MASTER THESIS

PROJECT PORTFOLIO MANAGEMENT USING CAPABILITY- BASED PLANNING

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This report is the result of my final project in Business & IT MSc program at the University of Twente. I conducted this research as a graduate internship at BiZZdesign B.V. After an intensive period, today is the day to write this note of thanks as the finishing touch on my thesis. It has had a big impact on me to write this thesis. Now, I would like to reflect on the people who have supported and helped me throughout this period. Without them, this accomplishment would not be possible.

Firstly, I would like to give my deepest gratitude to my supervisors from the University of Twente: Ms. Maria Iacob and Mr. Marten van Sinderen for their valuable guidance, pointing me to the right direction so that I can complete my thesis. I also want to sincerely thank Mr. Dick Quartel for all of the opportunities I was given to conduct my research, and for the freedom of choosing my research topic that provided an intense learning for me both in the scientific area and on a personal level. Besides, a special note of thanks is extended to Ms. Adina Aldea for her insightful comments on the thesis.

Secondly, I would like to thank my friend Tania. We were not only able to support each other by deliberating over our problems and achievements, but also by talking about things other than just papers.

Finally, I want to dedicate this thesis to my dearest parents and my boyfriend, Yi, for their constant encouragement when I encountered difficulties.

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Summary

In today's dynamic environment, organizations have to modify their strategy and deal with the ongoing project portfolios in a fast pace.

By using the technique of Capability-based planning, organizations could figure out the capabilities with strategic importance and constitute the focal points of strategy transformation; identify the gap by assessing the current and target states of the capabilities; implement the strategy by closing the gap with corresponding working packages.

Then, in order to ensure the strategy alignment of the project portfolios in a strategy shift, a complete method is designed based on the CBP with a start from the business strategy shift. The method goes through the determination of strategy capabilities shift and affected ongoing projects, and concludes by supporting the project selections and prioritizing.

The new method consists of three phases that respectively address what is the organization current situation; which projects are impacted by the strategy shift; and how the projects could be arranged. Then present organization ArchiPharma case to demonstrate the method. The professionals have validated the important aspects of the work in the thesis.

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Chapter1: Introduction

In this chapter, there are six sections generated to provide the general concepts of the research:

1. *Section 1.1 Problem Statements.* It provides a concise description of the problems that should be addressed in this research.
2. *Section 1.2 Research Objectives.* It describes the expected achievement of this research.
3. *Section 1.3 Research Question.* It states the formulated research questions, according to the research objective. This research involves one main question and three sub questions.
4. *Section 1.4 Research Scope***.** It defines the scope of this research, outlining the limitations of the research and explaining the exclusion of the research.
5. *Section 1.5 Research Methods.* It illustrates the research methodology applied to the research.
6. *Section 1.6 Report Structure.* It shows the general outlines of this thesis report.

1.1 Problem Statements

In early 2000s, people started to recognize the importance of applying portfolio management. As "*the art and science of making decisions about investment mix and policy, matching investments to objectives, asset allocation for individuals and institutions, and balancing risk against performance*" (Investopedia, 2003), portfolio management provides a central oversight of budget management. And it supports the strategy alignment of the investments (Jeffery & Leliveld, 2004). What's more, portfolio management can help organizations to make the decisions that will set them apart from competitors (Project Management Institude, 2012). Especially for the large-scaled organizations, dealing with numerous portfolios in different stages simultaneously is critical. Adopting a portfolio management approach could assist them deflect the issues like projects run without delivering because of focus lacking; or strategic targets could not be completely implemented by the deliveries because of alignment lacking.

Nevertheless, the traditional portfolio management approaches seem to be no longer enough. Nowadays, organizations are supposed to run their business in a dynamic environment. Since rapid development brings an explosion of new technologies such as mobile and cloud, turning out to be the tectonic shifts of lifestyle (Willmott, 2013). Consequently, in order to remain competitive in the new-type industry, or even in the new type ecosystem, organizations have to plan and change quickly to match

customers' changing habits. Then, they need to keep adjusting their ongoing projects to align with the latest strategy.

Without an appropriate approach, organizations have to face tremendous pressure of technology transformation in today's fast-paced business world.

However, currently the portfolio management literatures have made little mention of potential disturbances to the portfolios regarding to a strategic shift. Only the Project Management Institute's standard described two types of portfolio changes. One type refers to periodical reviews of the portfolio performance "*to ensure that the portfolio contains only components that support achievement of the strategic goals. To achieve this, components must be added, reprioritized, or excluded based on their performance and ongoing alignment with the defined strategy in order to ensure effective management of the portfolio*" (Project Management Institute, 2008b, p. 77). The other type relates to significant changes in the business environment leading to a new strategic direction: "*as environments inside and outside the organization change, criteria for determining the composition and direction of the portfolio may also change. When the need for new criteria becomes evident, the portfolio management team needs to examine the current criteria in the strategic plan and move ahead with appropriate changes, usually focusing first on categorizing. If strategic change is not occurring, the efforts should focus on portfolio balancing*" (Project Management Institute, 2008b, p. 84). Nevertheless, it only mentioned why to change and what to change about the portfolios. There are still no appropriate solutions to identify the projects, which did not align with strategy or being disturbed due to the strategy shift. Then organizations need an approach to remove the strategic deflection in the portfolios by identifying, assessing, and adjusting the disturbed projects in the portfolios.

