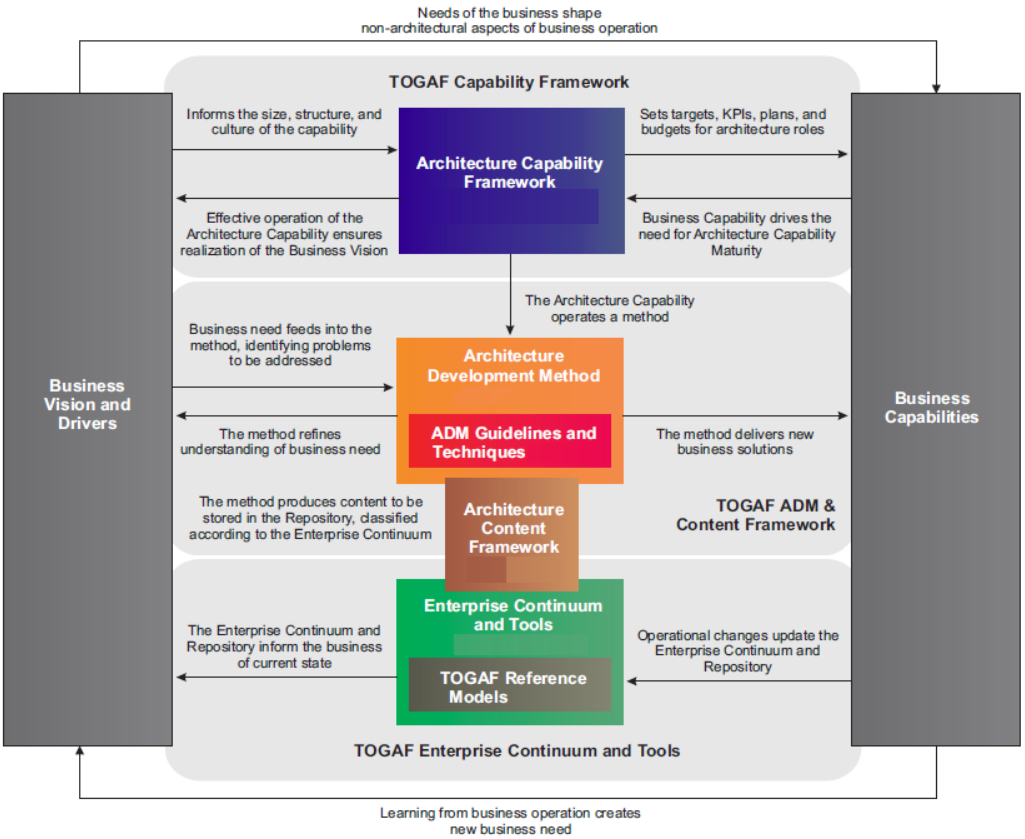

Figure 3-10: TOGAF Framework (TOGAF Foundation, 2010).

TOGAF has the following main components:

- Architecture Capability Framework helps on organization to improve its EA capabilities.
- Architecture Development Method: the ADM describes the process how architects can create enterprise architectures and each phase in the method is described in detail. The ADM cycle is regarded as the core of TOGAF and is depicted in Figure 3-11.

- ADM Guidelines and Techniques: contains a number of guidelines and techniques to support the usage of ADM.
- Architecture Content Framework: provides a model of the architectural deliverables and other artifacts
- The Enterprise Continuum provides a model on how to structure and classify the deliverables in a repository.
- The Enterprise reference model provides two reference models with generic architectures, which can be used as a basis.

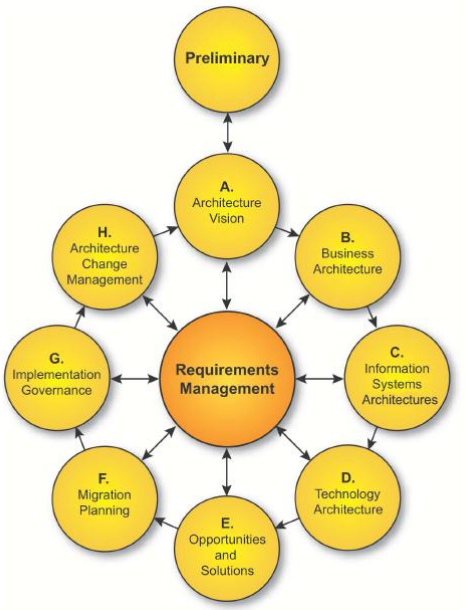

Figure 3-11: TOGAF ADM Cycle (TOGAF Foundation, 2010).

Phase C of the ADM cycle is called 'Information Systems Architecture', where TOGAF addresses the modeling of applications. Information Systems Architecture consists of both a data and application architecture. The main goal of this phase is to develop the target application architecture that enables the Business Architecture and Architecture Vision, while taking the Request for Architecture Work and stakeholder concerns into account. Furthermore, candidate architecture roadmaps can be identified based upon gaps between the baseline and target application architecture (TOGAF Foundation, 2010).

The whole ADM phase consists of 9 steps of which the first phase is interesting in particular: 'Select reference models, viewpoints and tools'. TOGAF specifies and suggests several activities, but of a different kind. Some activities suggest understanding the list of applications (which suggests there should be an application list). While other activities suggest removing duplicate functionality, which seems rather difficult if the information has not been collected or stored previously. TOGAF also suggest to select models needed to support each viewpoint identified (viewpoints are related to stakeholders). Furthermore it is suggested to identify logical applications and relate them to physical applications. Finally, TOGAF suggests the development of matrices that can relate applications to business services, business functions, data, processes, etc. Furthermore, TOGAF provides definitions of catalogs, matrices and diagrams for the development of an Application Architecture. Some of those definitions by TOGAF are shown in Table 3-4 (about 50%). A full explanation of the differences between catalogs, matrices, diagrams and the definitions of the content can be accessed from the TOGAF[1] website.

Catalogs	Matrices	Diagrams
Application catalog	Application / Organization matrix	Application communication diagram
Portfolio catalog	Organization matrix	Application and User Location diagram
Interface catalog	Role/Application matrix	Application Use-Case diagram

Table 3-4: TOGAF Application Architecture Catalogs, Matrices and Diagrams (TOGAF Foundation, 2010).

[1] http://www.togaf.info/togafSlides91/TOGAF-V91-Sample-Catalogs-Matrics-Diagrams-v3.pdf

TOGAF does not suggest nor mention the rating of an application from a technical, or business perspective. Neither do they suggest the collections of other application characteristics, for example the ones related to risk.

3.2.3 Federal Enterprise Architecture (FEA)

The Federal Enterprise Architecture (FEA) was introduced in 1999, to provide a common approach for IT acquisition and development for the United States Federal Government. The FEA is depicted in Figure 3-12. The FEA further specifies the framework in a matrix, showing architecture types. The FEA uses the same perspectives and some architecture types from the Zachman framework. Furthermore, the FEA framework specifies the products which are to be created and the appropriate tools doing so.

Application Sub-Architecture Domain
Application Interface Diagram (core)
Application Communication Diagram
Application Interface Matrix
Application Data Exchange Matrix
Application Service Matrix
Application Performance Matrix
System/Application Evolution Diagram
Enterprise Service Bus Diagram
Application Maintenance Procedure
Application Inventory
Software License Inventory

Table 3-5: Core Artifacts of the Application domain within the FEA framework (FEA, 2013).

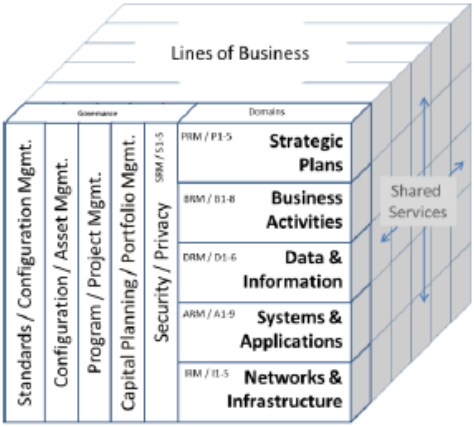

Figure 3-12: The Federal Enterprise Architecture (FEA) Framework (FEA, 2013).

The FEA recognizes six sub-architecture domains, where 'Enabling Applications' is one of them. These six sub-architecture domains specify the type of analysis to be conducted necessary to meet stakeholder requirements.[2] For each sub-architecture domains a *core* artifact is required, for the domain 'Enabling Applications' this is an 'Application Interface Diagram' (FEAF, 2012). The other artifacts are listed in Table 3-5.

An advantage of the FAEF is that the roles and responsibilities are clearly specified. Although they are not specified for each activity, they are described in 'general'. A disadvantage of the FAEF model is that is it focused on the US Federal Government; this means that the risk is that some roles and reference frameworks are only applicable or existing within the US federal government.

3.2.4 Dynamic Enterprise Architecture (DYA Framework)

The Dynamic Enterprise Architecture is a relatively new approach for enterprise architecture, launched in 2005. The DYA Framework is depicted in Figure 3-13. The approach is called dynamic because the creators wanted to emphasize the dynamic aspect of creating architectures. Therefore, the approach is specifically aimed to be agile and facilitate change (Wagter et al., 2005). According to Wagter et al. (2005) the DYA approach is more process focused than content focused. The Dynamic Architecture in the Framework is the *content* layer, while the middle bar with governance on top can be seen as the *process* layer.

[2] http://www.whitehouse.gov/omb/e-gov/fea/

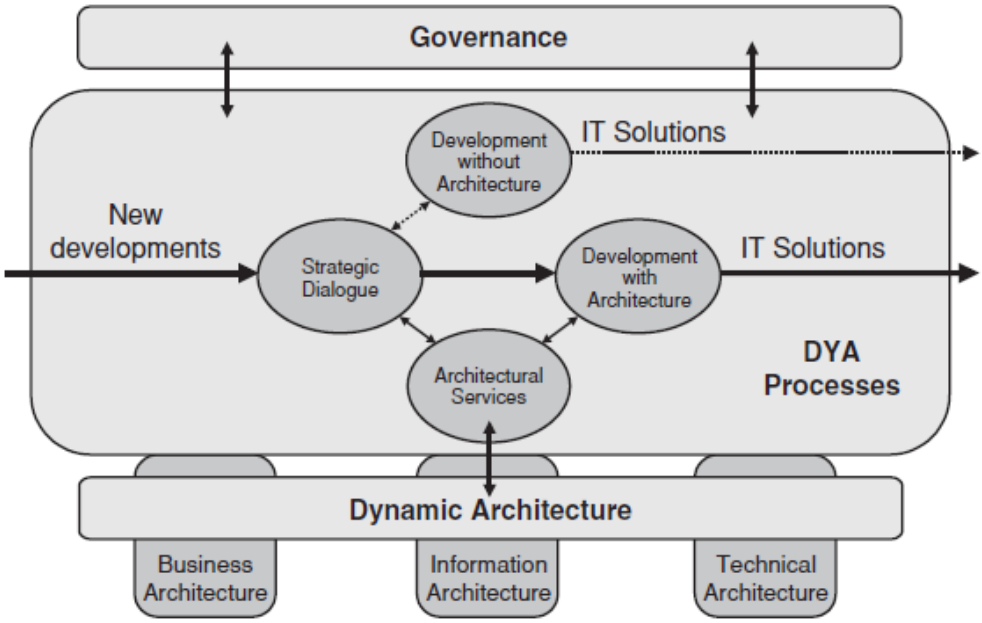

Figure 3-13: The Dynamic Enterprise Architecture framework (Wagter et al., 2005).

In the DYA Framework (original name DYA model) there are four core processes covering the entire change process:

- Strategic Dialogue, in which the business goals are formulated and elaborated using business cases and translate them into project proposals
- Architectural Services, in this process the chosen architectures are formulated and elaborated in a strategic dialogue and made available for the development with architecture.
- Development with Architecture, in which the architecture design to support business goals is created according to the DYA process
- Development without Architecture: a situation in which special circumstances allows to deviate from the architectural framework (i.e. time pressure)

The Dynamic Architecture itself, with business architecture, information architecture and technical architecture is only very briefly described. No direction, or reference frameworks exist and no definitions are given what to include in those architectures. It is only stated that information architecture consists of data *architecture* and *application architecture*. The DYA Framework is very much process focused on building EA capabilities within an organization. It provides best practices, tips, potential pitfalls and a very good approach how the maturity of EA can be measured.

3.3 Relation between APM and EA

A survey held among chief information officers (CIOs) showed that enterprise architecture

frameworks did not align with their concerns about the business (Lindström et al., 2009). In this survey CIO's were asked to prioritize 'concerns' according to their perceived importance. One of the main concerns was cost reduction and as stated previously, application portfolio(s) form a major part of IT budgets. The results were compared to the focus of two enterprise architecture frameworks, namely, Zachman's framework and the Department of Defense Architecture Framework (DoDAF). The results showed that the current frameworks insufficient support decision making on issues related to the IT organization. This chapter describes the relation between APM and EA and how both disciplines are used together.

Two papers were found in which APM is used from an EA perspective and in using an EA modeling language. Both papers are discussed in this section. The first scientific article where APM aspects were combined into a holistic view from an EA perspective was presented by Riempp & Gieffers-Ankel (2007). A combination of literature and case study research led to a number of relevant aspects for CIOs and senior IT managers APM related decision making. Riempp & Gieffers-Ankel (2007) argue that each of the relevant 'aspects' can be related to some role within an IT organization. By using typical IT governance models they abstracted relevant fields resulting in the following APM viewpoints (Riempp & Gieffers-Ankel, 2007):

- IT Strategy: governed by central IT department under direct supervision of the CIO;
- Business and application needs: covered by IT staff responsible for business requirements management;
- IT architecture: addressed by enterprise architects and supported by technical staff;
- IT operation: staff responsible for the 'run' organization and support the business users on a daily basis;
- IT project management: carried out by project management offices;
- IT investments: the central IT department negotiates with both business and IT and typically results in yearly budget cycles. (Riempp & Gieffers-Ankel, 2007).

Riempp & Gieffers-Ankel (2007) combined their empirical research results with the APM viewpoints above. They created a more detailed characterization of APM and relevant viewpoints which is depicted in Figure 3-14.

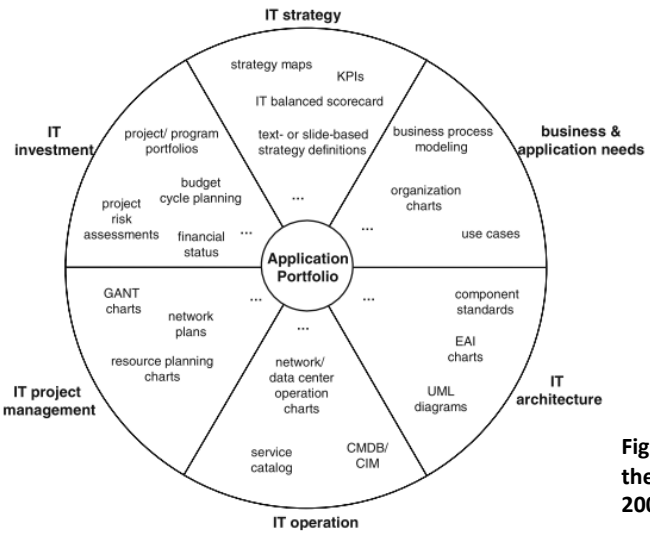

Figure 3-14: APM-relevant fields of decision-making with their associated models (Riempp & Gieffers-Ankel, 2007).

Riempp & Gieffers-Ankel (2007) argue that for a CIO it would be beneficiary to integrate those different perspectives into an 'APM dashboard' for APM. Riempp & Gieffers-Ankel (2007) show how APM can be combined with IT architecture. The result is depicted in Figure 3-15 in which a holistic view is presented and each application is ranked according to their state from an IT architecture perspective. The numbers indicate if a component is: (1) standard compliant, (2) not compliant but tolerated, (3) not compliant, minor issue, (4) not compliant, major issue, or is (-) undecided.

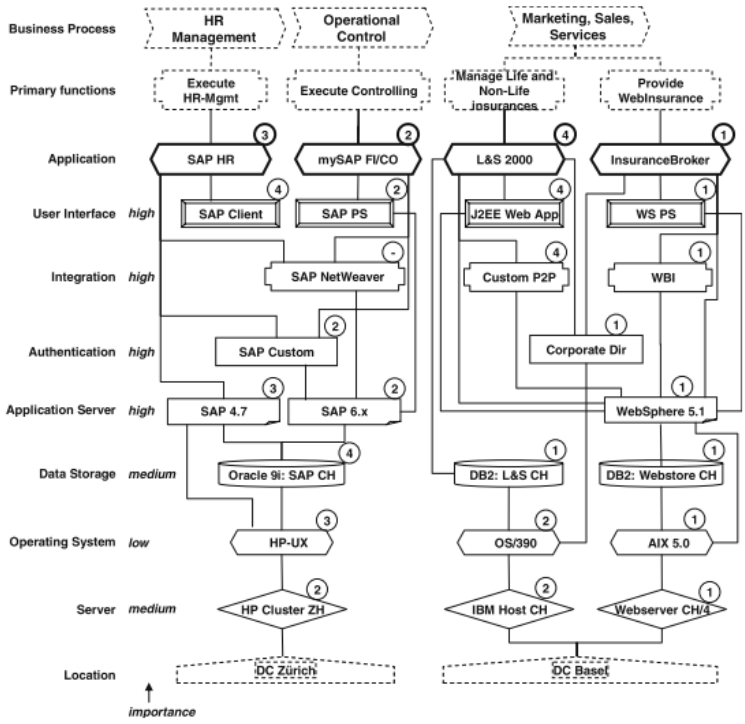

Figure 3-15: APM from an IT-architecture perspective (Riempp & Gieffers-Ankel, 2007).

Quartel, Steen, & Lankhorst (2010) demonstrate how various valuation methods of APM can be combined to models of business requirements and enterprise architecture. Quartel, Steen, & Lankhorst (2010) use Bedell's (1985) approach to assess the value of IT. Bedell's approach contains a few important questions. To investigate if IT investments are necessary, to identify which business processes are relevant for investments and which new IT projects or enhancements are most adequate. In the model of Bedell the effectiveness of an information system put out against the importance for the business. Quartel, Steen, & Lankhorst (2010) extended the model of Bedell and now consider four organizational levels: information systems, activities, business processes and organizational strategy and goals. The extended model is depicted in

. This model takes into account the importance of a business process to a certain business goal.

Figure 3-16: The extended model of Bedell in the ArchiValue project (Quartel, Steen, & Lankhorst 2010).

3.4 Literature summary

Application Portfolio Management:

In the past decades, organizations have collected up to thousands of different applications supporting their business. The immense growth has been stimulated by advances in technology, mergers & acquisitions and organic growth of organizations. APM is becoming increasingly a critical capability for organizations. Literature offers a variety of definitions for APM, and is often named differently such as APR. APM started with matrix based approaches in which applications can be ranked in one out four quadrants. Applications are usually rated for their technical value versus business value, or current value for the business against the expected value in the future.

Literature coins different names to the same phenomena, the 'migration' options for applications. Literature names it for example "Application Portfolio Migration Patterns" (Maizlish & Handler, 2005) or "Optimization Options" (Simon et al., 2010). The rationale behind these kinds of definitions is that the application is subject to change. The specification of those actions is different as well in literature. Some distinguish just 4 migration options for applications (e.g. tolerate, invest, modify, eliminate), while other literature suggests dozens of different migration options.

Literature offers a variety of views regarding what characteristics of applications are important to consider. The application characteristics, stored in an application inventory should include more than just general characteristics of applications that are currently being operated or planned (Simon et al., 2010). For example, "application name, release version, implementation date, application owner, key capabilities, user groups, number of users, vendor, operating system, enabled business processes, affected business units, lines of code and technical components" (Simon et al., 2010). Furthermore, Simon et al. (2010) suggest that identifying the costs and operational performance are essential as well. Weil & Vitale (1999) identified five interrelated attributes being key for assessing the health of an IS, namely: the importance of the system to the business unit, investment in the system, technical quality of the system, level of use of the system and perceived management value of the system. Again on this point, literature shows different views regarding what characteristics are important to consider.