1.2 Research Objective

Organizations need support quick identification, assessment and adjustment of affected ongoing projects. Then, organizations could have a more effective portfolio management. Therefore, it is essential to identify if the deliverables of the ongoing project align with the strategy.

Researchers have proposed Capability-based Planning (CBP) methodology in order to support the business IT alignment and suggested to apply this methodology in the strategy management or enterprise architecture (EA) domains. The Open Group summarized CBP as a versatile business planning paradigm that could assist in aligning IT with the business and focus IT architects on the continuous creation of business value (The Open Group, 2011). A series of studies conducted by Aldea et al. made contributions to implement CBP in TOGAF framework and practiced the method in the enterprise context (Papazoglou, 2014; Aldea, et al., 2015; Cheng, 2015).

According to the method, strategy is mapped into a set of capabilities. Besides, they adopted approaches like capability heat map and capability maturity assessment to quantify the current and target capability performance.

Moreover, the Open Group currently released a new framework the IT4IT reference architecture (IT4IT RA) for supporting the business management of IT. The framework provides a blueprint that organization could design and organize transformations via value streams that support the continuous measurement of portfolio's business value. It has a strong connection with the stakeholders (The Open Group, 2015).

Therefore, the main purpose of this paper is to investigate and develop a method that integrates the Capability-based Planning (CBP) into portfolio management: strategy alignment throughout the organization transformation. We use CBP in the new method because CBP has been adopted by organizations to support the strategy alignment (Azevedo, et al., 2015). With the capability standing in between, strategies could be turned into portfolios accurately.

What's more, since the IT4IT is a standard architecture from the open group to enable the supporting functions like financial tracking of the projects and it is as a vender neutral model, which means that most of organizations could refer it without vendor limitations. We also plan a literature review of the IT4IT to identify if it could help to optimize the project portfolio management method.

There are limitations that may also undermine the objective of the proposed research. One limitation in the research is the vast variations between organizations in terms of size: The proposed method may not be a proper method to support medium- and small- sized organizations because of their simple organization structure. They could easily identify if the project aligns with the strategy. Besides, the details of how to propose or adjust project will be simplified in this research, as they are not the emphases.

1.3 Research Question

1.3.1 Main Research Question

According to the determined problem and its corresponding research goal, the main research question is defined as:

How to support effective portfolio management using the Capability-based Planning in a dynamic environment?

In order to provide a comprehensive solution, the main research question is separated into sub research questions, which are shown as the following section 1.3.2.

1.3.2 Sub Research Question:

The new method needs to adopt some mechanisms from CBP. Thus, it is necessary to have a better insight of the portfolio management and CBP separately. Then with the knowledge of these elements, the new model could be optimized with the useful mechanisms. In general, two sub questions are identified as:

- RQ1: What is the relationship between portfolio management and CBP?
- RQ2: How could CBP help to optimize portfolio management?

1.4 Research Scope

The new method proposed here could be applied in the process of portfolio management, analyzing the dependency relationships within the new strategies and the ongoing portfolios in order to support adjustment, integration to optimize the transformation process in a dynamic situation.

In order to support the portfolio integration and management process iteration, in this research, it is assumed that portfolio management might not only monitor changes, but might also manage and control changes and track the implement processes. It is therefore suggested that the existing processes be supplemented with additional empirical information.

1.5 Research Method

1.5.1 Design Science Research Methodology

For this research project, to design a successful method is crucial to arrange the design process within a scientific research. Therefore, this research mainly follows the Design Science Research Methodology (DSRM) guidelines (Peffers, et al., 2008) which is frequently cited for developing new methods. Design Science offers an effective means of addressing the relevancy gap that has plagued academic research, particularly in the management and information systems disciplines. The type of "wicked organizational problems" could be more effectively addressed using a type of paradigm shift offered by design science. (Hevner & Chatterjee, 2010)

The research approach of this thesis includes the following steps: problem identification and motivation, define the objectives for a solution, design and development, demonstration, evaluation, and communication that is shown in Figure 1 (Peffers, et al., 2008):

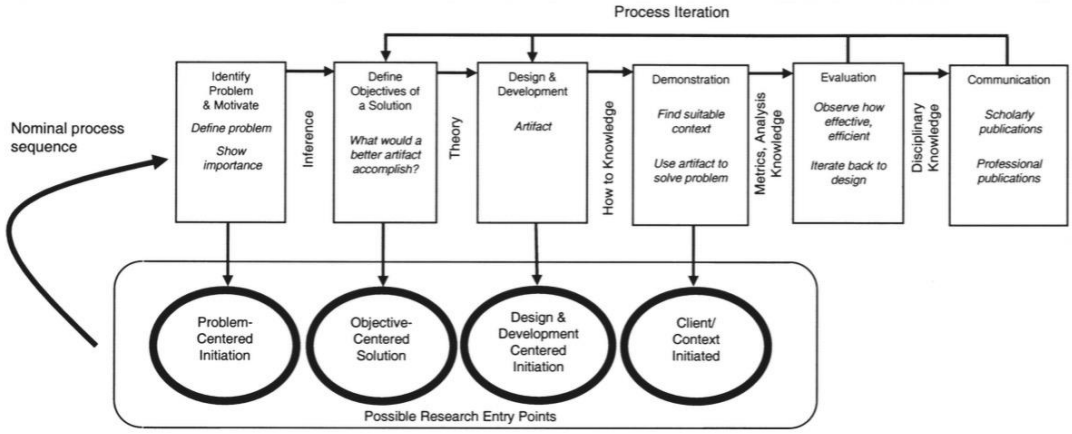

Figure 1 DSRM process model (Peffers, et al., 2008)

In the DSRM Process Model, there are six key activities processed in this research. These key activities are:

- Problem Identification and Motivation: In this phase, the research problems will be identified. Formulate the research questions of this thesis and relate them to the problem statement and the motivation of this research and problem identification is described in chapter 1.
- Define the objectives for a solution: The next step is to define the objectives of the solution. It is based on the defined problem and the studies of previous literatures. It will be documented in chapter 2
- Design and development: Depending on the literature review, the solution will be developed. The method for will be designed in chapter 3.
- Demonstration: After the method has been designed and developed, the usability of it should be demonstrated by solving one or more problems. This could be done by the experimentation, simulation, cased study, or other appropriate activity. Case study will be carried and described in chapter 4.
- Evaluation: To measure how well the method supports the solution of the defined problems. This step aims at comparing the objectives of the solution to the result from the use of the method, which will include the interview of the experts in this area. This part will be described in chapter 5.
- Communication: The communication step would be done in the end after the thesis is published and the thesis defense would be finished.

Within the design process, there is also an iteration arranged from “Define the objectives” to “Communication” if necessary.

1.5.2 Literature Review

Another method that adopted in this research is a systematic literature review method in order to answer sub research question one. It follows the proposed guidelines

(Kitchenham, 2004; Kitchenham & Charters, 2007). Although both guidelines are applied in software engineering area, they have been still widely adopted in the various literature reviews because of their essentials, generic and valid principles. Consequently, the guidelines are adopted in this systematic review as well.

The processes of each phase are shown in Figure 2 that generated by Sepúlveda, Cravero & Cachero (2016) and adapted from Kitchenham and Charters (2007). From the figure, all the steps are managed into three phases: planning, conducting and reporting.

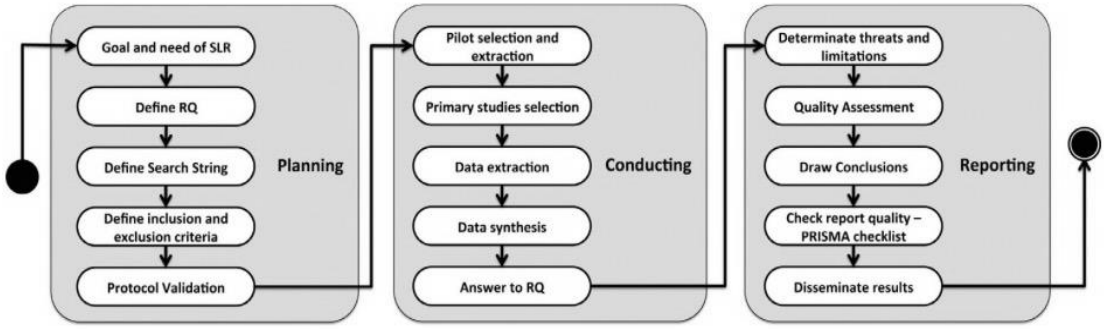

Figure 2 SLR process model (Sepúlveda, et al., 2016)

In the report, the literature review presented in Chapter2: with the searching process and searching result.

1.6 Research Structure

The main body of the research report consists of 6 chapters in order to illustrate the whole processes of defining the method. The identification of the research problem and the motivation behind are defined in Chapter 1 (Introduction). Then in Chapter 2, the summary of the literature review about the important concepts and techniques is given. Furthermore, in Chapter 3, the development of the new method is clarified with the explanation. Chapter 4 demonstrated the method with a case study. The evaluation of the method is presented in Chapter 5 using workshop and questionnaires. Finally, Chapter 6 comprises the research with the conclusion and results of the entire research questions.

Chapter2: Literature Review

In this chapter, a systematic literature review is generated. The result can be used to support the design of the new method and it could also be adopted as a reference for the future corresponding research. The chapter is structured with five sections. Section 2.1 introduces the searching strategy of the review. Then the following section 2.2, 2.3 and 2.4 present the result and discussion of the review; and a brief conclusion of the whole literature review is structured in the last section, section 2.5, as the answer to RQ1.

2.1 Searching Strategy

2.1.1 Searching Database

All the selected literatures in this literature review are from the following 4 databases:

- Scopus (https://www.scopus.com/)
- UT Library (https://www.utwente.nl/ub/en/)
- Google Scholar (https://scholar.google.nl/)
- ScienceDirect (http://www.sciencedirect.com/)

The defined searching strings are firstly applied in the databases Scopus and ScienceDirect. Two more databases (UT Library and Google Scholar) are adopted to support 1) search the articles from the bibliographic references of the selected literature and 2) searching for extra articles since there is just a few articles determined in Scopus and ScienceDirect.