Literature agrees on some aspects regarding the process of APM. First, APM should be seen as a continuous process (Simon et al., 2010; Fabriek et al., 2007; Maizlish & Handler, 2005). Applications have to be assessed and categorized (Simon et al., 2010; Fabriek et al., 2007; Maizlish & Handler, 2005). This counts for both applications on an individual level as for the application portfolio (Simon et al., 2010; Fabriek et al., 2007; Maizlish & Handler, 2005). While some of the activities in the process are similar, the majority of activities in the APM processes differ. For example, Fabriek et al. (2007) explicitly mention that the underlying patterns of the firm should be investigated. The approach of Maizlish & Handler (2005) combines APM and PPM activities, as the method is an approach for IT Portfolio management as a whole (consisting of APM and PPM). The approaches of Maizlish & Handler (2005), Fabriek et al. (2007) and Simon et al. (2010) have been modeled in PDDs and will be used for the method construction. The construction of the new APM method/framework is described in chapter 5.

Enterprise Architecture:

Four EA Frameworks have been analyzed, namely: Zachman Framework, TOGAF, FEA and DYA. The EA frameworks are either more focused on the product (specifying deliverables) or on the approach, specifying activities. TOGAF for example, very explicitly and detailed describes all the steps in the different phases. Zachman framework on the other hand, provides a simple conceptual model of 'things' that should become clear, by using the same questions every time. The DYA framework is more focused on building EA capabilities and provides best practices, tips, potential pitfalls and a very good approach how the maturity of EA can be measured. When specifically is looked at APM aspects in EA frameworks, then some 'aspects' can be identified. For example, both TOGAF and the FEA provide examples of deliverables related to applications. They both mention the application inventory as relevant input for EA, although in TOGAF is it referred to as application catalog.

Relation between APM and EA and vice versa:

Research of Lindström et al. (2009) showed that EA frameworks currently lack the support of estimating and managing costs related to the IT landscape. Although APM is not explicitly mentioned in this research, applications form the majority of IT costs and suggests that APM is not well positioned within EA frameworks. According to Walker (2007) APM and EA share a lot of synergies. These findings correspond with the EA frameworks analyzed in this research. Riempp & Gieffers-Ankel (2007) present a 'framework' of relevant fields for APM decisions making, where IT Architecture is mentioned as one of the six fields. Furthermore, they demonstrate how APM can be combined with IT architecture. Quartel, Steen, & Lankhorst (2010) extended the method of Bedell (1985) to in combination with an established architecture language, ArchiMate, to show the relations between the effectiveness of an IS, the importance for a business process and the importance of that for the business goal. The approaches of Riempp & Gieffers-Ankel (2007) and Quartel, Steen, & Lankhorst (2010) show that APM and EA are used together.

4 Empirical results: the application of APM in practice

This chapter describes how APM is applied in organizations and how EA relates to that. Several case companies were interviewed to investigate how APM is being applied. Furthermore, software tool vendors and individual experts were interviewed to investigate their experiences regarding APM and EA. Therefore, this chapter provides the answer the second research question. This chapter is structured as follows: first, section 4.1 offers an overview of the performed interviews. Section 4.2 provides the results of the explorative interviews and describes the implications for the consequent interviews. Section 4.3 offers the results for the case companies. Section 4.4 provides the results of the software tool companies interviewed. Section 4.5 provides the results of the individual experts interviewed. Finally, section 4.6 summarizes the empirical results.

4.1 Overview of performed interviews

In total 22 interviews have been conducted for this research between September 2012 and January 2013. Of those 22 interviews 3 were categorized as explorative, 8 as individual experts, 6 as case companies and 5 as software vendors. The interviews with software vendors were combined with a product demonstration. The full document of all transcriptions is provided in a separate document available to the supervisors of this project. Furthermore, this separate document includes an overview of all interviewed persons and their corresponding organizations. Finally, all interviews have been recorded (except for one).

The tables 4-1, 4-2, 4-3, and 4-4 provide an overview of the conducted interviews, stating: the respondent number, additional stakeholder information, date of interview and the duration. Table 4-1 lists the explorative interviews, mentioned as 'E1', 'E2', etc. Table 4-2 lists the 'Individual Experts', mentioned as 'IE1', 'IE2', etc. Table 4-3 lists the case organizations, further specifying their sector, mentioned as 'C1', 'C2', etc. Finally, Table 4-4 lists the interviews with software vendors, mentioned as 'S1', 'S2', etc. Whenever quotes are used the corresponding respondent number is given, e.g. 'E1: "quote message" '.

Note: The aim to collect a decent amount of respondents outside Deloitte has been well met. Of the 22 interviews, only 5 were conducted with colleagues from Deloitte. However, all case organizations, except for one, are clients of Deloitte, *although not specifically on this topic.*

Respondent number	Stakeholder type	Date	Duration
E1	Consultant (Deloitte)	21-09-2012	1H
E2	Consultant (Consultancy firm specialized in application management, modernization)	25-09-2012	45M
E3	CEO/Consultant (Consultancy firm using sophisticated software for migrating and modernizing applications)	27-09-2012	1H 05M

Table 4-1: Overview of performed explorative interviews.

Respondent number	Stakeholder type	Date	Duration
IE1	CEO/Consultant (Consultancy firm using sophisticated software for application portfolio analysis	10-10-2012	1H 30M
IE2	Consultant / researcher (Consultancy/Research firm)	29-10-2012	1H 10M
IE3	Consultant expert (Consultancy firm)	20-11-2012	50M
IE4	Consultant expert (Deloitte)	23-11-2012	1H 30M
IE5	Consultant expert (Deloitte USA)	11-01-2013	50M
IE6	Consultant expert (Consultancy firm)	11-01-2013	1H 15M
IE7	Consultant expert (Consultancy firm using sophisticated software for application portfolio analysis)	24-01-2013	1H 15M
IE8	Consultant expert (Deloitte)	28-01-2013	1H

Table 4-2: Overview of performed interviews with individual experts.

Respondent number	Sector of case organization	Date	Duration
C1	IT Manager @ Insurance Company (Financial Services)	04-10-2012	1H 30M
C2	Chief IT Architect @ Public Transport Company (Energy Resources & Transportation)	17-10-2012	2H 40M
C3	Architect (Deloitte) @ Bank Company (Financial Services)	26-10-2012	1H
C4	Project Manager @ Electricity Company (Energy Resources & Transportation)	07-11-2012	1H 35M
C5	Senior IT Manager @ Construction Company (Real Estate)	28-11-2012	2H 30M
C6	IT Manager @ Retail (Consumer Business)	05-12-2012	2H 10M

Table 4-3: Overview of performed interviews with case organizations.

Respondent number	Stakeholder type	Date	Duration
S1	Software tool vendor (EA and APM)	10-10-2012	1H 45M
S2	Software tool vendor (leader in MQ for EA tools)	31-10-2012	1H 45M
S3	Software tool vendor (leader in MQ for integrated IT portfolio analysis tools)	14-12-2012	2H 45M
S4	Software tool vendor (challenger in MQ for integrated IT portfolio analysis tools)	23-01-2013	1H 30M
S5	Software tool vendor (leader in MQ for EA tools)	23-01-2013	45M

Table 4-4: Overview of performed interviews with software vendors.

4.2 Results of the explorative interviews

The first three interviews were of explorative nature and the reasons have been motivated in section 2.3.3. The explorative stakeholders were held with a consultant from Deloitte (E1) and two consultants from other consultancy firms (E2, E3). The explorative interviews were analyzed and grouped in six topics.

1) Cost savings strategy

E1 explained a strategy which they used at a customer who clearly stated that the (IT) costs had to

be reduced with 15%. They started with the question what *can* you do instead of what do you *have*? Second step: what *information* do you need to assess those 'strategies'? Third, they looked at what was already *known* in the client organization. The rationale behind this approach is that building up an application inventory is not the first step. First, the best strategies to reduce costs are plotted on the organization at hand. The different strategies one can apply to applications used by E1 can be found in Appendix 7.4. E1 believes that most savings in such a cost-reduction program can be achieved by reducing the amount of redundant functionality in the application portfolio. Finally, E1 mentioned that it would be interesting to investigate what kind of strategies can be found to analyze an application portfolio.

"Instead of collecting tens or even hundreds of different characteristics of applications we looked at what actions are possible on the landscape of the customer organization." (E1)
Instead of building the application inventory, first potential 'actions' on the landscape were examined and determined

2) Building the application inventory

In every project related to APM it is very important that everyone has a consensus on what an application really is. Across the different functions in an organization different perspectives exist (E1).

3) Obtaining application characteristics

Although a strategy to assess the application landscape or goals of an organization may be different, when you collect application information you need to understand the basic characteristics of an application. Therefore, one has to answer questions like: How many people does an application require for support? What business value does it provide? What is the current state of technology? How often does it change? How often does it fail? How complex is it? How many interfaces does it have? Realize that some information resides within the business organization and some information resides within the IT organization (E2). For example, they might not know what kind of technology is used or if it is obsolete. Note that a lot of information is in the 'mind' of people within the organization, so it is beneficial to think carefully about how to extract the right information from the right people (E2). One of the most difficult things to do is to relate the costs to an application (E2). Another way to collect application characteristics is to use data mining tools for reverse documentation.

4) Think further than a base set of characteristics

Other aspects like contracted SLA's might not look that important. But if an application is replaced by another one, then it would be logical that it can offer at least the same service level as the 'old' application used to have. It is important to analyze all the dependencies of an application and between applications. External suppliers are therefore important in order to see whether they have an application for another system or in another language (E3).

5) The lack of APM maturity in organizations

E2 works at a Consultancy firm where they help companies with application development, rationalization and application life cycle management. Most of their customers are Fortune 500 companies and very few have APM processes in place. A good example -which often happens in organizations-, is that after SAP migration no one is responsible for retiring the decommissioned application (E2). Furthermore, organizations should improve their capability to build an application inventory.

"You will find very few companies with well-established APM processes." (E2)

"We advise our customers that they should conduct application portfolio analysis annually to create a strategic plan, stating which applications are to be retired, maintained, consolidated etc." (E2).

6) Conduct APM on a continuous basis

It is important to organize APM as a continuous process, where the goal is to improve the application portfolio (E2). The goal is to determine migration options for applications and they should be mentioned in an articulated strategy so that can be included in the budget, funded and be treated as a project.

Some implications that were identified during the first explorative interviews:

- Consultancy firms are not always willing to share their knowledge, because it is their intellectual property (E2, E3). Therefore, the methods will most likely need to come from case companies and literature and the individual experts can be used as to gain deeper knowledge.
- The cost-savings approach proved to be very successful in the case given by E1, where the target was to reduce costs by 15% and was well met. Most costs were allocated in reduction of applications with redundant functionalities.
- In the analysis of different APM approaches from literature and practice, E1 suggested to analyze if different application portfolio analysis strategies exist (e.g. cost-savings versus reduction of complexity)
- Acknowledge that people have different perspectives regarding applications. This means that whatever approach you are taking, you have to agree on consensus with all related stakeholders in an APM project on what type of software is being defined as an 'application'. It would be interesting to find out how organizations cope with this issue.
- A potential risk was identified: not being able to find good case companies which implement an APM approach.

The results were used to enhance the base-line of questions used in interviews, which can be found in Appendix 7.2.

4.3 Results of the case companies interviews

This section describes the results of the interviewed case companies. Each description follows the

same structure providing background information, the function & role of the interviewee. Depending on the results an APM approach is described and each summary concludes with lessons learned & key success factors. C4 is not described as the interview was of no use for this research.

4.3.1 Insurance Company (C1)

Background information: Insurance Company is part of an international insurance company. Their revenue is tens of billions of euros. The total IT budget for both management of existing IT landscape and new projects is several hundred million euros. The company has a large history of mergers and acquisitions. Insurance Company has a corporate IT structure and governance.

Function & role of the interviewee: The interviewee's role can best be described as an application portfolio manager for the Insurance Company as a whole. He leads an application portfolio management project, which consists of different APM managers (teams) throughout the whole organization. In his current role he is responsible to help reduce the complexity of the application landscape at Insurance Company.

The need for APM at Insurance Company: The strategy of Insurance Company used to be highly decentralized with independent firms, but almost a decade ago they merged all the firms into one and divided them into several divisions. Underneath the 'main' organization, many brands act in the market, which is called a multi-label strategy. Although from an organizational perspective Insurance Company had been transformed into 'one' company, on the technological side they remained separate. As a consequence, many different applications, different technologies and proliferation existed across the IT portfolio. An independent consultancy firm analyzed the IT landscape and concluded that in the long term the costs would form a potential risk for Insurance Company. If Insurance Company wanted to remain competitive, they had to take action. Therefore, an APM project had been set up a few years ago. According to C1 the main reason for APM at Insurance Company is reducing the complexity of the IT portfolio.

Building the application inventory: To gain more knowledge about the application portfolio, it was evident that an application inventory had to be built. Important experiences during this process are briefly described below:

- It is important to agree on definitions throughout the organization for an application, system, platform, etc. Different perspectives exist and there has to be an agreement with all relevant stakeholders. There is no best definition in this regard, it is important to reach a consensus with the relevant stakeholders. The stakeholders are from the business and IT, i.e. business owners, architects and application owners.
- It is most beneficial to start with analyzing applications where the business impact is the greatest. Therefore, a basic understanding of the relation between applications and business processes is required.
- Building the application inventory is an iterative process and there should be room for evaluation and expansion. Furthermore, roles and responsibilities have to be assigned, for example: who is responsible for what content and who tracks the progress of delivery.

"An architect will always attempt to find the best accepted academic definition, but for me that's useless." (C1)

- Start the application inventory with a very small set of characteristics, for example 5 questions to rate the business value and 5 questions to rate the technical value of an application. When too much information is collected at the start, it requires too much time. Furthermore, it would create a more complicated process as more people would get involved.
- An example of full application inventory used at Insurance Company is shown in Figure 7-12 in appendix 7.4.

The APM process at Insurance Company: The APM process at Insurance Company has been modeled in the PDD as is shown in Figure 4-1. After the application inventory has been built, the classification of applications can start. Stakeholders from both business and IT discuss the 'future' for each application. This results in an application roadmap, including an 'exit date'. An exit date is a synonym used for the decommission date and shows the importance to reduce the number of applications. As long as there is a positive business case regarding the reduction of complexity a (new) project will receive approval. Exceptions are only made for crucial maintenance tasks and required legislative changes. Finally, the APM process is 'continuously' improved, as is shown in the last step.

"The problem with defining target architecture is the illusion that exists that you can shift immediately from the current architecture to the target architecture." (C1)

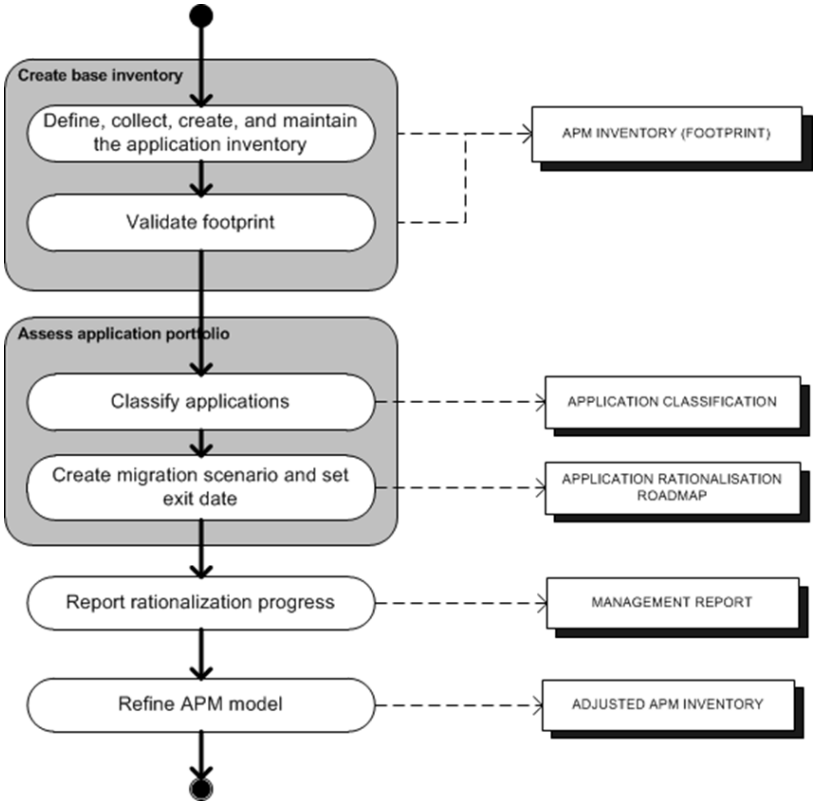

Figure 4-1: APM method at Insurance Company.

Lessons learned & key success factors:

- Embed 'APM' activities in existing processes; using the existing organization. Use existing

"Matrix-based approaches are good to create awareness, but too simplistic to be used solely." (C1)

processes as much as possible, for example, configuration management and build the application inventory in a configuration management database (CMDB).

- Reducing complexity in the organization became a strategic objective, supported and sponsored on board level. This led to authority for the project leader and APM teams.
- The first significant value of an application inventory is that is provides a single source of truth of application knowledge while the information used to be spread out throughout the organization in the past.

4.3.2 Transport Company (C2)

Background information: Transport Company is a company with revenue of tens of billions of euros. The budget of their IT department is several hundred of million euros. This excludes expenses on a higher 'group' level.

Function and role of the interviewee: The interviewee is a chief-architect within the IT organization of Transport Company. He leads a group of 20 architects and he is responsible for advising the business and development departments on new projects. He is part of the development department.

"It's not our goal to modernize the systems, it is our goal to be ready when a customer comes to us that we can consult him, and not only what the problems are, but the solutions. One of the most important things is to know what you actually do have *and this requires a structured framework" (C2)*

The need for APM at Transport Company: During the past few decades, the IT landscape grew immensely and there are a couple of issues that currently have the attention of Transport Company, particularly in the role of C2:

"It is really important that you don't dig down into all kinds of information; because the only thing you really want to know in the end is where do I have risks and where do I want to invest and where do I not want to invest." (C2)

- There are dozens of increasingly difficult to maintain legacy applications. This comes in combination with outdated user-interfaces in those legacy systems, lack of documentation and a redundancy of data and functionality.
- There is a lack of expertise due to an aging workforce, which will lead to severe risks in the future. The costs will rise and the development time will increase when they do not have the expertise to support specific systems.
- A number of applications are out-of-sync with business requirements.

The impact on the business can be summarized as follows:

- Increased time-to-market.
- Potential failure to conform to regulations which can ultimately jeopardize the business continuity.
- The inability to maintain competitive in the market.

Transport Company acknowledges the fact that they have a large bulk of applications between 5 and 30 years old and a lot of people involved in the development of those applications are going to retire. C2 is currently creating a framework for modernization (which they call transformation) in

order to determine what to do with those applications. They realized they need APM to build application knowledge, because the information that was available proved to be insufficient.

Building the Application Inventory: Transport Company started last year with building the application inventory. They started with a small list of applications, focusing on business importance, application quality, operational efficiency and external risks. The full list of application characteristics currently used by Transport Company can be found in appendix 7.4 in **Figure 7-11**. C2 explained that the first thing to find out is for example: What applications do we have? Where are they? Who owns them? What technologies do they use? Is it business critical?

APM / Architecture framework at Transport Company: Transport Company created a high-level transformation framework with its desired outcomes; the method has been modeled in a PDD and is shown in Figure 4-2. The main phases are briefly described below:

- Perform current-state analysis:
  In this phase the current state of the business, functional, technology and data architecture are analyzed. Furthermore, it includes an architecture assessment and an organizational assessment. This phase includes the creation of the application inventory.
- Define Target Architecture:
  In this phase the target business, functional, technology and data architecture are defined. Furthermore, the organizational state, including skills and personnel has to be defined.
- Create Roadmap:
  In this phase the target state for each application is decided. There are six modernization options used by Transport Company: Retain, Rejuvenate (Optimize), Reuse, Re-host, Reengineer/Re-architect and Retire/Rebuild/Replace.
- Implement actions:
  In this phase the intermediate and target architectures are being implemented by using proof of concepts.