2.1.2 Inclusion and Exclusion Criteria

Defining criteria could assist to search and screen the candidate articles. The criteria are broadly grouped into two categories: inclusion criteria and exclusion criteria.

The inclusion criteria are composed of:

- Articles that published since Jan 1st, 2000;
- Scientific Reports i.e. literature with clearly defined research questions, search process, data extraction and data presentation from academic publications;
- Grey Literatures i.e. survey reports or white papers from top consultant companies or published books.

There are two reasons leading gray literature involved as an inclusion criterion. Firstly, it is due to the insufficient amount of the scientific literatures, since both the IT4IT

RA and CBP are new topics in the research. Secondly, although some published books and white papers from top consulting companies are not documented completely in a scientific way, they are still widely cited by scientific literature, which confirms their academic ability.

Exclusion Criteria:

- Duplicate reports (the article exist in different journals with a complete version of the study has been included in the review).
- Articles from a non-academic digital magazine, blogs or newspaper.

2.1.3 Data Collection and Analysis

Following data should be extracted from each included article:

- The source (journal or conference) and full reference, which contributes to retrieve key literature.
- Classification of the article Type (i.e. SLR, Meta-Analysis MA, book), which supports the quality assessment of the literature review.
- Main topic area, which provides needed information for answering research questions.
- The author(s), their institution and the country where it is situated, which also supports the quality assessment of the literature review.
- Summary of the study.

From the extracted data, the analysis is arranged according to the research questions and research process. Besides, for addressing quality assessment, the affiliations of the authors and their institutions need to be reviewed and justify whether the selected study help to answer the research questions.

2.1.4 Deviations

Deviations in the search strategy are necessary in order to make the systematic literature review feasible. Either a great or an insufficient number of findings might make completion of the study impossible.

Combining the three sets of entry terms (“portfolio management”, “capability based planning”) resulted in 0 articles in all databases. Thus, the searching process is arranged for these three elements separately. Besides, the individual search for “portfolio management” returned more than 7000 results. Thus the search was performed again with some extra constraints (either title or keywords of the literature should contain “portfolio management”). Moreover, to include the articles that not

recorded in the selected databases, an extra step to screen the references of the key literature.

The searching process performed for each string could be concluded as:

Step 1. Initial searching. The defined searching string is firstly applied in the databases Scopus and ScienceDirect, meeting the inclusion criteria.

Step 1.2. Extra searching (Optional). Search the defined string in the databases Google Scholar and UT Library if the individual search returns less than 50 results.

Step 2. Articles Screen:

Step 2.1(Optional). The result articles are firstly excluded with extra constrains if the individual search returns more than 500 results.

Step 2.2. The filtered articles are excluded by scanning the title and the abstract.

Step 2.3. The filtered articles are excluded by viewing the whole context.

Step 3. 2nd round searching:

Step 3.1. Review the bibliographies of the selected articles

Step 3.2. Search the articles in Google Scholar and UT Library by their titles and authors.

2.2 Portfolio Management

2.2.1 Searching Process

The searching string is defined as “portfolio management” and initial searching results of ScienceDirect and Scopus are:

1438 results found for pub-date > 1999 and ("portfolio management").
6235 results for KEY (**portfolio management**) AND DOCTYPE (**ar**)

Then, the extra constrains are applied that limited key words should be contained in the title and abstract. Thus, the new searching query as applied in ScienceDirect.com and Scopus in April, 2016 is:

450 results found for pub-date > 1999 and **TITLE** (**portfolio management**) or **KEYWORDS** (**portfolio management**).
98 document results for TITLE-ABS KEY (**portfolio management**) AND DOCTYPE (**ar**) AND PUBYEAR > **1999** AND (LIMIT-TO (EXACTKEYWORD, **"Portfolio management"**)) AND (LIMIT-TO (EXACTKEYWORD, **"Project management"**)

The whole searching process of this section is illustrated as Figure 3 below with the action and the result of the filtered articles.

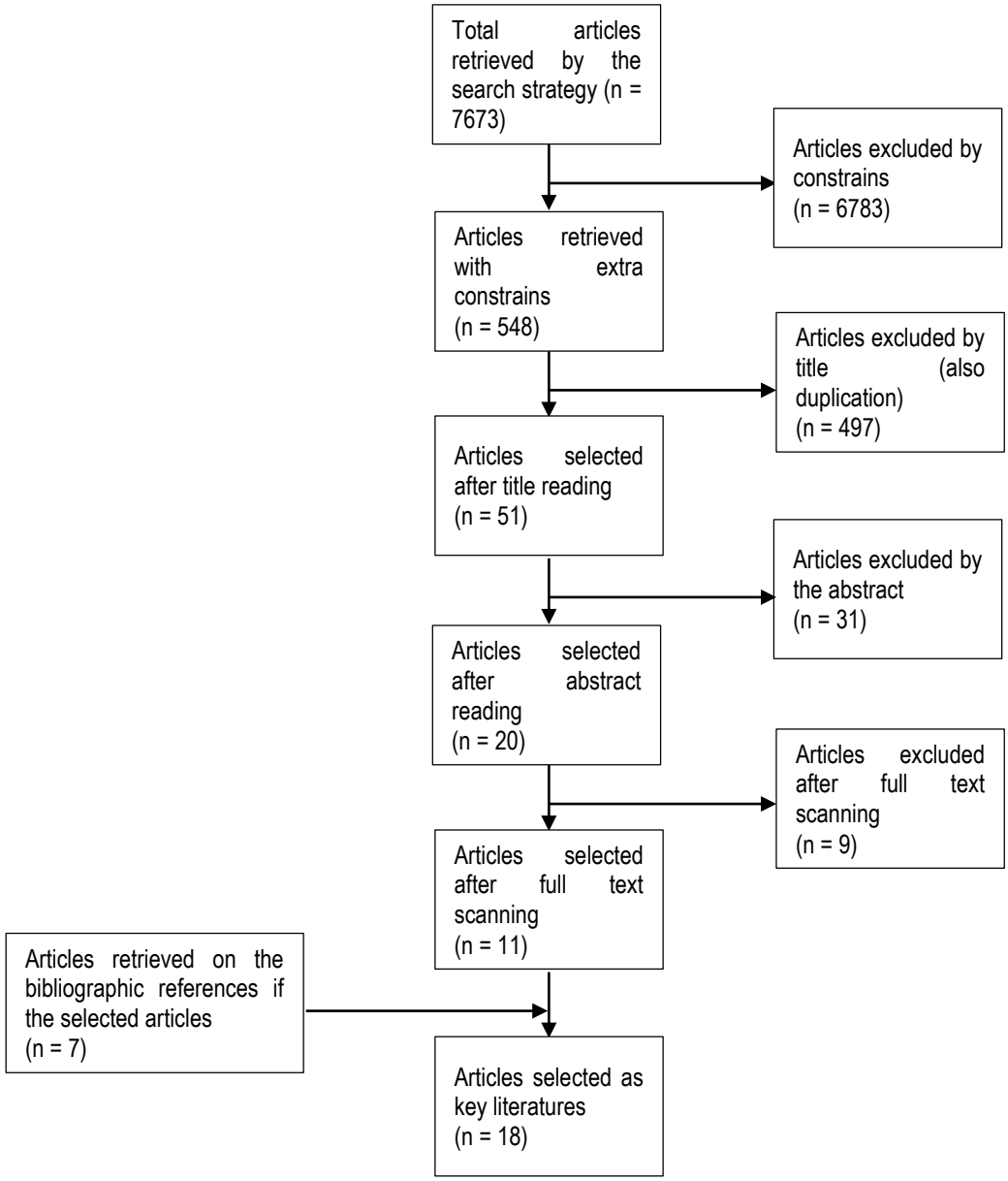

Figure 3 Searching process of portfolio management

After the screening process, there are 18 articles selected as the key literatures on portfolio management in this study. The Table 1 lists the selected articles and shows if it could provide the information about definitions and models.

Table 1 Literature contributions in portfolio management

#	Literature	Definition	Model
1	(Tavana, Keramatpour, Santos-Arteaga, & Ghorbaniane, 2015)		√
2	(Investopedia, 2003)	√	
3	(Jeffery & Leliveld, 2004)	√	√

4	(Padovani & Carvalho, 2016)	√	√
5	(Pajaresa & Lópeza, 2014)	√	√
6	(Project Management Institute, 2013)	√	
7	(Petit, 2012)		√
8	(Martinsuo, 2013)		√
9	(Killen & Kjaer, 2012)	√	√
10	(Heising, 2012)	√	√
11	(Melton, 2011)	√	
12	(Young & Conboy, 2013)	√	
13	(Amaral & Araújo, 2009)	√	√
14	(Bitman, 2005)		√
15	(Archer & Ghasemzadeh, 1999)		√
16	(Bodenstaff, Quartel, & Lankhorst, 2014)	√	√
17	(Bodenstaff & Quartel, 2014)	√	√
18	(Patanakul P. , 2015)	√	

In the following sections, the literature review result of portfolio management is expounded with details from three perspectives. Firstly, a comparison of the relevant term definitions is presented in section 2.2.2. Then, in section 2.2.3, we illustrate the importance of project dependency relationship. At last, the process of portfolio management is exemplified with three proposed models selected from these key literatures, which is in section 2.3.4.

2.2.2 Portfolio Management Definition

According the definition from the book *Real Project Planning* (Melton, 2011) the terms project, portfolio and program are used to describe specific activities:

Project: is a bounded piece of work which is non-routine for the organization. It is not a part of business as usual (BAU) but has a defined start and end point (when it is integrated into BAU).
Program: is a set of interdependent projects working together to achieve a defined organizational goal. There is dependency between project outputs/benefits.
Portfolio: is a collection of projects using a common resource pool. These resources could be assets, people or funding.

Apart from Melton, Project Management Institute (PMI) also provides a series of definitions, which involve:

Project: is a temporary endeavor undertaken to create a unique product, service, or result.
Program: is a group of related projects, subprograms, and program activities that are managed in a coordinated way to obtain benefits not available from managing them.
Portfolio: means projects, programs, sub portfolios, and operations managed as a group to achieve strategic objectives.
project management: is the application of knowledge, skills, tools, and techniques to project activities to meet the project requirements.
program management: is the application of knowledge, skills, tools, and techniques to a program to meet the program requirements and to obtain benefits and control not available by managing projects individually.
portfolio management: is the centralized management of one or more portfolios to achieve strategic objectives.