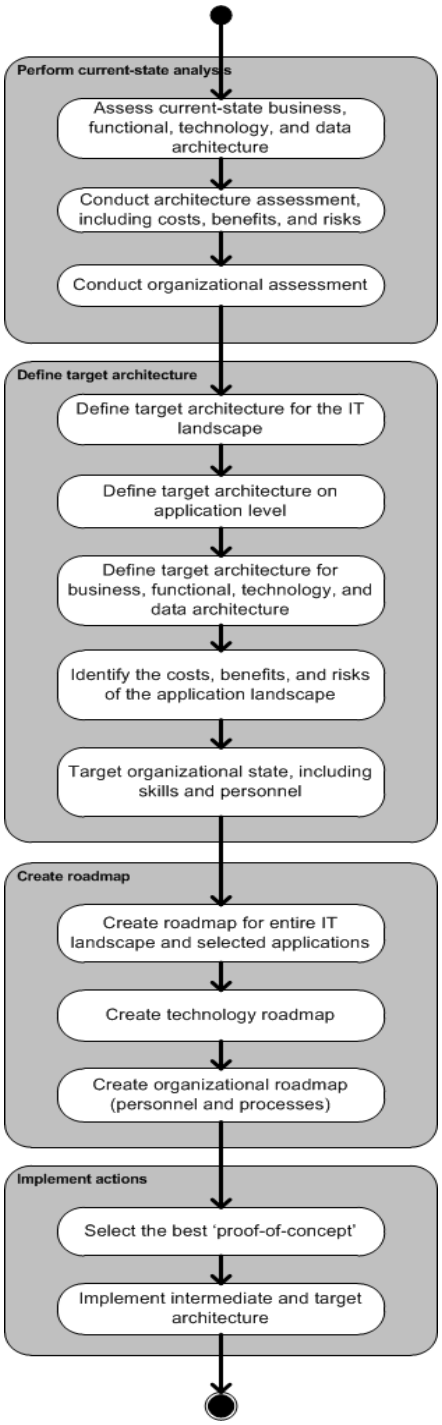

Figure 4-2: APM/Architecture framework at Transport Company.

Lessons learned & key success factors:

- One of the most important things is to know what applications are actually there and it takes a structured framework to identify the applications in the organization. Building up the application inventory is the process that supports this.
- Both look at individual applications, as well as the portfolio of applications. The relations between the applications have to become clear. For example, an application can be secure on individual level, but it might be influenced by other applications in the portfolio
- Continuous APM is the end goal instead of large one-time transformations, since the large one-time transformations take more time and carry higher risks. In this way you can take small steps in improving the landscape, instead of major steps. This is demonstrated in Figure 4-3. Please note that the target architecture is never definite and will always change over time.
- C2 does not believe it is important to have one definition for an application. "In the end it is only important if you can relate the different perspectives in an organization together." (C2). Whereas in the other interviews this was often described as an important precondition, C2 disagrees.

"Even last year I was unable to tell you how many applications run on an IBM mainframe, this year I can." (C2)

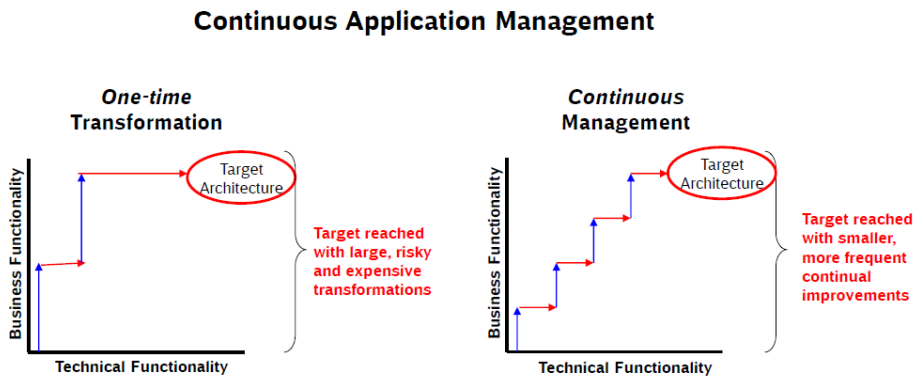

Figure 4-3: The need for continuous application management. Source: C3.

4.3.3 Bank Company (C3)

Background information: Bank Company has revenue of tens of billions of euros. The budget of their IT department is hundreds of millions of euros. A centralized IT organization supports the main Bank Company organization and its local offices. It consists of architecture, maintenance, development department and some other less important departments. Architects are outside the management and development departments. The balance of power used to be in favor with the business but nowadays IT is the steering component. In the past things went wrong too often, being orchestrated

by the business. Therefore, decisions are often taken from an IT perspective.

Function & Role of the interviewee: He is part of an architect team that governs a huge business transformation project 'modernization' [fictive name] where the 'payment' functions is being modernized/redesigned. At the moment they are focused on migration strategies for the existing landscape. He works on behalf of Deloitte. Please note C3 is part of a 'domain' within Bank Company and other domains lead their own architecture projects, roadmaps, etc.

The need for an application inventory: Bank Company defined target architectures, but the question was how to get there. The problem was that Bank Company did not have a good picture of the applications that were affected by this 'modernization' program. It became clear that an application inventory had to be built, linking applications to projects and their owners etc. They analyzed the application portfolio and the applications which lagged behind the target architecture most were selected as first candidates for modernization/migration.

"The main reasons for this large project are the reduction of the complexity, to cope with (new) legislation, and modernization of the landscape." (C3)

Bank Company created a process to make sure the application inventory was kept up to date, involving the business, the 'change' organization, the development organization and the application management organization. The application inventory is shared across the organization and different perspectives exist specifically tailored for each stakeholder involved. The application inventory can be viewed from the following perspectives: a technical, a business critical view, affected by compliancy, recoverability / scalability and for general information like business owner contact information. A part of the application inventory used at Bank Company is shown in Table 4-5.

Application characteristics	
Application name	Service owner
CI identifier (link to CMDB)	Program manager
Application description	Business change manager
Target architecture state	Process owner
Platform	Process manager
Business critical	Product manager

Table 4-5: Application Inventory at Bank Company. Note that only a part of the application inventory is shown to secure the anonymity of the case company. Source: C3.

Lessons learned & key success factors:

- Changes being requested by the business are being assessed with criteria from both a business and architectural perspective
- Back-up from senior management was essential for the creation of an application inventory.
- The application inventory provided a way to communicate with different stakeholders. This is stimulated by the fact that the application inventory can be viewed from different perspectives.

"The application inventory is a precondition to successfully run change in your business." (C3)

- A 'single source of truth' was provided by the application inventory. People knew this was a reliable list.
- The creation of the application inventory was an iterative process which evolved over time. The application inventory started with a small set of characteristics and included the most important applications.

4.3.4 Construction Company (C5)

Background information: Construction Company has revenue of several billion euros. Their IT budget is tens of millions of euros. The company has a history of mergers and acquisitions and consists of many operating companies.

"When you place someone from a manufacturing site of Henry Ford 100 years ago at a todays Volvo manufacturing site, he would have no clue what kind of factory he is in. However, if you would get someone who worked 100 years ago on the empire state building, that person would see some new things, but his view of the world has not changed completely. This demonstrates how IT in our sector has not evolved as far as in other sectors. Some sectors would have been 'unthinkable' and not even existent if there was no IT." (C4)

Function & Role of the Interviewee: He is an information manager at Construction Company; his main focus is to improve the dialogue between the business and the IT. He works on improving the maturity of processes, with roles and functions being defined for the business and IT.

Interview results, not applicable for this research: The IT organization is not that mature and have not started with an APM initiative so far. The immaturity is probably heavily influenced by the way Construction Company is organized, a highly decentralized organization with a lot of autonomy for the operating companies, typical for the construction sector in general (C5). A lot of power resides within the business and the IT is typically addressed as a supportive function. Unfortunately, the results of this interview cannot be used for this research. C5 made an interesting remark by stating that he does not believe that their costs for ongoing operations and maintenance versus innovation are becoming increasingly unbalanced (in disadvantage to innovation), which literature also suggests, as described earlier in section 3.1.

4.3.5 Supermarket Company (C6)

Background information: Supermarket Company has thousands of employees and has revenue of hundreds of millions of euros. The budget for the IT organization is several million euros. Although the IT budget seems very low compared to the total revenue, this is normal for the supermarket sector. This company is relatively small compared to the other case organizations interviewed and has no recent history of mergers and acquisitions. Supermarket Company has dozens of applications in operation.

"Our replenishment systems are most essential, because as Supermarket Company we are continuously monitored by the VWA." (C6)*
VWA = Voedsel- en Waren Autoriteit

Function & Role of the interviewee: C6 was the first computer operator at Supermarket Company. Currently he is the main IT manager of Supermarket Company.

The need for APM: As retail organization they play a game between the manufacturer and the customer. Questions that are important for Supermarket Company and their customers are: What

do you offer? When do you offer it? Where can you find us? Keeping the customer satisfied while being most effective in operational efficiency. A few years ago Supermarket Company started a program to improve their IT organization. Main reasons to improve the IT organization were:

- To be able to react more efficiently and effectively to change.
- To reduce costs while increasing efficiency.
- To secure continuity of the business.

Supermarket Company realized they lacked the knowledge of their (significant) business processes. They decided to model the most important business processes and link the 'ICT' objects to those processes.

Approach used by Supermarket Company: The approach used by Supermarket Company is shown in Figure 4-4. First, they started by training their personnel in the concepts of APM and BPM while the organizational perspectives were provided by BISL and ASL. Second, they started to model the core business processes, starting with their replenishment processes. Third, they created an inventory in Mavim Rules where various aspects of applications and business processes were stored. This included: the application name itself, its interfaces, the relation to its business processes, people responsible for the functional-, technical- and application management, the physical servers and more. Finally, the outcomes were evaluated and improved until all the important processes and systems were captured.

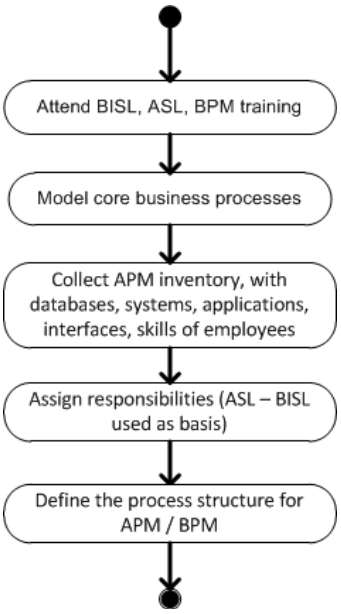

Figure 4-4: APM approach at Supermarket Company.

Lessons learned & key success factors:

- APM and its use had to be explained properly to all the internal stakeholders within the business. Good communication is therefore essential.
- C6 gained a lot of credibility and trust within the organization. Therefore, he gained support from senior management and business units. This was also due to the fact that Supermarket Company is relatively small in size and C6 has been working there for over 20 years.
- To increase the success factor: start with a small scope of applications and application characteristics and increase the scope over time while the process is improved in the meantime.

4.4 Results of the software tool vendors interviews

The selection for APM and EA tools was based on the ranking in the magic quadrant reports from Gartner, from which the leaders were selected. Magic quadrant reports for software are renowned for their ranking of different (software) products for a specific use and are usually reassessed each year. Companies (with their corresponding products) are divided into four categories, namely: niche players, visionaries, challengers and leaders.

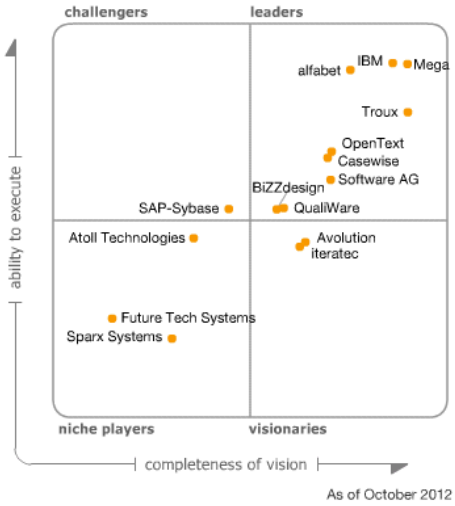

Figure 4-5: The Magic Quadrant for Enterprise Architecture Tools (Gartner, 2012).

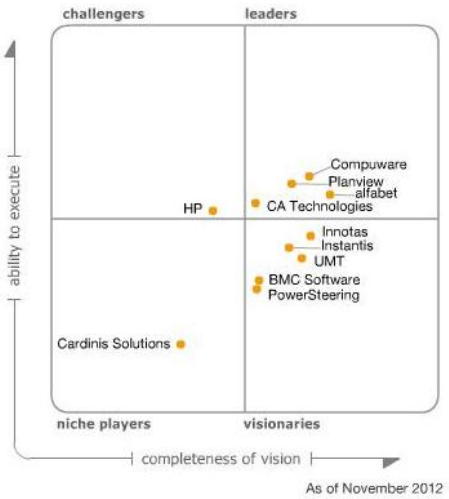

Figure 4-6: Magic Quadrant for Integrated IT Portfolio Analysis (Gartner, 2012).

Software vendors are rated for their 'completeness of their vision' and their 'ability to execute'. Vendors who are categorized as leaders have the most complete product. The Magic Quadrant for Enterprise Architecture Tools is used to select tools for EA and is depicted in Figure 4-5. The Magic Quadrant for Integrated IT Portfolio Analysis is used to select tools for APM and is depicted in Figure 4-6.

Change in one of the research objectives: During September and October 2012 all leaders for both 'Integrated IT Portfolio Analysis tools' and 'EA tools' were contacted. Few software companies actually responded and some stated it would be impossible to test an 'evaluation' version. Most software vendors explained that it was usual to attend product trainings first in order to learn how the tool works. Therefore, the initial ambition to test the software tools was dropped and the research objective changed into obtaining the software vendors' perspective on APM. My supervisors agreed that it would be unrealistic to test the tools during this research.

About the software vendors interviewed: In total 5 software vendors were interviewed of which 2 fell in the category of leader in magic quadrant for EA tools, while 2 fell in the category of leader in the magic quadrant of integrated IT portfolio analysis tools. The fifth software vendor that was approached is not mentioned in any of the two magic

"APM anno 2012 is a strategic initiative, and it should be a topic at board level." (S1)

quadrants, but holds a significant market share in the Netherlands in this field.

Difference between 'EA' focused and 'PPM' focused vendors': It seemed that many software vendors placed in the "Integrated IT portfolio analysis" were PPM focused. Some software vendors *only* had PPM functionality and no APM functionality at all. In the software demonstrations the 'focus' was clearly visible. For example at S2 their whole 'model' is inspired by the Zachman framework and for each 'object' that was added, an application for example, the 'W' questions like: what, why and where had to be answered. In practice this would be: what kind of application, the motivation for the application and the physical presence of the application. On the other hand, S4 was totally built on PPM capabilities and in a later phase, APM was added. In the service offered by S4 one could easily create relations between applications and projects.

What do software vendors offer? All software vendors offer a base set of predefined applications characteristics, which can be modified to an organization's needs. For example, S2 delivers are predefined set of characteristics for a business, application, IT and vendor perspective. Most offer functionalities like the ability to use/plot matrices and total cost ownership functionalities. Some software vendors also offer the possibility to send questionnaires. These questionnaires can be used to analyze the perceived value of applications across its users.

Approach advised by software vendors: At this point the knowledge varied a lot between the software vendors. While some software vendors did not have a complete vision on how a good approach would look like, often stating that they have implementation partners and/or consultants. On the other hand, some software vendors were very capable of describing their approach. The approach envisioned by Software Vendor 2 is shorty discussed below. The approach envisioned by S2 consists of 5 steps:

1) Establish clear authority & sponsorship: this is essential as a first step to secure the sponsorship from senior management and a clear authority for the project.
2) Assess maturity of your organization: the organization has to be assessed from an organizational and technological perspective. In this step it is crucial to find out what is already known within the organization and how and where this information is available.
3) Define scope and timeframe: in this step the breadth and depth (business units, type of applications etc.) of the project are determined.
4) Implement APM processes based on maturity: first, start simple and focus on quick wins. Second, you have to determine application criteria/metrics. Third, the application inventory has to be built. When the application inventory has been built, you rank each application and give a recommendation. Finally, you execute and monitor the portfolio.
5) As a final step, it is advised to improve the previous steps while you re-do the process.

Critical success factors according to software vendors: S5 mentioned a list of critical success factors specifically for APM. Some of them were already mentioned in the previous paragraphs:

- Secure senior sponsorship.
- Stimulate cross-organizational involvement.
- Collect and combine data; collect just as much as needed.
- Communicate along the process.

- Strive for practical quick-wins and set goals for the long-term.

Why should you not use a tool? Although this has not been mentioned during the interviews with software vendors, it has been mentioned during the interviews with case companies: - A tool, whether more EA of PPM focused is a significant investment, both in terms of purchase or subscription and the cost of implementation. Furthermore, APM activities like the creation of an application inventory can be executed by using more cost-efficient tools, like Excel.

4.5 Results of the individual experts interviews

In this section the results of the interviews with individual experts are given. In total 8 interviews with individual experts were held. Most of them are consultants, while two can be seen as both a consultant and researcher.

Why do organizations start with APM?

There are several reasons why organizations start with APM. These can be summarized as follows:

- Reduction of costs: budgets are decreasing but maintenance costs are increasing. This leaves less opportunity for innovation. Thus triggering the conscious of organizations that they have to reduce their complexity in order to move forward;
- It happens around mergers & acquisitions, although often only a snapshot is taken rather than really implementing APM (an APM snapshot is discussed below);
- In some cases (which happen more often nowadays) it is because of the continuity of the business;
- There can be a strategic motivation, for example, an organization wants to focus on customer satisfaction.

Functionalities are becoming a commodity: According to IE3 functionalities are becoming a commodity, thus available as a standard package in the market. This causes a new 'trend' in businesses can look at their business components and ask themselves whether they want to outsource it or not?

"you [business] have to ask yourself: which components are you [business] going to host on your own? And which components are you going to outsource?" (IE3)

Top-down approach: Application inventories are usually built by using questionnaires or by organizing workshop with stakeholders. This approach is often referred to as a 'top-down' approach *(Forrester, 2011),* while the usage of data mining tools is often named as the 'bottom-up' approach. The top-down approach relies more on subjective data from users, the bottom-up approach is backed with objective data. For the top-down approach consultancy firms have a set of offers. Consultancy firms, like Deloitte, typically offer an application 'snapshot'. This is a one-time analysis of the application landscape, for example at a merger & acquisition or in the support of a modernization project. While such an assessment typically improves the knowledge, it remains a one-time operation, where the goal is not to make an organization ready to conduct APM on a

continuous basis. (IE4).

Bottom-up approach: IE7 does not refer to a bottom-up approach, but names it a technology based approach, in which you analyze the source code of the applications and use a strategy approach to gather subjective data IE7 states that if you do not analyze the source code, you will only find about 20-40% of the dependencies between applications. IE7 mentioned the fact that specific information dwells in the minds of people and is often inaccurate. The approach that is used by the consultancy firm of IE7 can be described as follows:

"Specific information related to applications usually dwells in the mind of a few people and is often inaccurate." (IE7)

1) Select an entire portfolio or a cluster of application from a given portfolio: the first step consists of capturing the business strategy. Furthermore, the scope of the applications/cluster should be agreed upon. Finally, an inventory session is held to see what sources can be used for the analysis.
2) Analysis in the lab, analysis on quality and risk and costs: second, during the analysis in the lab the costs, quality and risks are assessed. Costs are assessed using a bottom-up approach where the code is being analyzed and compared with historical data using statistical analysis. The risks are being determined by analyzing the application architecture. Finally, the quality of an application is assessed in the lab.
3) Analyzing the lab results (from a consultant perspective, operational; quality and costs): in the third step the results are being interpreted by consultants. The consultants are experienced in translating the data from different tools into advice.
4) Results: in the fourth step the results are visualized, preferable in a one-dimension chart. It can be used to show how applications are ranked against each other. Furthermore, a roadmap for the new optimized portfolio i.e. target architecture can be defined.

IE1 is another example where a bottom-up approach is being applied. The difference with IE7 is that the company of IE1 is focused on the costs of an application. They analyze each application (given a certain scope) and compare the costs per application with 'relevant' peers in their industry. When a difference is encountered more in depth questions are to be answered, for example, why is application 'A' 50% more expensive in comparison to its peers?

Relation between APM and EA

IE2 sees a trend where more and more 'APM' aspects are included in architecture maps, like life-cycle metrics for example. However, IE2 stated many detailed characteristics are better suited for a CMDB. Furthermore, EA gives a good overview of the relations between applications which are essential to assess certain portfolio aspects. For example, it can be used to determine security over a portfolio, or from a project perspective e.g. to find project dependencies or conflicts (IE2). : A combination of APM and EA can be used to assess the required importance of an application for the business more accurately. From a project perspective this can be used to motivate the need for a project.Finally, IE2 believes that APM is becoming a part of the EA field and not the other way around.