And according to the data collection of the literature review, the definitions of the relevant terms in portfolio management are listed as Table 2:

Table 2 Definitions about portfolio management

#	Literature	Definition Term
1	(Investopedia, 2003)	**portfolio management:** is the art and science of making decisions about investment mix and policy, matching investments to objectives, asset allocation for individuals and institutions, and balancing risk against performance.
2	(Jeffery & Leliveld, 2004)	**IT portfolio management:** is managing IT as a portfolio of assets similar to a financial portfolio and striving to improve the performance of the portfolio by balancing risk and return.
3	(Padovani & Carvalho, 2016)	**portfolio management:** is a dynamic decision process that deals with multiple goals (Cooper, Edgett, & Kleinschmidt, 2001) reflecting internal and external stakeholders' perspectives (Beringer, Jonas, & Kock, 2013), encompassing strategic considerations and adaptability to internal and external changes (Patanakul P. , 2015), resulting in a dynamic and uncertainty decision-making process. **project portfolio management:** Project portfolio management is an emerging aspect of business management that focuses on how projects are selected, prioritized, integrated, managed and controlled in the multi-project context that exists in modern organizations (Young & Conboy, 2013)
4	(Pajaresa & Lópeza, 2014)	**project portfolio management:** can be considered as a managerial approach for helping firms to obtain corporate objectives more efficiently.
5	(Project Management Institute, 2013)	**project management:** The application of knowledge, skills, tools, and techniques to project activities to meet the project requirements. **program management:** The application of knowledge, skills, tools, and techniques to a program to meet the program requirements and to obtain benefits and control not available by managing projects individually. **portfolio management:** The centralized management of one or more portfolios to achieve strategic objectives.
6	(Killen & Kjaer, 2012)	**project portfolio management:** Project portfolio management is central to many organizations' strategic processes and requires consideration of multiple factors and the ability to envision alternative future consequences to support strategic project portfolio decision making.

7	(Heising, 2012)	**project portfolio management:** can be considered as the simultaneous management of the collection of projects that make up an investment strategy of a company (Artto & Dietrich, 2004; Levine, 2005; Patanakul & Milosevic, 2009)
8	(Amaral & Araújo, 2009)	**project portfolio:** is defined as a group of projects that compete for scarce resources and are conducted under the sponsorship or management of a particular organization. (Archer & Ghasemzadeh, 1999)
9	(Bodenstaff, Quartel, & Lankhorst, 2014)	**enterprise portfolio management:** is an integrated portfolio management approach that tightly manages strategy planning against the various portfolios of interdependent assets, like product portfolios and project portfolios.
10	(Bodenstaff & Quartel, 2014)	**application portfolio management:** is a management approach that allows structuring large IT landscapes by grouping applications (e.g. based on functionality or dependency) into portfolios which are then managed as a whole.

The series definitions of portfolio management provided by Project Management Institute (PMI) and the project portfolio management definition from Young & Conboy (2013) are adopted. This is a conscious decision for two reasons. First, according to the cited number, these definitions have been widely adopted by other literature (Petit, 2012; Martinsuo, 2013; Young & Conboy, 2013; Abrantes & Figueiredo, 2015; Patanakul P. , 2015). The definition proposed by Young & Conboy also referred the definition from PMI. Secondly, PMI provides the most comprehensive definitions in its lexicon (Project Management Institute, 2015) with the context of portfolio management.

2.2.3 Project interdependencies

Although in this model, shown projects are independent entity groups (no interdependence among projects). It has been proved that interdependencies may exist between project resources in the organization which has large scale and requires dozens of projects (Melton, 2011). What's more, the increasing importance of acknowledging project interdependencies has also been widely accepted (Stummer & Heidenberger, 2003; Dahlgren & Söderlund, 2010; Killen & Kjaer, 2012). Thus, organizations have to identify the dependent relationships between projects in order to make optimal decisions for providing the best outcomes.

Horizontal relationship

The dependency relationship could be identified "*when the success of a project depends upon other project(s)"* (Killen & Kjaer, 2012). In the research, several examples are shown to describe project interdependencies from different perspectives. Some interdependencies rise due to the limitation of common resources in two projects that one could not start until the resources released from the other one. This kind of interdependencies may disappear while the resources are enough to support both projects. Besides, there is no strict order limitation (project a could be implemented before project b and vice versa). Apart from resource interdependencies, there are also outcome dependencies and learning dependencies. A project has the

need of the outcome or the knowledge that provided by another project. For these interdependencies, the project implementation should be strictly scheduled otherwise a project may have to pause and wait for the knowledge or outcome from another project.

Vertical relationship

Although definitions are proposed in use of projects, programs and portfolios by different researchers or organizations with different perspectives, the interaction relationship among these three terms are presented similarly. The figure before is an example that shows how portfolios programs, and projects fit together in one organization.