Key issues regarding the use of APM:

Some of the following points have already been discussed in earlier sections and will therefore only be discussed briefly:

- There are different lenses (or perspectives): the functional, business and technology perspective have to be combined.
- Catch the 'Shadow IT': IE7 specifically mentioned 'Shadow IT', which brings along a lot of extra costs. It is called Shadow IT because the IT organization is not aware of their existence. It can be a very small application or tool used by a few users. For example, a number of excel files throughout an organization of which the IT has no clue of. The danger lies in the fact that the IT organization has no idea how many hours are spent on the Shadow IT landscape, on maintenance, support etc. Therefore, it is important to be aware of its existence and it has to be tracked down as good as possible.
- Decommissioning is very important and is often not given the required attention. If an application is not decommissioned the potential cost savings will not be achieved.
- If an organization starts with APM they should continue to use it and integrate it with their existing processes.
- Enterprise Architecture can help improve the communication between the business and IT and thus help APM as well.
- The reduction of redundant functionalities will lead to most of the cost savings, far more than standardizing, although standardizing requires less effort.
- Most organizations are not mature regarding APM, very few organizations conduct APM properly.

"The most money is not spent on the 'run' side but on the maintenance side." (IE3)

"Making something 'new' is always more fun than cleaning something up and people can easily think: that is someone else his problem." (IE3, concerning the decommissioning of applications)

4.6 Empirical research summary

4.6.1 Explorative interviews summary

The explorative interviews formed the base set of questions used in the interviews. Some of the issues raised by the explorative interviews, like starting with a small set of application characteristics, were confirmed in the follow-up interviews. Furthermore, the fact that not many organizations have a mature APM process in place has been confirmed in later expert interviews as well. Luckily, some case companies were found with an APM process already in place.

4.6.2 Case company interviews summary

In total six different case companies were interviewed, unfortunately two cases, namely Construction Company and Electricity Company were not applicable for this research. The other case companies, C1, C2, C3 and C6 all had either full or partial APM processes in place or were in the process of starting such an initiative. The examples given clearly show how APM is used in practice within organizations. The three most complete approaches were modeled and therefore C3 was left out as it consisted mostly of the building the application inventory. Therefore, cases C1, C2 and C6 have been modeled in a PDD which is used for the APM method construction described in chapter 4.6.1.

Short summary of the cases:

- Insurance Company (C1) showed the most mature APM processes and the project itself was initiated to reduce the complexity in its IT landscape to ultimately reduce the costs and maintain competitiveness in the long run. Insurance Company (C1) has been continuously improving the APM processes since they started with APM about three years ago.
- Transport Company (C2) has identified some 'common' concerns related to a complex IT landscape with the proliferation of application and created a framework/method to analyze the application landscape in order to consult the business more efficiently. The approach of Transport Company is shown in Figure 4-2 and clearly shows the influence of an architects' perspective, where the main focus lies on defining the target architectures and the different layers (application, data, infrastructure, system etc.), as well as collecting information regarding those layers.
- Bank Company (C3) started with a large modernization program in which they quickly realized that they were unable to determine which applications were affected by this program. Therefore, an application inventory had to be built, which as literature and the other cases have shown, is an important step in an APM process.
- Supermarket Company (C6), although being relatively small in size, acknowledged the benefits of having a good APM process in place. They started with building an application inventory, including other relevant items like physical location, server, what business processes the application is used for etc.

Differences per company:

Insurance Company and Bank Company (C1, C3) showed that the IT organization has a lot of power or influence on the business. Both mentioned that in the past this used to be the other way around.

The way APM is being applied at Insurance Company differs a lot from Transport Company and Supermarket Company. Insurance Company uses APM to move the business in a certain direction (towards target architecture) and project initiatives are used in new projects to reduce the complexity of the current landscape. Transport Company and Supermarket Company (C2, C6) on the other hand, use or will use APM to be able to consult the business in a better way. In both organizations the business always has the final decision. In the case of Transport Company it was even the case that some relevant information was not available to the architects (e.g. the costs related to application), because it was owned and used by other departments. Construction Company (C5) motivated that, although he saw the relevance for APM, he argued that the dialogue/maturity between the business and IT first had to be improved. Therefore, in these case companies the influence of the IT organization clearly affected the APM process.

Tools being used in practice:

Supermarket Company (C6) is the only case which already uses sophisticated (APM) tools to store the application inventory. The tool has a connection with the CMDB (Topdesk) and the business processes are modeled in Visio. The information is being shared with Sharepoint. Note that Topdesk, Visio and Sharepoint were existing applications. Insurance Company (C1) has used Excel for about three years and is now in the process of implementing a tool to replace Excel for APM data. Insurance Company uses Sharepoint to share the application inventory across the organization. Transport Company and Bank Company (C2, C3) currently use Excel for their application inventory. Bank Company uses Sharepoint to share the application inventory.

Shared experiences at case companies:

- Secure sponsorship from senior management, which is required for the success of an APM initiative.
- Start with a small scope of applications (both in breadth and depth), for example, start where the business impact is the highest with just a few technical and functional characteristics.
- Building the application inventory is an iterative process, as is the APM process as a whole.
- You have to agree on definitions for application, component, etc. in an organization (*However, C2 disagreed on this fact).*
- Integrate APM into existing processes.
- The APM should cover the concerns of different stakeholders from both business and IT.
- The influence /power of the IT organization over the business affects the APM process and maybe even the ability to successfully initiate APM. However, due to the small amount of case interviews, this statement cannot be made generic.

4.6.3 Software tool vendor interviews summary

Software vendors demonstrated a lot of knowledge on the topic of APM, as their envisioned approach to APM and key success factors seems very similar to the topics mentioned at the case study interviews. The software tool vendors all have their traditional roots in either PPM or EA. This means that their tools are either better in modeling and creating relations between ICT objects or support more project related information. For example, in project benefit analysis, where different

migration options can be rated against each other.

4.6.4 Individual interviews summary

The individual interviews gave more insight on why organizations start with APM. The reduction of costs and exposure which threaten the continuity of the business has been encountered at some of the interviewed case companies. Furthermore, individual experts mentioned the strategic motivation for organizations and mergers and acquisitions as reason to start with APM.

Building the application inventory: Building the application inventory can either be done by using a top-down approach or a bottom-up approach. The top-down approach uses input from individual users, stakeholders and other experts, while the bottom-up approach uses automated tools to analyze the application landscape. The individual experts using bottom-up approaches claim that by using solely a top-down approach the relations between applications are not well identified. However, none of the case companies interviewed used such a bottom-up approach.

Relation between APM and EA: APM aspects are included in architecture views and models more often nowadays. APM is emerging as a part of EA and not the other way around.

Experiences from individual experts: The key points of shared experiences of the case companies have all been mentioned by one or more individual experts. However, some other relevant experiences have been mentioned specifically by individual experts:

- The importance of decommissioning old applications, potential cost savings will not be achieved if old applications are not decommissioned.
- Functionality is increasingly becoming a commodity (at least in the Banking sector, IE3) and businesses have more and more the option to outsource an application.
- Enterprise Architecture can help improve the communication between the business and IT and thus APM as well.
- The reduction of redundant functionalities will achieve most cost savings, far more than standardizing, although standardizing is easier.
- Most organizations are not mature regarding APM, very few organizations conduct APM properly.

5 Method Construction

5.1 Method base

In chapter 3 the APM approaches of Maizlish & Handler (2005), Fabriek et al. (2007) and Simon et al. (2010) were described and modeled in PDDs. In Chapter 4 the approaches of Insurance Company (C1), Transport Company (C2) and Supermarket Company (C6) were modeled in PDDs. Furthermore, the existing APM approaches used at Deloitte Consulting Netherlands were used and modeled in PDDs. The complete list of methods is shown in Table 5-1 which includes the references to the corresponding PDDs in appendix 7.2. These methods formed the method base for the creation of the new APM method/framework.

In order to compare the created methods and design a new APM method/framework, a workshop was organized and functioned as construction instrument. Section 5.2 describes the workshop procedure. All activities of the eight base methods were categorized for easy comparison. The Deloitte APM approach was used as baseline for the categorization. The category list can be found in Appendix 7.6.1. This resulted in an overview of all the methods available and the 'type' of activities they supported (Appendix 7.6.2). This allowed for easy comparison during the workshops.

Author(s) / Company of APM method	Corresponding PDD appendix 7.2
Literature	
Maizlish & Handler (2005)	Figure 7-1
Fabriek et al. (2007)	Figure 7-2
Simon et al. (2010)	Figure 7-3
Case Companies	
Insurance Company Method (C1)	Figure 7-4
Transport Company Method (C2)	Figure 7-5
Supermarket Company Method (C6)	Figure 7-6
Deloitte	
Deloitte Consulting	Figure 7-7
Deloitte Consulting (Cost-savings APM approach)	Figure 7-8

Table 5-1: List of methods modeled in PDD format for comparison.

5.2 Workshop procedure

The aim of the workshop was to create a new APM method/framework by combining the best parts of existing approaches, from practice, literature and Deloitte. Four experts were contacted to attend this workshop of which three participated. The attendees were a senior manager of Deloitte (individual expert), one expert of a case company and an expert of a software vendor.

The workshop had a length of four hours and consisted of three steps:

1) Define deliverables: the deliverables of the APM approach were discussed and selected.
2) Define activities: activities were assigned to deliverables by comparing the activities of the methods.
3) Discussion: At the end of the workshop the new APM method was discussed. Furthermore, method base was used for missing activities and deliverables. Finally, the main stakeholders and roles involved were determined.

Although it was initially planned to start the discussion with activities, the experts urged that it would be more useful defining the deliverables for the APM process first. The suggestions by the experts were directly modeled and shared on a big screen, which allowed for direct comments by the experts to improve the participation. The initial method consisted of the APM process with all activities and the relations with processes outside the APM process. In order to keep the proposed APM method focused on activities considered required for the APM process, it was decided that the non-APM processes should not be included in the final APM method. Therefore, after the workshop it was decided to create a high-level APM overview, representing the APM process and 'external' processes.

5.3 High level APM Method overview

The APM process on a high level is illustrated in Figure 5-1. The APM process consists of five different phases, each influenced by external 'factors' within an organization. The process as a whole is highly iterative and although it is necessary to perform each step once, iterations can only cover two or three phases, depending on the situation. For example, the business strategy may be defined for 3 years, however they are subjected to change when senior management is replaced.

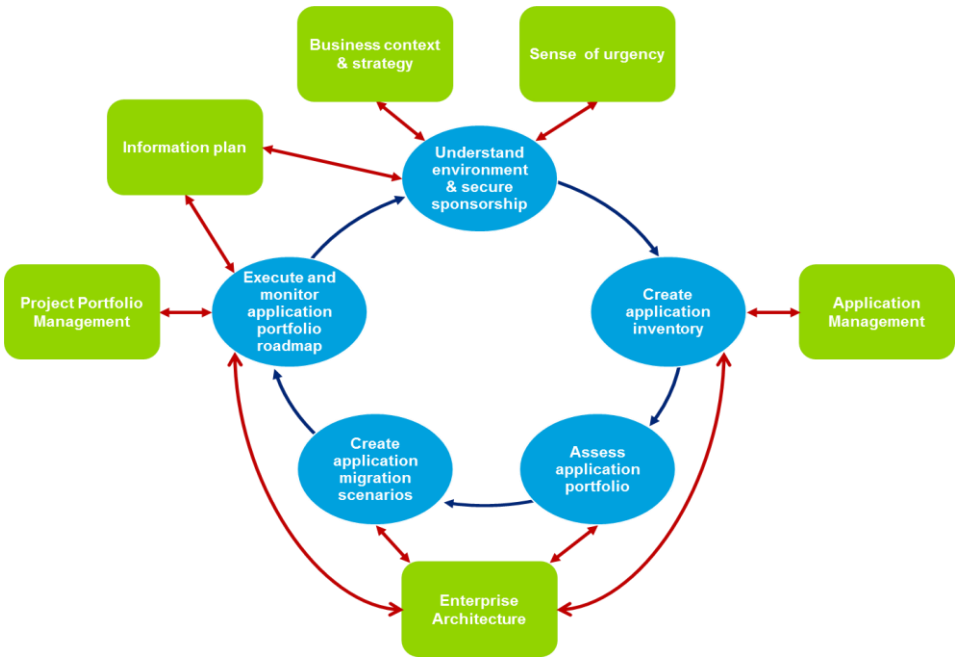

Figure 5-1: High-level overview of APM and its external factors.

The APM processes are shown in blue whereas external processes are shown in green. The blue arrows represent flows between the main APM activities, while the red arrows represent the influence of the external processes. Note that the green 'APM' activities were kept in the detailed APM method and consist only of the 'blue' activities. The detailed APM method is described in section 5.4. Note that 'external processes' only refers to processes outside the APM process, but they performed in the same organization.

Section 5.3.1 elaborates on the stakeholders involved and describes their roles within the organization. Section 5.3.2 defines the external factors involved in the APM approach. Finally, section 5.4 provides a detailed representation of the APM process and all the activities and deliverables are specified.

5.3.1 Stakeholders and roles

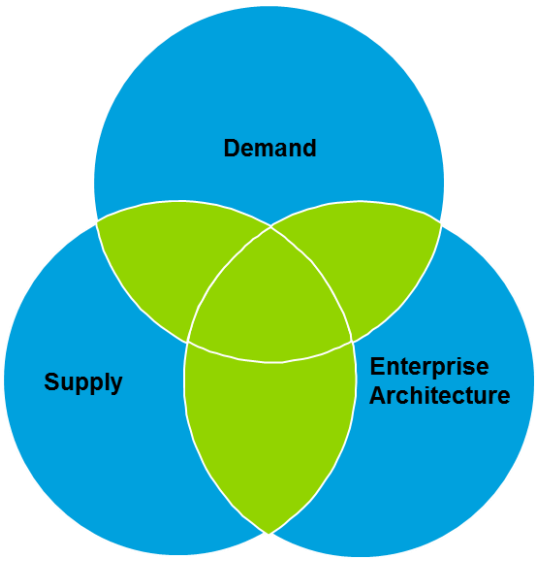

Figure 5-2: Main stakeholders involved in APM process.

The roles defined below represent the main stakeholders involved in the APM method. These roles are presumed to be found in most organizations and most roles were present in 5 out of the 6 case companies interviewed. The roles were identified in the workshop together with existing material from case companies. The roles defined in the supply organization correspond with roles found in ITIL[3].

Demand roles: business

Business owner: the business owner manages an application on a functional level. He is in direct contact with end-users, business consultants and other stakeholders. He is responsible for a part of the application inventory, from a business perspective. The business owner is sometimes referred to as a functional owner.

[3] Last accessed 24-06-2013, from http://wiki.en.it-processmaps.com/index.php/Service_Level_Management

Business change manager: A business change manager is aware of the issues that play part within an organization. Usually, he has several business owners reporting to him. Therefore, he is aware of the issues that have high priority.

Supply roles: the IT organization

Application Portfolio Manager: the application portfolio manager guides and facilitates the process. The application portfolio manager is responsible for maintaining the pre-set goals. The managers' responsibilities include sponsorship, design and the continuous improvement of the process and its metrics. ITIL uses the term 'Process Owner' and mentions that in larger organizations there might be separate Process Owner and Process Manager roles, where the Process Manager has responsibility for the operational management of a process.

Service Owner: "the Service Owner is responsible for delivering a particular service within the agreed service levels. Typically, he acts as the counterpart of the Service Level Manager when negotiating Operational Level Agreements (OLAs). Often, the Service Owner will lead a team of technical specialists or an internal support unit. The service owner is responsible for feeding the application inventory with technical characteristics"[4].

Project manager: "the Project Manager is responsible for planning and coordinating the resources to deploy a major Release within the predicted cost, time and quality estimates" [5]. Furthermore, he has a good overview of the available resources.

Enterprise Architecture: part of the IT organization

Enterprise Architect: "The Enterprise Architect is responsible for maintaining the Enterprise Architecture (EA) i.e., a description of the essential components of a business, including their interrelationships" [6]. More mature organizations may opt for specialist architect roles like: domain, project start architect (PSA), business, infrastructure architects, etc. In this context he is responsible for classifying applications and feeding the application inventory with 'architecture' related characteristics.

[4] http://wiki.en.it-processmaps.com/index.php/Service_Level_Management
Last accessed on 01-03-2013
[5] See 4
[6] See 4

5.3.2 Processes 'outside' the APM process

The processes which are considered to be outside the APM process are shown Table 5-2. Note that these processes sometimes can be a deliverable, such as information plan, and sometimes can be regarded as business functions (PPM).

Concept	Description
BUSINESS CONTEXT AND STRATEGY	A formulation of the current business strategy. The mission and vision is often clearly formulated on a very high level at organizations. However, on a more detailed level a translation has to be made and it can usually be extracted by combining the opinions from different key stakeholders.
SENSE OF URGENCY	An identification and prioritization of key drivers within the organization could be improved by implementing APM as a process. This is the current situation at hand which can act as a catalyst for the process.
APPLICATION MANAGEMENT	Application management deals with the existing applications and has to task to continuously monitor, improve and provide maintenance to applications.
ENTERPRISE ARCHITECTURE	In this context, EA provides an architecture view, modeling capabilities, process maps and often shows the relations between applications, processes and infrastructure.
PROJECT PORTFOLIO MANAGEMENT	"Project portfolio management consists of processes designed to rationalize and prioritize IT investment decisions based on objective criteria. PPM allows an organization to understand and quantify business needs and the investments needed to deliver software to achieve those benefits" (Mckeen, Business, Smith, & Gonzalez, 2012).
INFORMATION PLAN	The information plan is usually the result of an IT budget cycle, which provides: policies, principles and current roadmaps. (existing planned projects)

Table 5-2: External factors in the APM method.

5.4 Detailed APM Method overview

Figure 5-3 shows the detailed APM method, the method itself is described below.

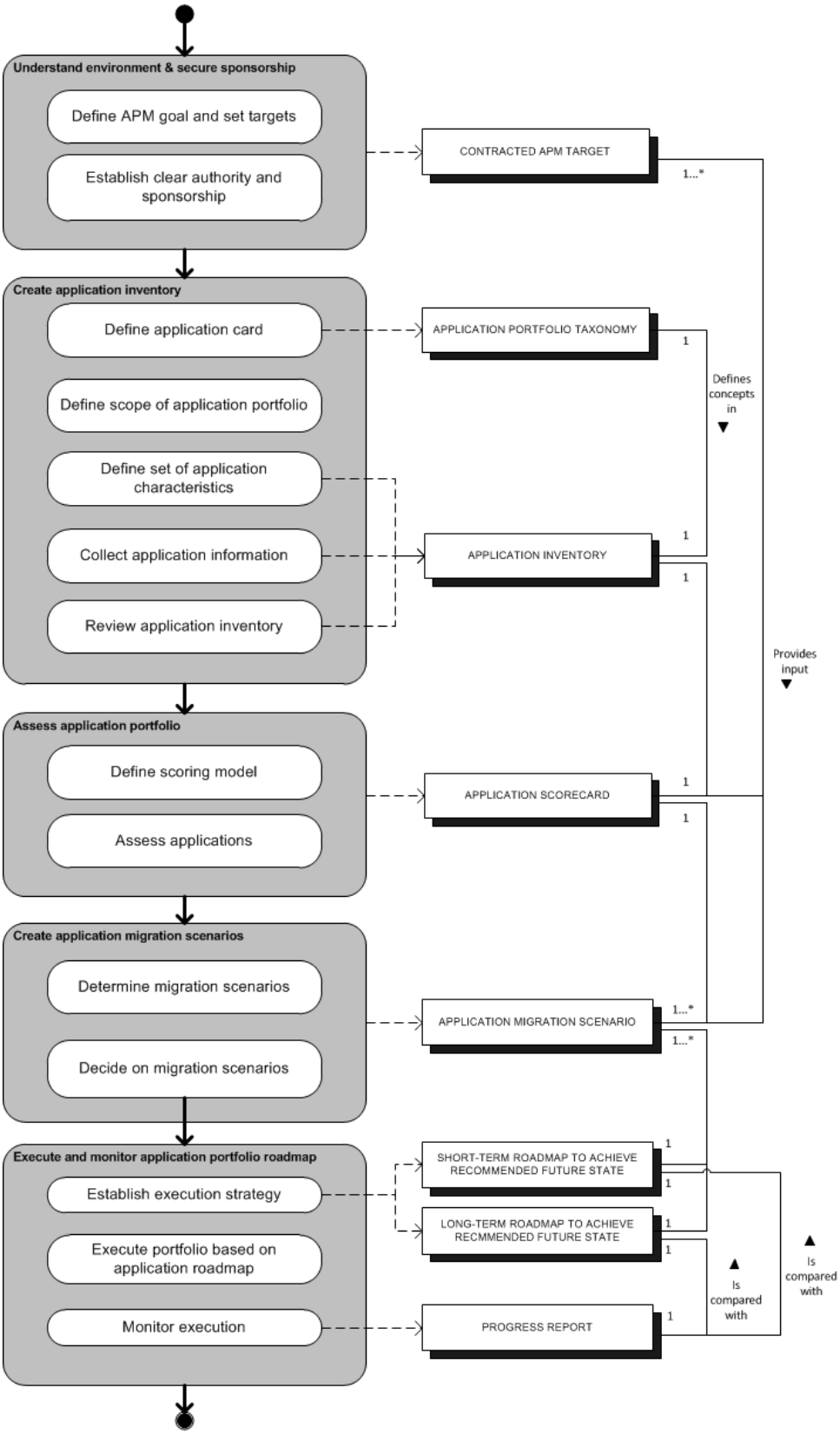

Figure 5-3: The proposed APM method (detailed).

The detailed APM method provides a clear overview of all the activities and deliverables. The activities have been specified and are listed in Table 5-3. The specification includes external processes involved in those activities, which are shown in bold italic (e.g. ***business context & strategy***). The deliverables of those activities are specified in Table 5-4.

Please note that the original method created during the workshop differs slightly from the current method. The original method created during the working can be found in appendix 7.5 in Figure 7-13. As described earlier, the APM process is iterative and should be a continuous process. This requires the integration of the APM process with existing processes, as results in chapter 3 & 4 showed earlier. During the workshop this activity was named 'Embed AI maintenance in existing processes'. The deliverable was defined as 'MODIFIED PROCESS DESIGN'. This activity was removed in the final APM method due to modeling reasons. Finally, the external processes involved in the APM process were used in the high level APM framework described earlier.

Finally, the responsibilities per role for each activity in the process have been defined using the RACI format. This is described in section 5.4.3.

5.4.1 Activities

Activity	Sub-activity	Description
Understand environment & secure sponsorship	Define APM goal and set targets	In this activity clear APM goal and targets are defined based on the input from your current ***business context & strategy*** and the ***sense of urgency***. This is influenced by the current ***information plan*** as well.
	Establish clear authority and sponsorship	The application portfolio manager secures a clear authority and sponsorship. Furthermore, he contracts targets and corresponding escalation process. By contracting targets the goals and vision of the APM initiative are signed by senior management. It results in CONTRACTED APM TARGET.
Create application inventory	Define application taxonomy	The (domain) architect, business owner, service owner and application portfolio manage establish a consensus on the combination of their perspectives regarding the application portfolio taxonomy. Resulting in an APPLICATION PORTFOLIO TAXONOMY, in which the most important concepts for APM are defined.
	Define scope of application portfolio	The (domain) architect and the application portfolio manager define the initial scope of the application portfolio; this is influenced by the ***sense of urgency*** and APM goals defined in CONTRACTED APM TARGET. This concerns the breadth and depth of the scope as well.
	Define set of application characteristics	The (domain) architect and application portfolio manager define the initial scope of the application portfolio; this is influenced by the ***sense of urgency*** and APM goals defined in the CONTRACTED APM TARGETS.

	Collect application information	Application information is collect from the business owner, the service owner and (domain) architect and is led by the application portfolio manager. The business owner collects 'functional' characteristics whereas the service owner collects the technical characteristics. Finally, the (domain) architect collects characteristics from an EA perspective. This results in an APPLICATION INVENTORY.
	Review application inventory	The application portfolio manager is responsible for reviewing the content of the APPLICATION INVENTORY regularly.
Assess application portfolio	Define scoring model	The functional owner, the service owner and (domain) architect (guided by the application portfolio manager) define a scoring model on which the applications will be ranked. This results in an APPLICATION SCORECARD.
	Assess applications	The business owner, the service owner and architect, guided by the application portfolio manager use the scoring model to rank all application which results in a filled in APPLICATION SCORECARD.
Create application migration scenarios	Determine migration scenarios	The application portfolio manager and the service owner create scenarios based on the APPLICATION SCORECARD.
	Decide on migration scenarios	The application portfolio manager and the service owner validate the migration scenarios with the architect and business owner. This results in an APPLICATION MIGRATION SCENARIO.
Execute and monitor application portfolio roadmap	Establish execution strategy	The application portfolio manager and the service owner consult the architect and business owner to formulate the SHORT- and LONG-TERM ROADMAP TO ACHIEVE RECOMMENDED FUTURE STATE. A strategy includes a prioritization for the short and long-term. The strategy is created taking into account the current ***information plan*** and current projects known under ***PPM.*** Therefore, budget and resources are taken into account and projects are prioritized.
	Execute portfolio based on application roadmap	The service owner is responsible for executing the portfolio based on SHORT- and LONG-TERM ROADMAP TO ACHIEVE RECOMMENDED FUTURE STATE. The executions lead to a new application portfolio.
	Monitor execution	The application portfolio manager and the business owner monitor the execution of the application roadmap. The application portfolio manager writes a PROGRESS REPORT to the contracted sponsor.

Table 5-3: The APM Method: specification of its activities.

5.4.2 Concepts (deliverables)

Concept	Description
CONTRACTED APM TARGET	A document describing the APM goal contains realistic targets for the project. Contracted means that the goals, targets and escalation process are signed by sponsors (senior management).
APPLICATION PORTFOLIO TAXONOMY	A document stating the main definitions that will be used throughout the organization, taking into account the different perspectives that exist. This forms as basis for the APPLICATION INVENTORY.
APPLICATION INVENTORY	The application inventory is a listing of applications with application characteristics. It functions as a single source of truth. The listing can be stored in Excel for example.
APPLICATION SCORECARD	A scoring model used to score applications. Applications can be scored on different variables derived from the APPLICATION INVENTORY.
APPLICATION MIGRATION SCENARIO	A scenario describing what the recommended future state of an application will be and what the corresponding action should be. For example, sustain, consolidate, or retire, etc. an application.
SHORT-TERM ROADMAP TO ACHIEVE RECOMMENDED FUTURE STATE	A document listing the recommended migration strategies for the application portfolio for the short-term. These could be aspects like migration date, (new) platform, estimated project duration etc. Furthermore this report describes the execution strategy. It includes for example: chosen migration strategy, roadmap of prioritized opportunities and the approval of all stakeholders.
LONG-TERM ROADMAP TO ACHIEVE RECOMMENDED FUTURE STATE	A document listing the recommended migration strategies for the application portfolio for the long-term. These could be aspects like migration date, new platform, estimated project duration etc. Furthermore this report describes the execution strategy. It includes for example: chosen migration strategy, roadmap of prioritized opportunities and the approval of all stakeholders.
PROGRESS REPORT	This report describes the progress of the application portfolio execution and is compared with the short-term roadmap and long-term roadmap defined and agreed upon earlier.

Table 5-4: The APM Method: specification of its deliverables.

5.4.3 Activities, roles and responsibilities in RACI format

The activities and roles are presented in a RACI matrix in Table 5-5. The roles involved in the APM method have previously been defined in section 5.3.1.The letters are defined as follows[7]:

- R = Responsible: a person responsible for executing the task.
- A = Accountable: a person accountable and responsible for the final result.
- C = Consulted: a person being consulted in the activity.
- I = Informed: a person which is notified of a certain action or result.

The numbers in front of an activity refer to one of the five main APM process phases. The RACI model was not created during the workshop, but the experts suggested using the RACI format for a clear definition of the roles and responsibilities related to the activities.

	Supply			**Demand**		**EA**
Role **Activity**	APM Manager	Service owner	Project manager	Business owner	Business change manager	Architect
1.1 Define APM goal and set targets	R	-	-	-	-	-
1.2 Establish clear authority and sponsorship	R	-	-	-	-	-
2.1 Define application card	I	A	-	A	-	R
2.2 Define scope of application portfolio	C	I	-	I	-	A
2.3 Define set of application characteristics	C	I	-	I	-	A
2.4 Collect application information	-	A	-	A	-	A
2.5 Review application inventory	A	R	-	R	-	-
3.1 Define scoring model	C	A	-	A	-	C
3.2 Assess applications	R	A	-	R	-	C
4.1 Determine migration scenarios	R	C	-	A	-	C
4.2 Validate results of analysis in workshop with stakeholders	R	C	-	A	-	C
5.1 Establish execution strategy	R	I	C	I	A	C
5.2 Execute your portfolio based on application roadmap	-	R	A	R	A	C
5.3 Monitor execution	R	-	A	-	A	-

Table 5-5: The APM Method: Activities related to actors in RACI matrix.

[7] In Dutch: R: Verantwoordelijk; A: Eindverantwoordelijk; C: Raadplegen; I: Informeren.

5.5 APM Method evaluation

5.5.1 Expert comments

The APM method has been evaluated by three experts using the review template given in appendix 7.6.3. Two experts are employees at Deloitte; one expert was selected from another consultancy company. The results of each expert evaluation are given separately.

First expert evaluation:

Questions regarding the high level overview:

The expert found the high level overview model credible and clear. The expert noticed that the model uses roles defined by ITIL and suggests comparing the model/roles with the roles envisioned by the ASL BiSL framework.

Questions regarding the stakeholders & roles defined:

According to the expert the right roles are identified in the APM method, he motivates that r he uses these kinds of roles in the financial sector.

Questions regarding the detailed method and RACI model:

According to the expert, the detailed method is clear. However, the APM method vaguely addresses the dependencies between applications (for example, interfaces, services, etc.). The expert wonders if this is done in the 'Collect application information'. The expert motivates his answer with the following: if it has been decide to decommission an application it will most likely have an effect on other applications as well. Therefore, the relations (between applications) have to be clear.

The deliverables CONTRACTED APM TARGET and APPLICATION SCORECARD are not concrete enough.

Second expert evaluation:

Questions regarding the high level overview:

The process should be continuously aligned with the strategy. The strategy should be translated into business capabilities. Enterprise architecture should be connected to business strategy & context as well.

Questions regarding the stakeholders & roles defined:

The expert believes that the roles of a CFO and CIO should be included. They should be the ones that sponsor the APM initiative at the start of the process.

Questions regarding the detailed method and RACI model:

The CONTRACTED APM TARGET should be to integrate the proposed APM processes in existing processes. IT provides the means to support goals.

The opinion of the expert is that the scope should always be the whole IT landscape within an organization, however, that it is possible to start with a smaller scope. The assessment of applications is typically based on 5 'categories', stored in the application inventory. These are maintenance / ownership details, functional aspect given by the business, non-functional

information by architects and financial aspects. When the applications are assessed, the business capabilities can be translated to business architecture. There should be an activity where the budget, resources and planning is taken into account. This is required in order to prioritize the projects, which ultimately leads to a selection of projects planned for the next release cycle.

Third expert evaluation:
Questions regarding the high level overview:
The expert believes the model is clear. However, the expert noted that the model itself misses a description: what is the difference between the red and the blue arrows? Furthermore, the expert finds it unclear what application management represents and why it is not connected to 'assess application portfolio'

Questions regarding the stakeholders & roles defined:
Suggestion to rename supply, demand and enterprise architecture to: business and IT. The right sorts of roles have been identified for the process.

Questions regarding the detailed method and RACI model:
The detailed method is complete. The expert delivered a modified RACI model, where the main change was that there should be a person responsible for every activity.

5.5.2 Conclusions of APM method evaluations

The evaluation consisted of several questions regarding the proposed APM method. Questions were asked putting forward the several artifacts of the proposed APM method namely: the high level overview, the stakeholders & roles, the detailed method and RACI model. These results are summarized as follows:

- Overall the high-level overview was clear and credible; although one expert did make suggestions regarding EA / the business context & strategy. The expert suggested that the business context & strategy should be connected to all main (five) APM processes. Furthermore, EA should be connected to the first main APM process as well.
- The stakeholders and roles defined correspond with the APM process according to the experts' experience.
- The detailed method is clear and credible however, some activities should be described in more detail.
- The RACI received most corrections and could therefore be considered as least credible. Therefore, the RACI model is inadequate for direct application in its current form.

On several aspects many (small) suggestions were given. Because most suggestions differed, not many changes have been made after the evaluation. Implemented changes included more detail specifications, mainly affecting the activities and deliverables described in Table 5-3 and Table 5-4.

6 Discussion and conclusions

6.1 Discussion

Scientific contribution:

In this research existing APM approaches obtained from literature, practice and Deloitte were modeled through the usage of Method Engineering. Although, existing research has offered knowledge on how APM is applied in practice, up and until now the identified APM approaches have not been modeled. This research provides insight on how companies apply APM in practice and presents their approaches in a structured and consistent format by using Method Engineering. Furthermore, existing literature does not specify roles and responsibilities consistently throughout the approaches. The APM approach of Fabriek et al. (2007) and Simon et al. (2010) both mention the roles and responsibilities only for a sole activity. The RACI model itself has proven itself as an adequate tool for specifying roles and responsibilities. However, the RACI model was considered as the least credible part of the APM method, therefore its scientific and practical value is currently low. Finally, the method combines shared experiences from APM practitioners, consultants and software vendors. The key lessons learned that derive from the interviews provide a set of guiding principles and pitfalls when applying APM and can be used besides the APM method. Although some lessons learned can be found in other literature, this research combines both an APM method and key lessons learned.

Limitations of literature approach and selected candidate methods:

The literature study provides the foundation for this research and included method candidate selection as explained in section 3.1.6.The name 'selection' implies that criteria have been used to select the appropriate methods. However, this was not the case. Initially eight papers were selected based on their completeness of the APM approaches they provided. The choice for three methods was mainly based on how well the activities and processes in the APM approach were present and described.

Internal validity:

Internal validity refers to the reliability of the conclusions derived from the collected data are, which depends mainly on the research design. First of all, a good research design intends to tackle potential bias. Therefore, in order to improve the reliability of this research, triangulation has been used. Triangulation involves the selection of at least two different types of sources for data input. As a result, three different types of stakeholders were selected. These were: individual experts (consultants/researchers), case company experts and experts from software vendors. This resulted in a data set with a variety of perspectives. The interviewed case companies were used to construct the approaches applied by those case companies. However, at every case company only one person has been interviewed. So, if multiple people per case company were interviewed the internal validity would have been better. Yet, in this research the priority was given to interview multiple case companies across different sectors. The other option would have been to perform a single case study design, in which various people would be interviewed. However, in order to support the main

research question it was essential to collect multiple approaches being applied in practice because this allowed the description of differences between companies in different sectors.

External validity:

External validity refers to how generic the results are. One of the research questions was to describe sector differences in the application of APM. Deloitte standards were used for sector classification. Of the four case companies (C1, C2, C3 and C6), two companies belonged to the financial services sector (C1, C3). C2 belonged to the energy resources & transportation sector and C6 belonged to the consumer business. The implication of this select group of case companies led to a non-generic conclusion for the respective sectors as a whole. If qualitative research would have been combined with quantitative research this question could have been answered in a better way.

Limitations of the APM workshop:

A workshop was organized as construction instrument, which resulted in the proposed APM method. In total, eight APM approaches have been modeled from literature, practice and Deloitte into PDDs and formed the method base. The workshop lasted for four hours and was attended by three different types of stakeholders. The group was small enough to be effective. However, if more experts would have attended it might have improved the results. Furthermore, some of the attendees' methods were used as method base during the workshop, which forms a potential bias. For example, one of the eight methods used for the new APM method construction was the approach of Insurance Company (C1). Therefore, C1 might have been biased in favor of his own approach. Moreover, the expert from Deloitte is the author of the Deloitte cost-savings approach. In order to eliminate these threats, the APM method was evaluated by three other people: two people of Deloitte (different service lines) and a consultant of another consultancy firm. This includes the thesis supervisor at Deloitte, which might result to a potential bias as well.

6.2 Conclusions

Based on this research the main research question "How can a framework and corresponding method be created to value an application portfolio from an enterprise architecture perspective?" can be answered by answering the sub-questions presented in section 6.2.1, 6.2.2 and 6.2.3.

6.2.1 Sub-question 1: what methods exist to support APM in the context of enterprise architecture?

The first research question contained four sub-questions:

- What are the processes in APM?
- What characteristics of applications are to be considered in APM?
- What is the relation between APM and EA?
- How is APM used in EA and vice versa?

APM process and application characteristics:

First, it is of note that there is no consensus in literature regarding the use of the definition 'APM'

and the name 'APM' is not used consistently. Fabriek et al. (2007) use 'APR', while Maizlish & Handler (2005) do not mention APM explicitly but its processes are included in IT portfolio management.
Three APM approaches were selected and modeled in PDD format: the approaches of Maizlish & Handler (2005), Fabriek et al. (2007) and Simon et al. (2010). The processes involved in these methods were grouped into categories as described in chapter 5 and resulted in the following APM processes which are present in all three methods:

- Building the application inventory: activities that are related to the collection of application characteristics, resulting in an application inventory
- The analysis of application portfolio: activities that are related to the analysis of the application portfolio, resulting in the ranking of applications
- Decision making: activities that are related to the planning of decisions, resulting in a roadmap and execution of planned actions (projects).

Finally, these three methods all explicitly mention that APM should be conducted on a continuous basis.

Building the application inventory:

Some methods mention that the first step is to determine the scope of application analysis before collecting application characteristics. Literature offers a variety of views regarding what characteristics of applications are important to consider. The application inventory should include more than just general characteristics of applications that are currently being operated or planned. For example, "application name, release version, implementation date, application owner, key capabilities, user groups, number of users, vendor, operating system, enabled business processes, affected business units, lines of code and technical components" should be considered(Simon et al., 2010). Furthermore, the costs related to an application can be an important aspect. In order to build the application inventory, data can be collected in three different ways: automatic data collection, semi-automatic data collection and manual data collection.

The analysis of application portfolio:

Applications can be analyzed by looking at several attributes, amongst them are: business process support, strategic fit, costs, risks, technical value and business value. A common way to plot the applications using these kinds of dimensions is the use of matrix-based approaches. Matrix-based approaches are considered a powerful and simple tool. The disadvantage is that applications can only be plotted against two dimensions or three dimensions at a maximum by adjusting the bubble size of an application in the matrix. In addition, process maps can be used to link applications to processes. The approach of Weil & Vitale (1999) can be used to assess the business and technical value of applications and consists of five subjects as described in section 3.1.4.

Decision making:

The future goal has to be decided for each application. Literature offers a variety of definitions regarding application migration options. This probably means that there is no definite answer, but the application migration options provided by ASL BiSL foundation described in 3.1.3 provide a set of

options that is supported by several private and governmental organizations. Furthermore, decisions such as: buying a new application or choosing a new platform leads to new proposals. The proposals need to be planned while taking the current project portfolio into account. The deliverable of these kinds of activities could result in a road map in which time and costs are taken into consideration.

What is the relation between APM and EA; how is APM used in EA and vice versa?

In the 'picture' approach of Groot et al. (2005) applications are linked to business processes including the types of interfaces. The approach could be considered as a form of EA, because taking a holistic viewpoint and providing several layers in a model is a typical procedure in EA. Riempp & Gieffers-Ankel (2007) provide relevant viewpoints for APM in a framework, of which IT architecture is one of them. Therefore, EA could be considered a relevant viewpoint for APM. The approach presented by Quartel, Steen, & Lankhorst (2010) demonstrates how applications can be rated on their effectiveness, their importance to business processes and how important those business process can be for the business goals. Again, this approach presents a holistic modeling based approach.

The four EA frameworks analyzed and discussed in section 3.2 showed different levels of APM integration. In TOGAF and FEA the applications form a major part of analysis. TOGAF defines an application catalog as deliverable and FEA defines deliverables such as application inventory, which can be used to assess applications. However, the EA frameworks do not define the APM activities as clearly as the APM methods discussed above. It has to be noted that in the EA frameworks the focus lies on capturing the relations between the different layers in order to facilitate change. The DYA framework acknowledges the same type of layers, but is more focused on governance aspects and provides best practices. Finally, Zachman provides the least detail and the APM concepts are not clearly visible

In the three APM methods of Maizlish & Handler (2005), Fabriek et al. (2007) and Simon et al. (2010) EA is explicitly mentioned. Maizlish & Handler (2005) mention EA as a key skill and support area for IT portfolio management. Furthermore, they state that EA has a direct effect on the strategy of an enterprise, by translating and aligning the (EA) requirements to the strategy (Maizlish & Handler, 2005). Furthermore, some researchers view APM as a major EA process (Simon et al., 2010). In addition, Fabriek et al. (2007) mention the EA part of analysis in the step 'evaluate underlying patterns'. EA modeling can be used to support APM by the creation of application overlay maps in which applications are mapped with business processes. In conclusion, it can be stated that APM is strongly influenced by EA and becomes increasingly visible in EA and vice versa.