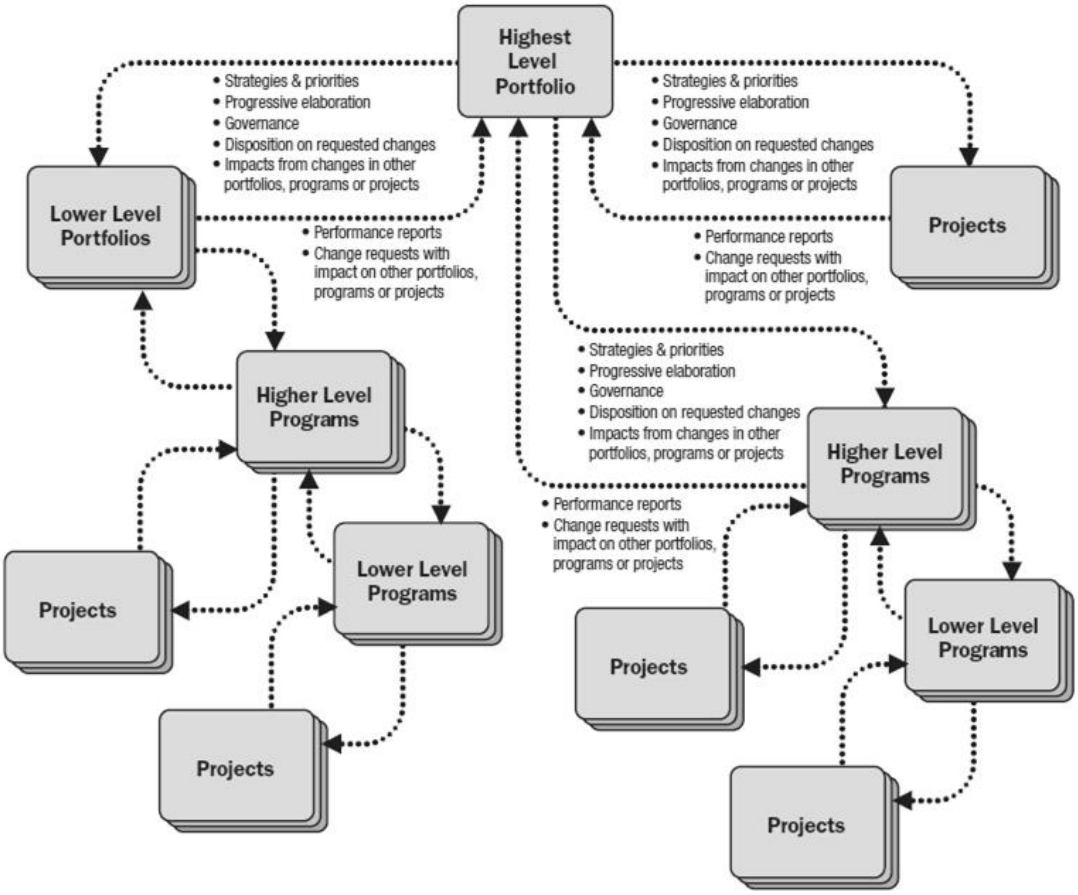

Figure 4 Portfolio, program and project management interactions (PMI, 2013)

In organizations, as Figure 4 illustrates, a portfolio may consist of lower level portfolios, programs, and projects with shared strategies. The similar relationships are also modeled between programs and their projects.

2.2.4 PPM method

In this section, three process models are illustrated. The first one is a construct model about the core processes involved in portfolio management. The other two models put more emphases on the process of project selection.

2.2.4.1 Core Process Model in Portfolio Management (Padovani & Carvalho, 2016)

A construct model of project portfolio management is proposed in one of the latest researches (Padovani & Carvalho, 2016). In the literature, authors identified the core processes in project portfolio management. And validated the model using a survey-based research. Besides, they also did an investigation for the relationship between project portfolio management and enterprise performance. And the result shows a strong significant and positive relationship between the process of project portfolio management and performance.