6.2.2 Sub-question 2: how is application portfolio management executed in enterprises and how is enterprise architecture related to that?

The second sub-question consisted out of three questions:

- What similarities and differences can be found in APM application in different sectors?
- What are experiences from practice in APM and EA?
- What are experiences from software tool vendors in the APM / EA field?

APM applied in practice showed a lot of differences. First, the approach applied at Insurance

Company (C1) was the only approach in which roles and responsibilities were defined for the whole process. Second, the approach of Transport Company (C2) was clearly influenced by the perspective of an architect, not surprisingly as the initiator of the APM project was a lead architect. Its approach included a whole phase of defining the target architecture. Third, Bank Company (C3) had a mature capability of building and maintaining the application inventory and was led by enterprise architects as well. Last, Supermarket Company (C6) considered APM relevant enough to implement it while being a relative small company compared to the other case companies. In addition, the experiences from practice showed a lot of similarities as well. Some interviewed companies coped with the same problems, such as proliferation of applications and dozens of legacy applications that are increasingly harder to maintain. Furthermore, other issues were also raised, for example the need for modernization because of increased legislation and the risk of losing competitiveness in the long-term.

Results showed that EA provides a significant role in the process of some case companies. In two case companies the APM initiative was being executed by architects (C2, C3). In other companies architects had an important role in providing information for the application inventory and the evaluation of the technical quality of applications. The approaches of Insurance Company (C1), Transport Company (C2), and Supermarket Company (C6) were modeled in PDD format. Furthermore, examples were given of application inventories being used in practice. The results showed the influence of the IT organization was stronger in companies in the financial services industry (C1, C3). Unfortunately, insufficient case companies were interviewed to draw generic conclusions regarding sector differences as mentioned previously in the discussion. The relevance of EA is clearly visible in the proposed APM method / framework, both in the high-level APM overview and providing key roles and responsibilities through the detailed APM process.

The application of APM in practice led to the following shared experiences when applying APM and can be used to complement the proposed APM method / framework:

- Secure sponsorship from senior management, which is required for the success of an APM initiative.
- Start with a small scope of applications (both in depth and breadth) and where the business impact is the highest, with just a few technical and functional characteristics.
- Building the application inventory is an iterative process, as is the APM process as a whole.
- You have to agree on definitions for application, component, etc. in an organization (*However, C2 disagreed on this fact).*
- Integrate APM into existing processes.
- The APM should cover the concerns of different stakeholders from both business and IT.
- The influence / power of the IT organization on the business influences the APM process itself and potentially even the ability to successfully initiate and conduct APM. However, this statement cannot be made generic due to the small amount of case interviews.
- The importance of decommissioning old applications, potential cost savings will not be achieved if old applications are not decommissioned.
- Functionality is increasingly becoming a commodity (at least in the Banking sector, IE3) and the opportunities to outsource an application are increasing for businesses.
- Enterprise Architecture can help improve the communication between the business and IT

and therefore for APM as well.

- The reduction of redundant functionalities will achieve more cost savings than standardizing, although standardizing requires less effort.
- Most organizations are not mature regarding APM, very few organizations conduct APM properly.
- Software tool vendors are either more EA focused or PPM focused.

6.2.3 Sub-question 3: how can the method and framework be created?

The third sub-question consisted out of two questions:

- How can the experiences from practice be integrated in the framework plus method?
- How can the framework plus method be evaluated?

Method engineering was selected as technique to create the new APM method/framework. The workshop functioned as construction instrument for the new AP method/framework. The workshop itself proved to be very effective, as during the four hour workshop the eight methods were compared and used to create a new APM method. Furthermore, the workshop attendees were three experts themselves and different types of stakeholders. However, the key lessons learned from the interviews were not applied during the APM workshop. It would have led to too much data for the workshop. However, the key lessons learned can be used to complement the APM method/framework as guidelines.

Three experts were contacted for the evaluation of the APM method / framework and were provided with a review template. The main conclusions from the evaluation are restated below:

- Overall the high-level overview was clear and credible; although one expert did make suggestions regarding EA / the business context & strategy. The expert suggested that the business context & strategy should be connected to all main (five) APM processes. Furthermore, EA should be connected to the first main APM process as well.
- The stakeholders and roles defined correspond to the APM process according to the experts' experience.
- The detailed method is clear and credible. However, some activities should be described in more detail.
- The RACI received most corrections and could therefore be considered as least credible. Therefore, the RACI model is inadequate for direct application in its current form.

6.2.4 Main research question: how can a framework and corresponding method be created to value an application portfolio from an enterprise architecture perspective?

The main research question can be answered with the previous answers to the sub-questions. The goal of this research was to provide a framework and corresponding method to value an application portfolio from an EA perspective. In order to construct the new APM method and to compare existing methods, method engineering was chosen as technique. Eight APM approaches were modeled into PDDs. A workshop was organized and fulfilled the role of a construction instrument for

the proposed APM method. The proposed APM method is focused on APM activities, although external factors are included in the high-level APM and have been defined. The proposed APM method includes activities, deliverables, roles and responsibilities. The high-level overview, RACI model, and key lessons learned can be considered as the framework around the APM method. Finally, the proposed APM method has been evaluated by three experts of whom the main conclusion is that the method is credible and clear, although RACI model was not considered credible.

6.3 Future research

In this research the APM method/framework has been created and evaluated but not validated in a real case. Therefore, for future research it would be useful to validate the APM method/framework in multiple projects. The results could be used in order to enhance the APM method/framework. In the scope of this research the maturity of APM itself was not included. However, this research shows that the influence of the IT organization on the business does influence the process. Therefore, it would be interesting to map APM against the maturity of IT within the organizations. An interesting combination lies with the APM maturity model proposed by Simon et al. (2010), in which five APM maturity levels are distinguished. Although the model itself is very clear, the model does not specify how it relates to concrete actions and required conditions to reach a certain maturity level. Furthermore, for future research it would be interesting to conduct a larger case study to identify sector differences. Finally, one would expect APM most promising for large organizations with huge IT landscape. However, this research showed a relative small company with no history of mergers and acquisitions (Supermarket Company, C6) which had an APM process in place. For future research it would be interesting to create a model which can be used to determine when it is ‘valuable’ to start with APM based on size, IT budget, sector, etc.

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7 Appendix

7.1 Appendix I: Concepts & Definitions

Concept	Definition
Application	An application is "an aggregation of software code impounding business logic and rules, transforming users or systems input into data output, for the purpose of automating and optimizing business functions, processes, tasks and activities therein" (Maizlish & Handler, 2005)
Application Portfolio	The sum of all applications run by a specific organizational body is called its application portfolio (AP) (Riempp & Gieffers-Ankel, 2007)
Application Overhaul	"Application Overhaul is the concept of trying to rework the application portfolio such that firms are in a better position to meet the future needs of IT and the business unit" (Gartner, 2009)
Application Portfolio Management	"Application Portfolio Management is the ongoing application of systematic and structured decision-making processes to evaluate an organization's applications along various dimensions (from a business and a technical viewpoint), weigh various actions for the purpose of optimization and implement appropriate actions to resolve identified issues and meet key enterprise objectives. The promise of Application Portfolio Management lies primarily in reducing the complexity of the application landscape, which is approached from a holistic viewpoint" (Simon et al., 2010)
Enterprise	The Open Group (2011) defines an 'enterprise' in this context can be defined as "any collection of organizations that has a common set of goals and/or a single bottom line"
Enterprise Architecture	''a coherent whole of principles, methods and models that are used in the design and realization of an enterprise's organizational structure, business processes, information systems and infrastructure'' (Lankhorst et al., 2005)
Framework	A basic structure composed of a set of principles, ideas etc., which can be used when decisions and judgments are formed. (Combination of definitions from Oxford Dictionaries & MacMillan Dictionary).
IT asset	"An IT asset is defined as anything in the operational baseline under the domain of IT (e.g., hardware, software, data and information, people and processes)" (Maizlish & Handler, 2005)

IT Portfolio Management	"IT Portfolio Management is a combination of people, processes and corresponding information and technology that senses and responds to change by: Communicating effectively with, with appropriate agility to rapidly reprioritize and rebalance investments and assets. Creating and cataloging a detailed, value-based, risk assessment of the inventory of existing assets Eliminating redundancies while maximizing reuse Scheduling personnel and other resources optimally Monitoring and measuring project plans (costs, schedule, scope, timing, yield, risk, benefits, etc.) from development through post-implementation including disposal" (Maizlish & Handler, 2005).
IS	Information System.
Method	"A method is an approach to perform a systems development project, based on a specific way of thinking, consisting of directions and rules, structured in a systematic way in development activities with corresponding development products" (Brinkkemper, 1996).
Method Engineering	"Method engineering is the engineering discipline to design, construct and adapt methods, techniques and tools for the development of information systems" (Brinkkemper, 1996).
Program	A program is a collection of several projects
Process Deliverable Diagram	"Process-deliverable diagrams (PDDs), a meta-modeling technique that is based on UML activity diagrams and UML class diagrams. The resulting PDDs models the processes on the left-hand side and deliverables on the right-hand side" (Weerd, Weerd & Brinkkemper, 2007).
Project Portfolio Management	"Project portfolio management consists of processes designed to rationalize and prioritize IT investment decisions based on objective criteria. PPM allows an organization to understand and quantify business needs and the investments needed to deliver software to achieve those benefits" (Mckeen, Business, Smith, & Gonzalez, 2012).
Tool	"A tool is a possibly automated means to support a part of a development process" (Brinkkemper, 1996).

Table 7-1: Concepts & Definitions.

7.2 Appendix IV: Method base

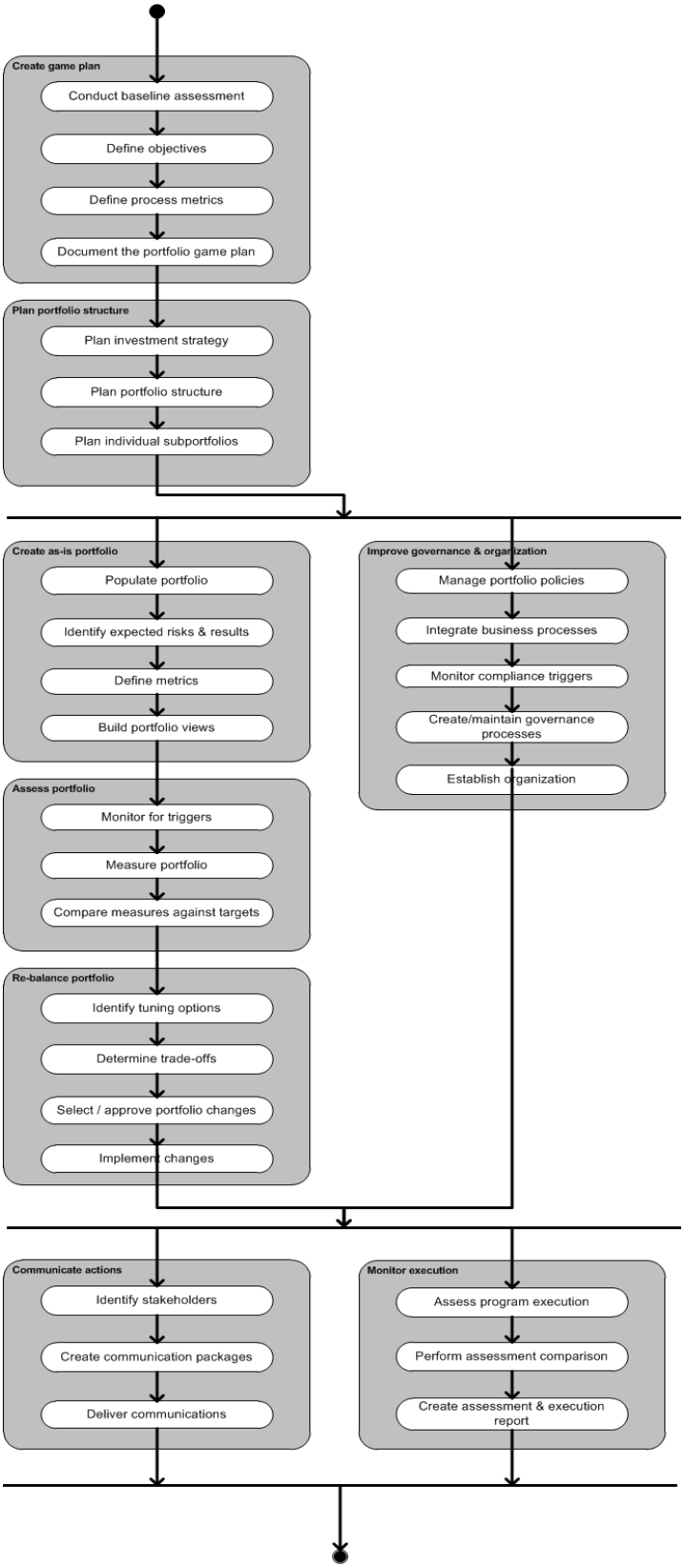

Figure 7-1: Integrated IT portfolio approach by Maizlish & Handler (2005).

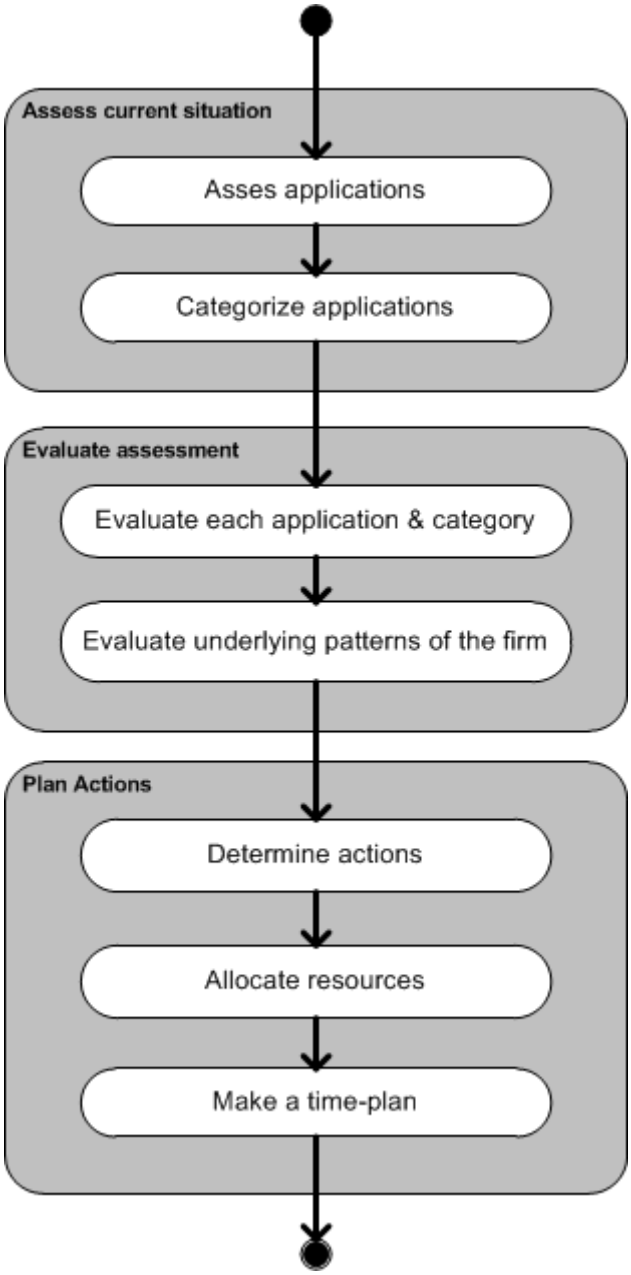

Figure 7-2: APR method by Fabriek et al. (2007).

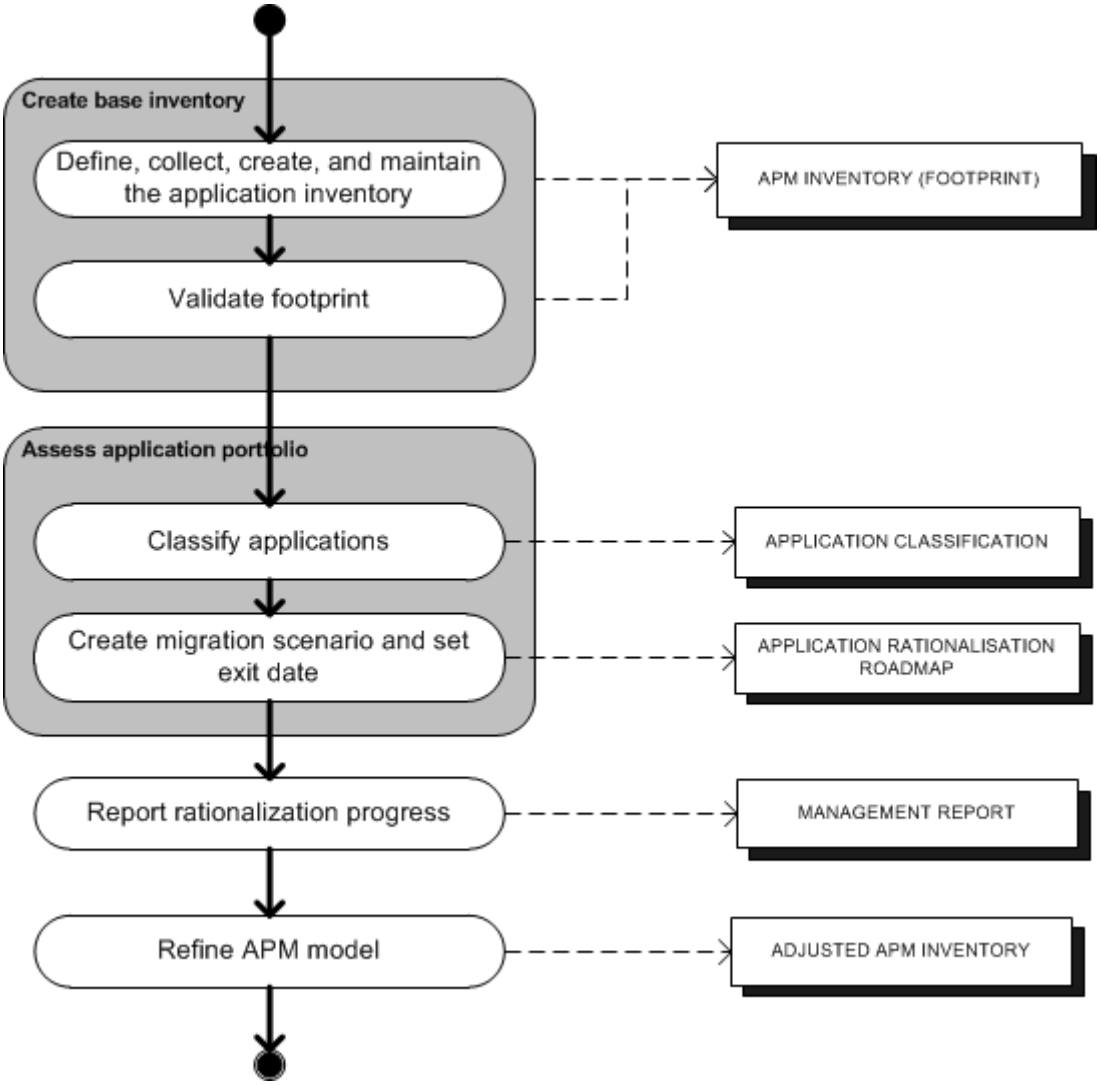

Figure 7-4: APM approach at Insurance Company (C1).

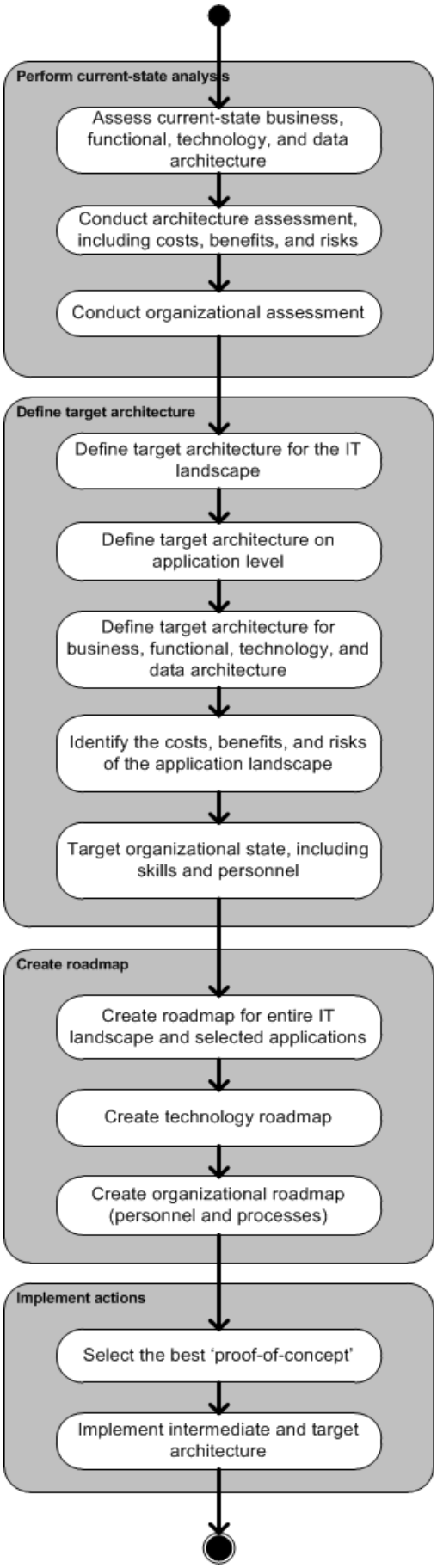

Figure 7-5: APM/Architecture framework at Transport Company (C2).

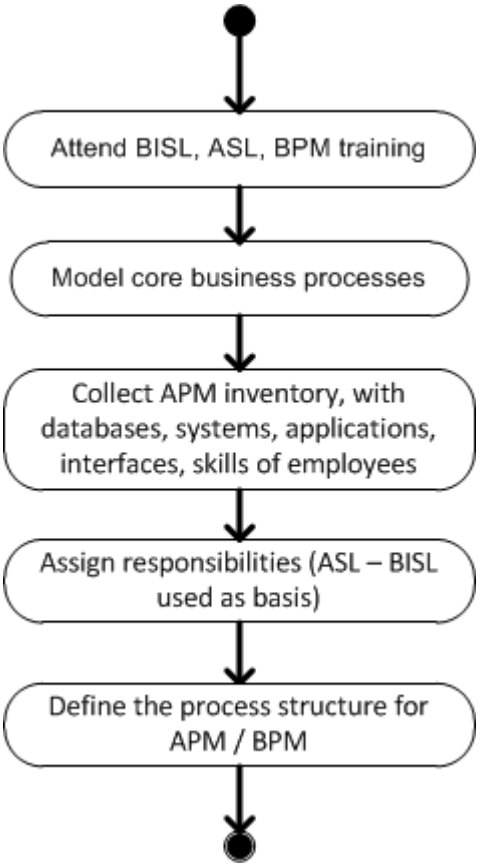

Figure 7-6: APM approach at Supermarket Company (C6).

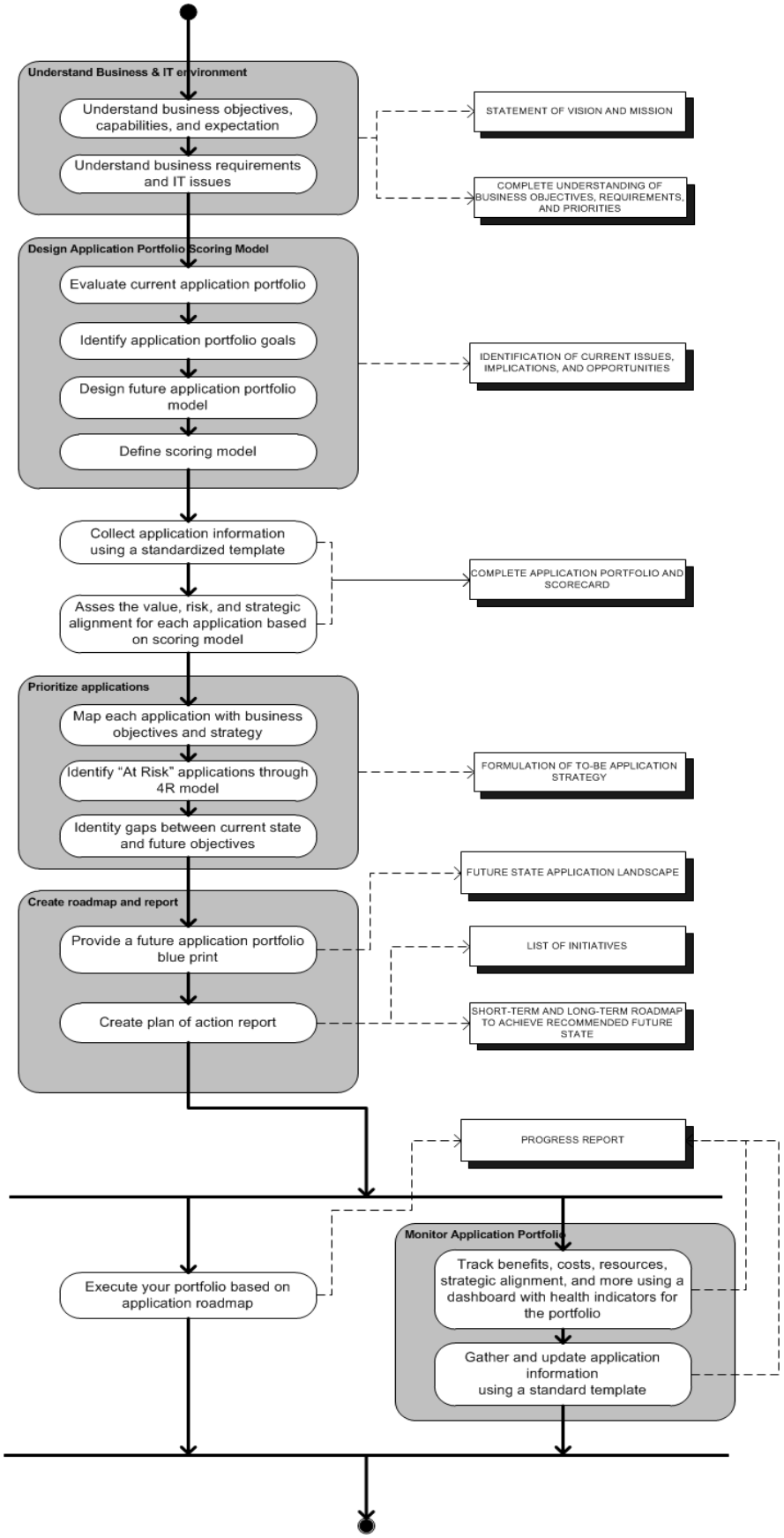

Figure 7-7: APM approach by Deloitte.

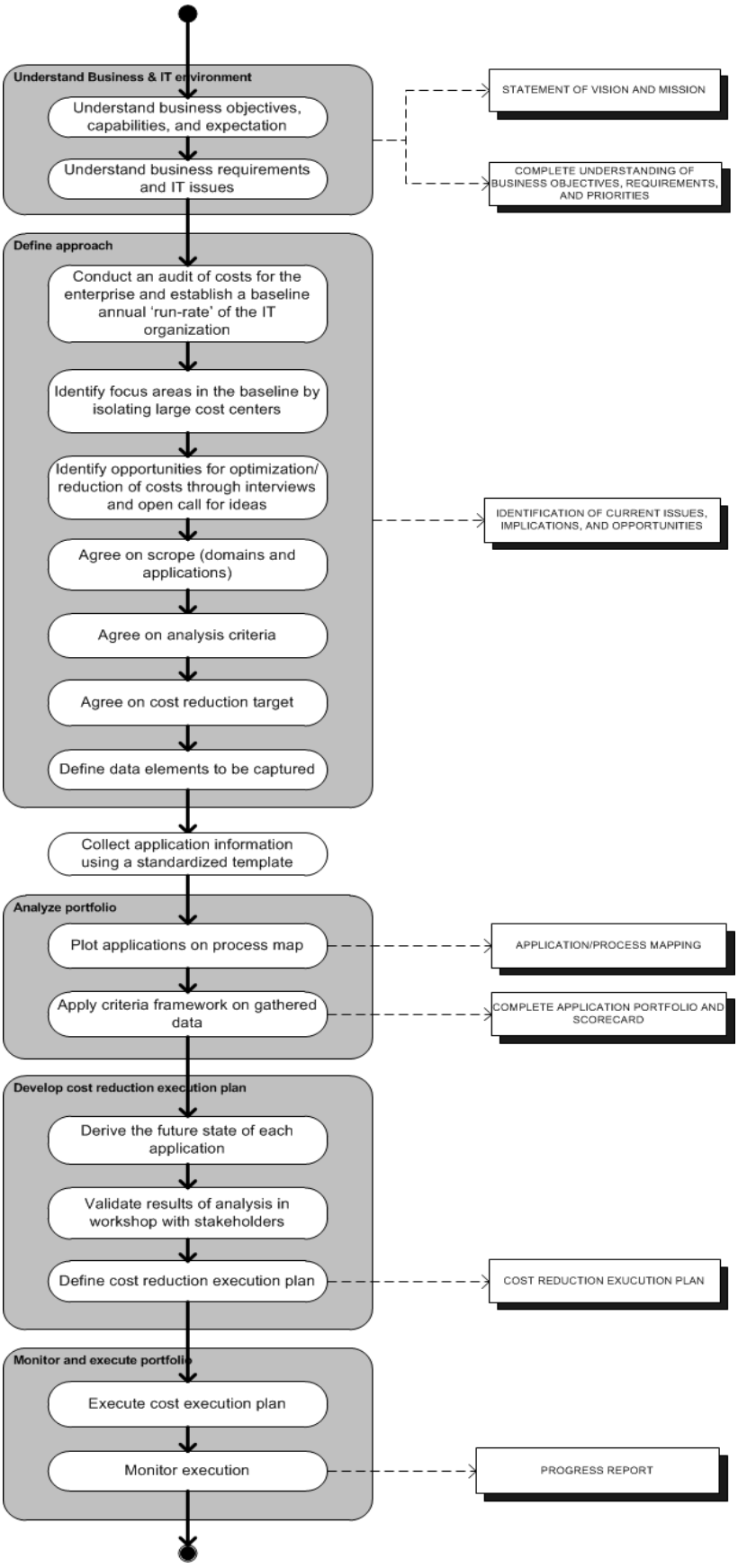

Figure 7-8: APM Cost-savings approach (Deloitte).

7.3 Appendix II: Interview protocol and base set of questions

Introduction of the interview:
Each interview starts with asking the interviewee for permission to record the session.
Introduction of the interviewee, his role, company, company structure etc.
Introduction of the researcher, the literature research, research questions, etc.

Not the exact same text has been said to the interviewees each time, the introduction varied from just a minute to almost 10 minutes discussion. However, the text below describes the main essence that has been told to each interviewee.

I am currently conducting my master thesis research on the topic of Application Portfolio Management and Enterprise Architecture at Deloitte Consulting Netherlands. I study business informatics at Utrecht University. As part of my research I conduct some case studies to gain insight how companies use and implemented APM. During my job at KPN quickly realized that KPN possesses hundreds of applications, many of which shared redundant features. Furthermore, I was not always convinced of the business quality of those applications, as some were lacking important features, at least in my opinion. In that way, my interest rose for Enterprise Architecture and that's how I came to this topic. Application Portfolio Management started already 30 years ago, but according to what I've found in literature, there is still much potential to gain for organizations.

Let me take you my main research question, "How can a framework and corresponding method be created to value enterprise application portfolio(s) from an enterprise architecture perspective?" Organizations usually have a large and complex IT landscape, often storing redundant information and implementing similar features. How do you assess the value of an organization's portfolio? In which applications do you want to invest and which ones do you want to retire/phase out? All these kind of questions are part of my research.
This is of course a very short explanation of my research, but it will probably give you a good idea of the direction of my research.

My research consists of three main steps. First, there is a literature study. Existing methods and tools in the APM / EA field will be compared. Second, empirical research will be conducted by means of case studies (at companies), interviews with software vendors and individual expert interviews. Third, this will finally lead to the creation of artifacts: an APM framework and corresponding method how to use it.

So the final research output will be a 'best-practice' APM framework with a corresponding method, possibly with market sector differentiations depending on the case study results.

This is of course a very short explanation of my research, but it will probably give you a good idea of the direction of my research.

Areas of interest and base set of questions:

APM:

- How do you define an application? I ask this because you can with different perspectives to Applications, from a user, designer, or contract with the software supplier for example.
- What characteristics of applications are important to consider / map?
- If, how do you collect them?
- Who collects them?
- APM approaches have begun with matrix-based approaches (i.e. Ward), do you use them? If so: Are they useful for you? What are their strengths and weaknesses?
- How do you measure 'subjective' values like business value?
- How do you see the relation between APM and PPM?

APM as a process:

- What kind of tools do you use? What kinds of tools are useful for APM?
- Have you done APR/APM projects?
- If so, have you established any APM method/framework, or do you use any?
- Have you set up APM processes? (Towards an ongoing process)
- Can you explain how you created your 'method/framework'?
- Can you explain how that process went?
- Do you believe different APM strategies exist? Can you distinguish them?
- How do you believe an APM a process looks like? How do you establish it?

Relation between APM and EA:

- How would you see the relation between APM and EA?
- Can enterprise architecture frameworks be used in APM and vice versa? How useful are they for APM processes?

7.4 Appendix III: Specific interview data

Interview with: E1

E1 introduced an example of an Application Portfolio Rationalization project (APR) at a large pharmaceutical company. E1 explained the way they executed their project. Instead of collecting tens or even hundreds of different characteristics of applications they looked at what actions are possible on the landscape of the client's organization. This will result in a more actionable and feasible approach. They started with the question what *can* you do instead of what do you *have*? The next step what *information* you would need to assess those 'strategies'. As third, they looked at what was already *known* in the client organization.
The client had a clear goal with this APR project, they wanted to reduce IT costs by 15%. E1 (and his team) used a list of 28 cost reduction strategies and evaluated with strategies would fit for the clients organization. These 28 cost reduction strategies are the result of two workshops and practice for over years as Consultant in similar projects. The full list of strategies is shown in [confidential information, only available to supervisors]. The benefit when you work with such a 'hard' target is that you can have more clear and narrow focus.

[Confidential content]

7.5 Figures and tables

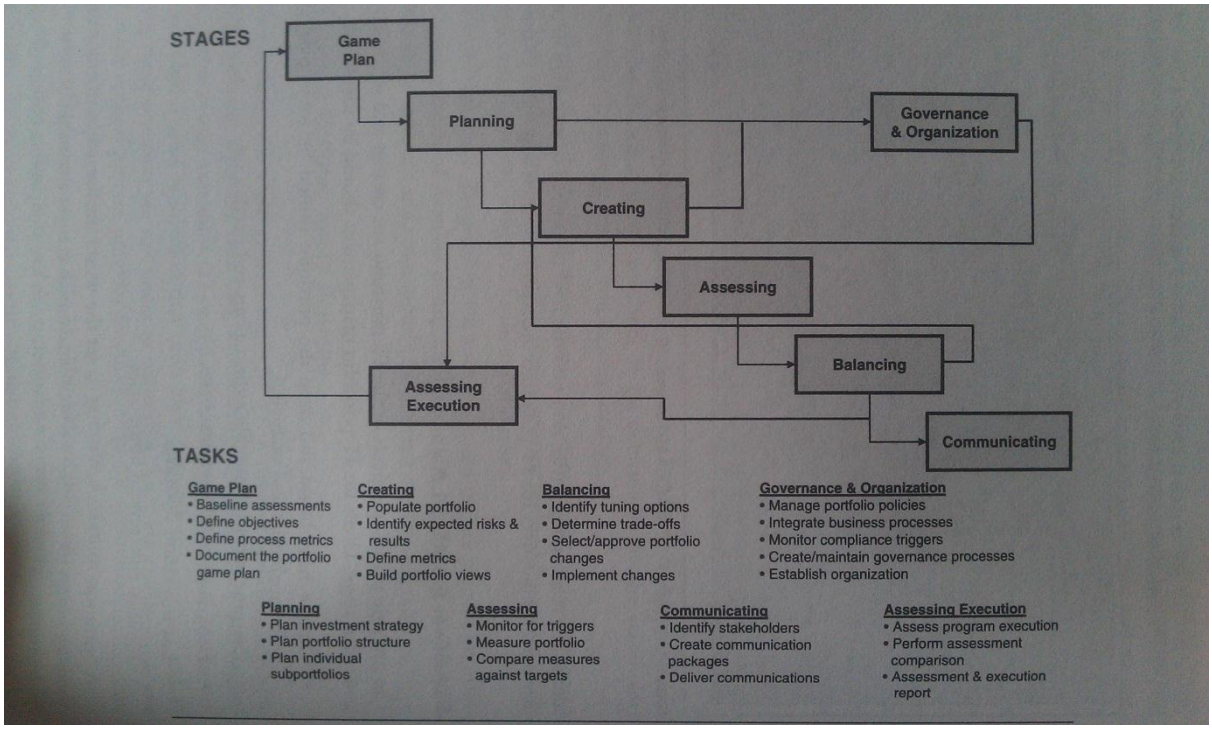

Figure 7-9: Original IT portfolio management method by Maizlish & Handler (2005).

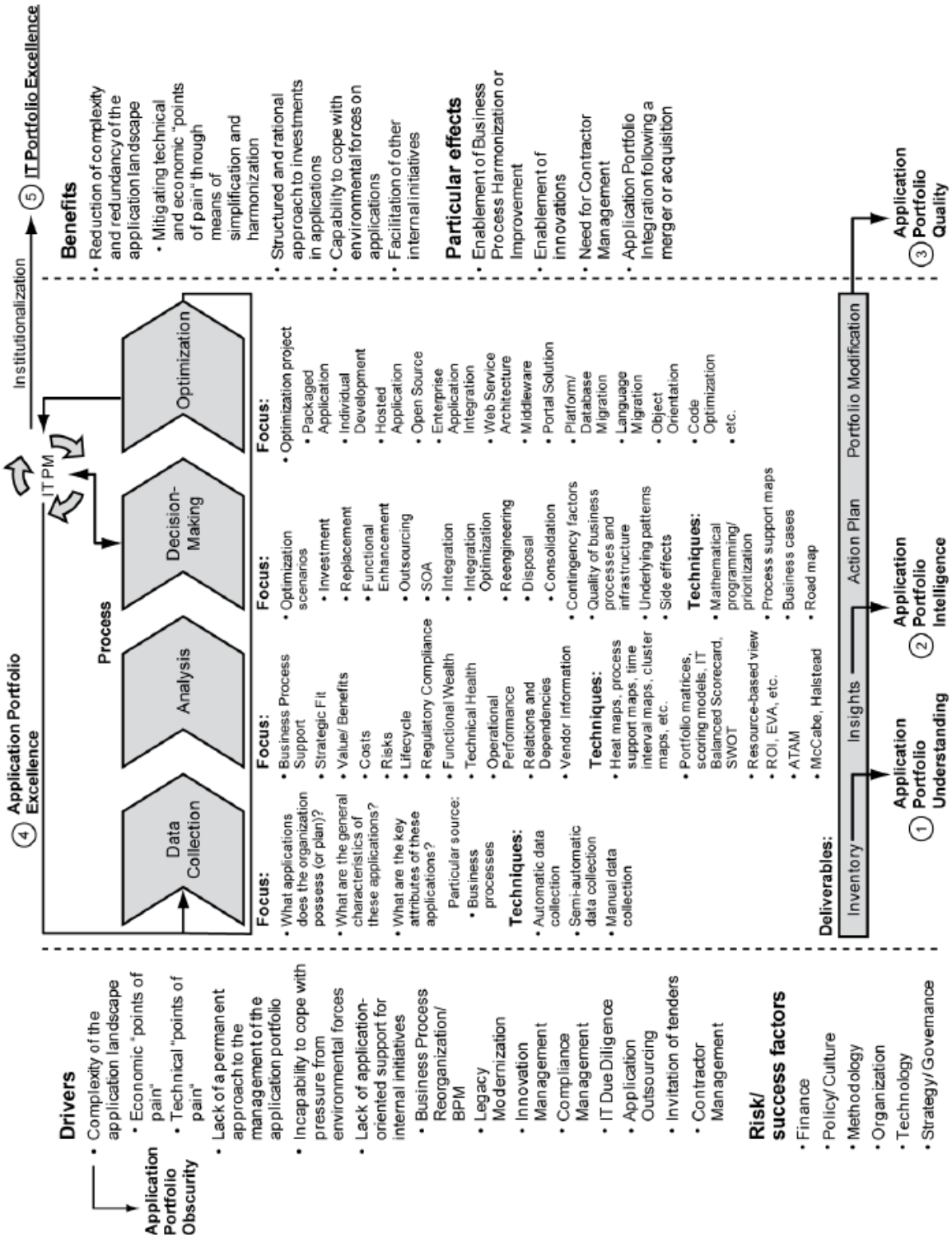

Figure 7-10: Original APM method by Simon et al. (2010).

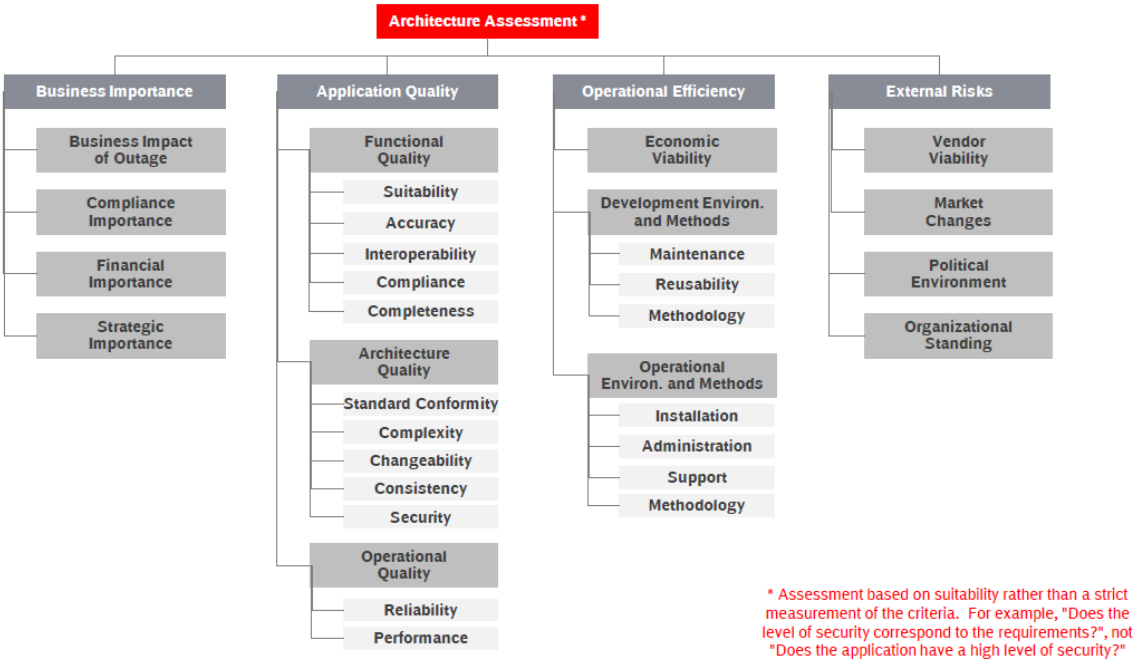

Figure 7-11: APM characteristics for the application inventory at Transport Company (C3).

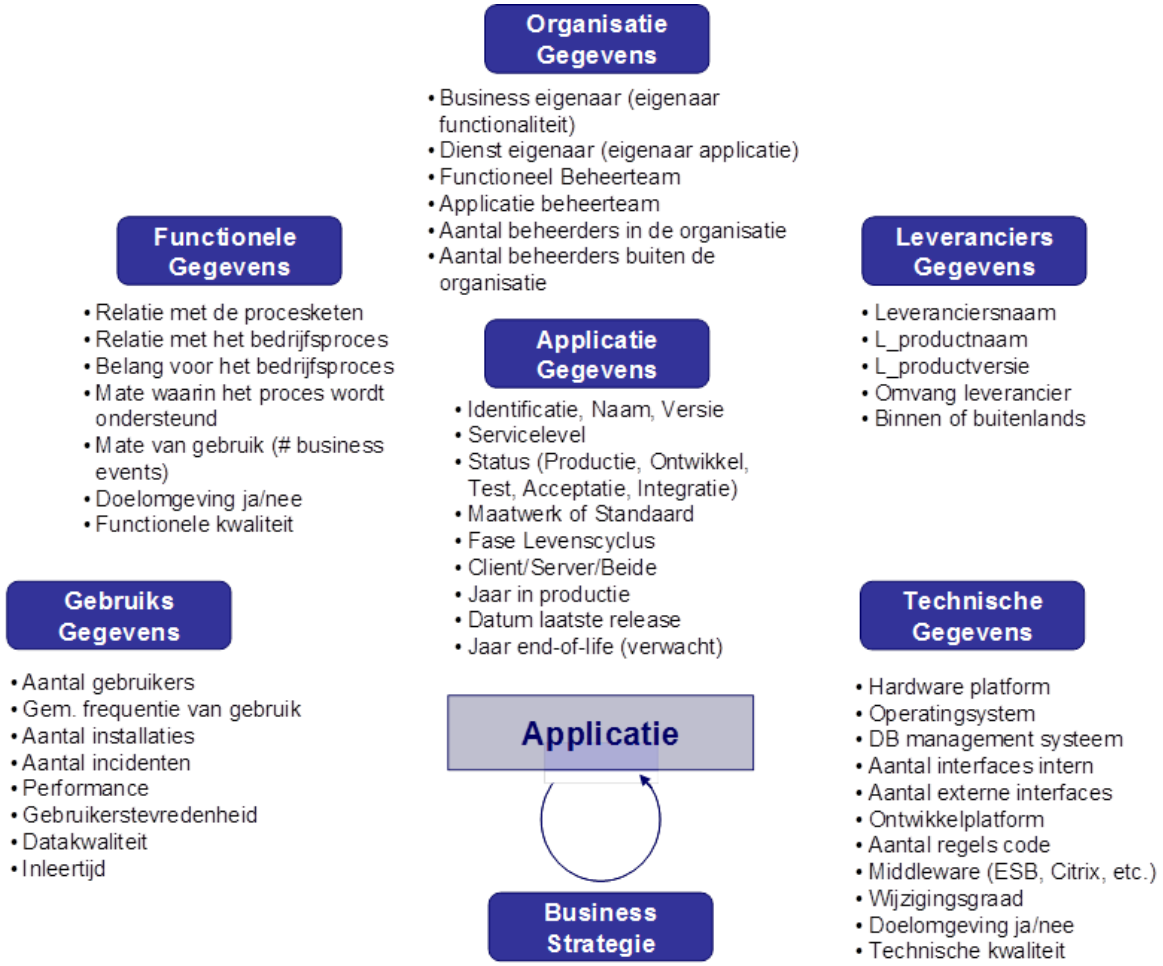

Figure 7-12: Example application inventory (APM footprint) at Insurance Company (C1), in Dutch.

Application characteristics	
Application name	Service owner
CI identifier (link to CMDB)	Program manager
Application description	Business change manager
Target architecture state	Process owner
Platform	Process manager
Business critical	Product manager

Table 7-2: Application Inventory at Bank Company. Note that only a part of the application inventory is shown to secure the anonymity of the case company. Source: C3.

Guideline	Description
Guideline 1: Design as an Artifact	Design-science research must produce a viable artifact in the form of a construct, a model, a method, or an instantiation.
Guideline 2: Problem Relevance	The objective of design-science research is to develop technology-based solutions to important and relevant business problems.
Guideline 3: Design Evaluation	The utility, quality and efficacy of a design artifact must be rigorously demonstrated via well-executed evaluation methods.
Guideline 4: Research Contributions	Effective design-science research must provide clear and verifiable contributions in the areas of the design artifact, design foundations and/or design methodologies.
Guideline 5: Research Rigor	Design-science research relies upon the application of rigorous methods in both the construction and evaluation of the design artifact.
Guideline 6: Design as a Search Process	The search for an effective artifact requires utilizing available Process means to reach desired ends while satisfying laws in the problem environment.
Guideline 7: Communication of Research	Design-science research must be presented effectively both Research to technology-oriented as well as management-oriented audiences

Table 7-3: Design science guiding principles (Hevner at al., 2004).

7.6 Appendix V: Workshop Templates

7.6.1 Categorized activities

Identified main activities

Main Activity number	Description of type of activities
1	Activities related to: understanding the business, the strategy, business objectives, IT issues etc.
2	Activities related to: defining the approach, creating application score cards, assessing the current application portfolio etc.
3	Activities related to: related to collecting all the relevant application characteristics
4	Activities related to: assessing or analyzing the application portfolio
5	Activities related to: prioritizing applications, comparing them, ranking them, plotting them etc.
6	Activities related to creating scenarios, roadmaps, executions plans etc.
7	Activities related to executing your roadmap plans.
8	Activities related to monitoring your application portfolio
9	Activities related to communicating your actions and progress to various stakeholders
10	Activities related to setting up and improving governance and organization related to APM capabilities. This also includes the formalization of formulation of the APM process
11	Activities related to defining target architecture, on an IT level, application level, taking into account the organizational skills and personnel as well.
12	Activities related to improve your organizational skills attending training on APM relevant topics and capabilities.
13	Activities related to modeling core business processes

14 Activities related to assigning responsibilities and roles

7.6.2 Method overview

Method	**Main Activity**							
1 1,2,3,4 5,6,7,8	**(1)** Understand Business & IT environment	**(2)** Design Application Portfolio Scoring Model	**(3)** Collect application information using a standardized template	**(4)** Asses the value, risk and strategic alignment for each application based on scoring model	**(5)** Prioritize applications	**(6)** Create roadmap and report	**(7)** Execute your portfolio based on application roadmap	**(8)** Monitor Application Portfolio
2 1,2,3,4 6,7,8,	**(1)** Understand Business & IT environment	**(2)** Define approach	**(3)** Collect application information using a standardized template	**(4)** Analyze portfolio	**(6)** Develop cost reduction execution plan	**(7-8)** Monitor and execute portfolio		
3 3,4,6	**(3)** Assess current situation	**(4)** Evaluate assessment	**(6)** Plan Actions					
4 3,4,6,7?	**(3)** Create application inventory	**(4)** Analyze application portfolio	**(6)** Analyze application portfolio	**(7?)** Optimize project				
5 2,3,4,5, 6,7,9,10,7, 8	**(2)** Create game plan	**(2)** Plan portfolio structure	**(3)** Create as-is portfolio	**(4-5)** Assess portfolio	**(6-7)** Re-balance portfolio	**(9)** Communicate actions	**(10)** Improve governance & organization	**(7-8)** Monitor execution
6 2,3,4,5,6 8,9,10	**(2-3)** Create base inventory	**(4-6)** Assess application portfolio	**(8-9)** Report rationalization progress	**(10)** Refine APM model				

7 3,4,11,6,7	**(3-4)** Perform current-state analysis	**(11)** Define target architecture	**(6)** Create roadmap	**(7)** Implement actions				
8 12,13,3,14, 10	**(12)** Attend BISL, ASL, BPM training	**(13)** Model core business processes	**(3)** Collect APM inventory, with databases, systems, applications, interfaces, skills of employees	**(14)** Assign responsibilities (ASL – BISL used as basis)	**(10)** Define the process structure for APM / BPM			

7.6.3 Review template

Questions	Answer
Is the high level APM overview clear? Are the input concepts/disciplines correct? Do you miss anything, if so please specify?	
Does the high level stakeholder overview (Supply, Demand and Enterprise Architecture) cover the most important stakeholder groups in the APM process? Do you miss anything? If so, please specify.	

Are the right sorts of roles identified? Are the names 'general' enough; i.e. do you believe those roles are found in a typical organizations?	
When you look at the detailed method, are the activities you believe should be included currently present? NOTE: The ACTIVITY table specifies all activities. Do you miss anything? Do you agree with the semantics? (word choice)	
Please look at the RACI table (Responsible, Accountable, Consulted and Informed). Feel free to change the table according to your opinion. Do you have any other remarks?	

Activities according to RACI model

R = Responsible
A = Accountable
C = Consulted
I = Informed

FEEL FREE TO CHANGE THIS TABLE

Role Activity	Process owner (APM manager)	Service owner	Project manager	Business owner	Business change manager	Architect
Define APM goal and set targets	R	-	-	-	-	-
Establish clear authority and sponsorship for the target and corresponding escalation process	R	-	-	-	-	-
Define application card	I	A	-	A	-	R
Define scope of application portfolio	C	I	-	I	-	A
Define set of application characteristics	C	I	-	I	-	A
Collect application information	-	A	-	A	-	A
Review application inventory	A	R	-	R	-	-
Define scoring model	C	A	-	A	-	C
Assess applications	R	A	-	R	-	C
Determine migration scenarios	R	C	-	A	-	C
Validate results of analysis in workshop with stakeholders	R	C	-	A	-	C
Establish execution strategy	R	I	C	I	A	C
Execute your portfolio based on application roadmap	-	R	A	R	A	C
Monitor execution	R	-	A	-	A	-

7.6.4 Workshop deliverables

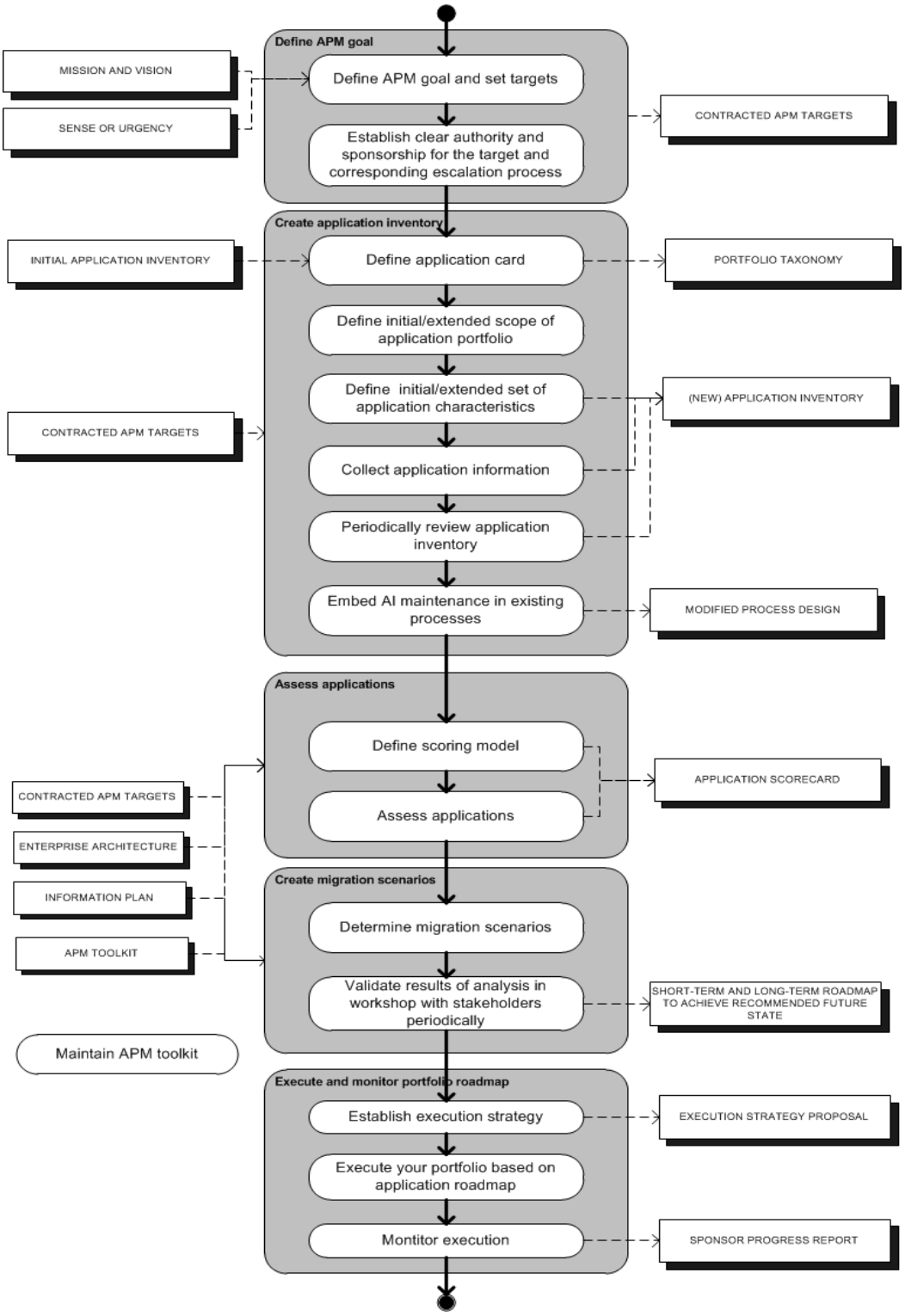

Figure 7-13: The initial method created during the workshop on 25-02-2013.

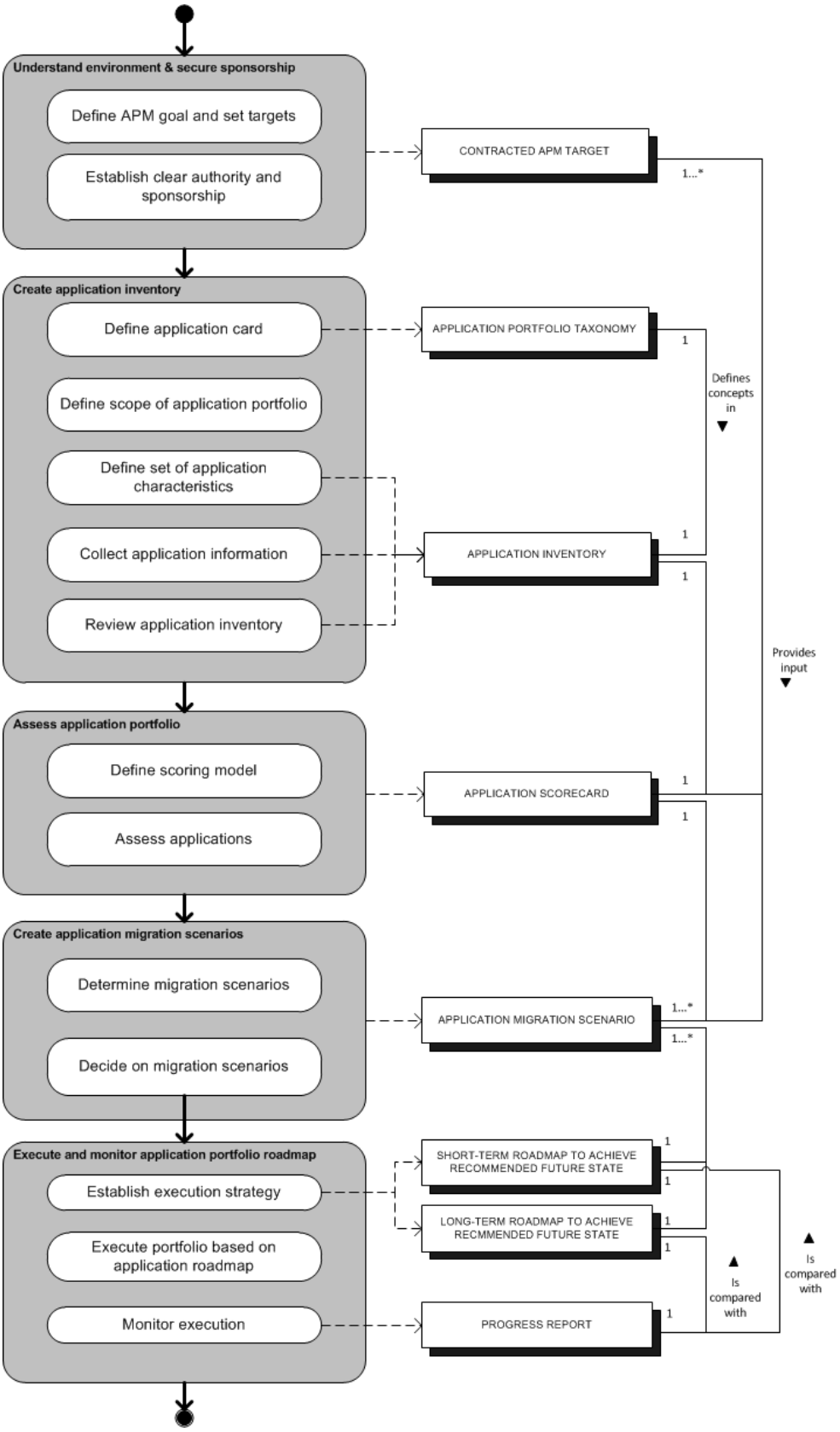

Figure 7-14: The 'actual' APM method.