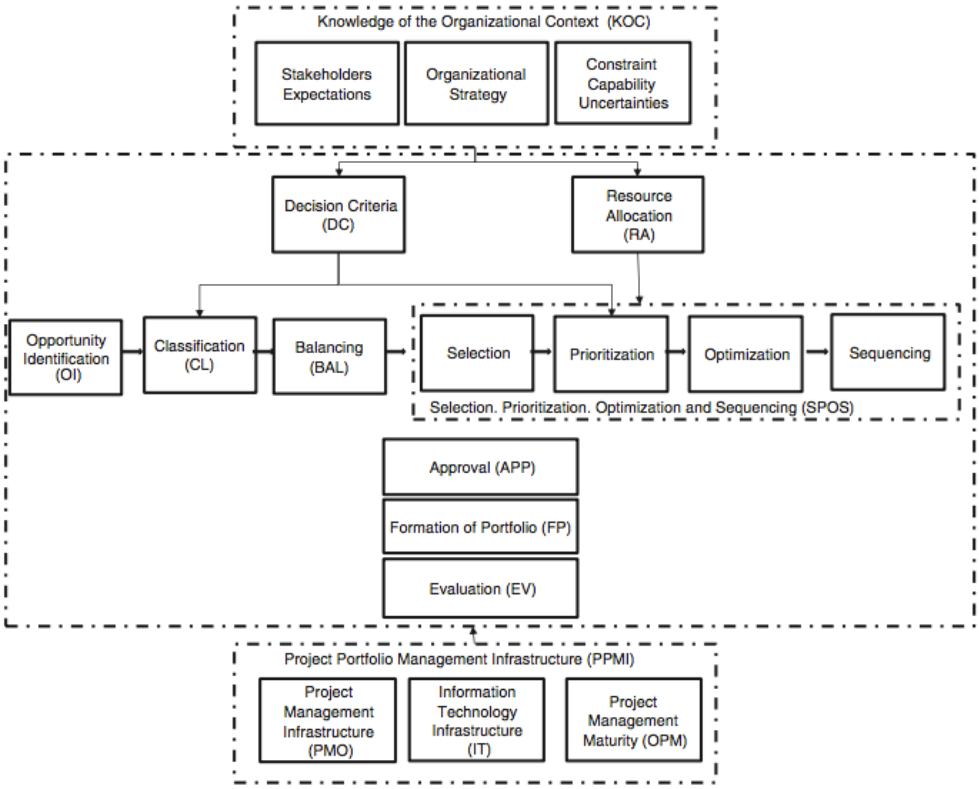

Figure 5 PPM construct model

According the literature review, (Padovani & Carvalho, 2016) extracted the processes in the portfolio management and concluded as construct model shown in Figure 5. In the figure, the construct model consists of three parts. The first part in the top is the "knowledge about the organizational context (KOC)". As the knowledge base, it drives the decision-making of portfolios and it is essential for supporting the portfolio

management alignment. The emphases are put on both the external environment and internal context.

The second part located in the middle shows needed processes in project portfolio management. There are two preparation activities decision criteria (DC) - to identify the criteria for decision making and Resources Allocation(RA) - to investigate the allocable resources. They are quite essential since they are the key to support the activities that require decision making. The needed inputs of these two activities are from the top level. Thus, they are also the key to insure the strategy alignment. Apart from Decision Criteria and Resources Allocation, there are also relevant activities of proposing, evaluating, selecting and arranging projects.

The last part in the bottom of the figure is the project portfolio management infrastructure (PPMI) block. It consists of three main activities which are information technology infrastructure, project management maturity and project management structure. They are emphasized since they do affect the success of both project portfolio management and projects themselves. A brief description of each block composing the suggested model together with each one of their corresponding activities is presented in Table 3.

Apart from this construct model, there is also a comprehensive literature review result showing the indicators of each key element in the construct model with their corresponding references structured in Appendix A.

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Table 3 Activities in PPM construct model

Block	Activity	Description
Knowledge of the organizational context (KOC)	Stakeholders Expectations	Existence of a formal planning process, reflecting internal and external stakeholder's perspectives
	Constraint Capability Uncertainties	It is necessary to have a certain knowledge about the constraints, capabilities, uncertainties information about the organization.
	Organizational Strategy	Have strategic performance measure systems
Main Portfolio Management Process	Decision Criteria (DC)	Identify the Criteria for: individual project evaluation project selection and prioritization
	Resource Allocation (RA)	Identify the resource to be allocated
	Opportunity Identification (OI)	Provide a global vision of the entire portfolio of projects with brief information of the candidate proposals (scope, objective, value, earnings, market etc.)
	Classification (CL)	Consists of the projects classification used to compare similar projects so that the budget can be allocated to projects according to classification. Besides, projects with the same classification are compared and may have concurrent resources that could support the resources management.
	Balancing (BAL)	Balance the criteria (e.g. investment and outcome) to align the project portfolio with the organization's strategy.
	Selection. Prioritization. Optimization and Sequencing (SPOS)	In the research, Selection, prioritization, optimization and sequencing are grouped together. Optimization is to consider resource limitations as a constraint in the analysis of which and how many projects an organization should approve for a given period. Optimization tools are used in allocation resources and prioritization of projects Tools or models could be adopted in these activities
	Approval (APP)	Set the gateway to support formal approval process of projects in the enterprise.
	Formation of Portfolio (FP)	This step is suggested by PMI (Project Management Institute, 2013). It allows multi-project level to conduct the approved portfolio and it provides the planning of projects in the portfolio.
	Evaluation (EV)	The project evaluation is set for reviewing the ongoing projects in the portfolios. The study shows the literature review result that the key performance indicators of projects in this step should include: a) The alignment of the project with the organization's strategic plan; b) Compare the projects to each other and compete for the same resources.
Project Portfolio Management Infrastructure (PPMI)	Project Management Infrastructure (PMO)	Influence of the types of PMO on portfolio management
	Information Technology Infrastructure (IT)	Impact of the use of IT on project success
	Project Management Maturity (OPM)	The OPM selected in the model because the maturity stage of project management in an organization will affect the performance of the strategy implementation.

Apart from this construct model, there is also a comprehensive literature review result showing the indicators of each key element in the construct model with their corresponding references structured in Appendix A.

2.2.4.2 Project Portfolio selection process (Tavana, et al., 2015)

The study from Tavana, et al. (2015) proposed a three-stage hybrid method for the project selection in the portfolio management with a process model described in the paper. The proposed method integrates the models fuzzy TOPSIS (the technique of order preference by similarity to ideal solution), DEA (data envelopment analysis) for multiple criteria decision making in order to make the framework more structured and systematic. And the scope of this framework covers the processes from project creation to the final project selection in the portfolio management.

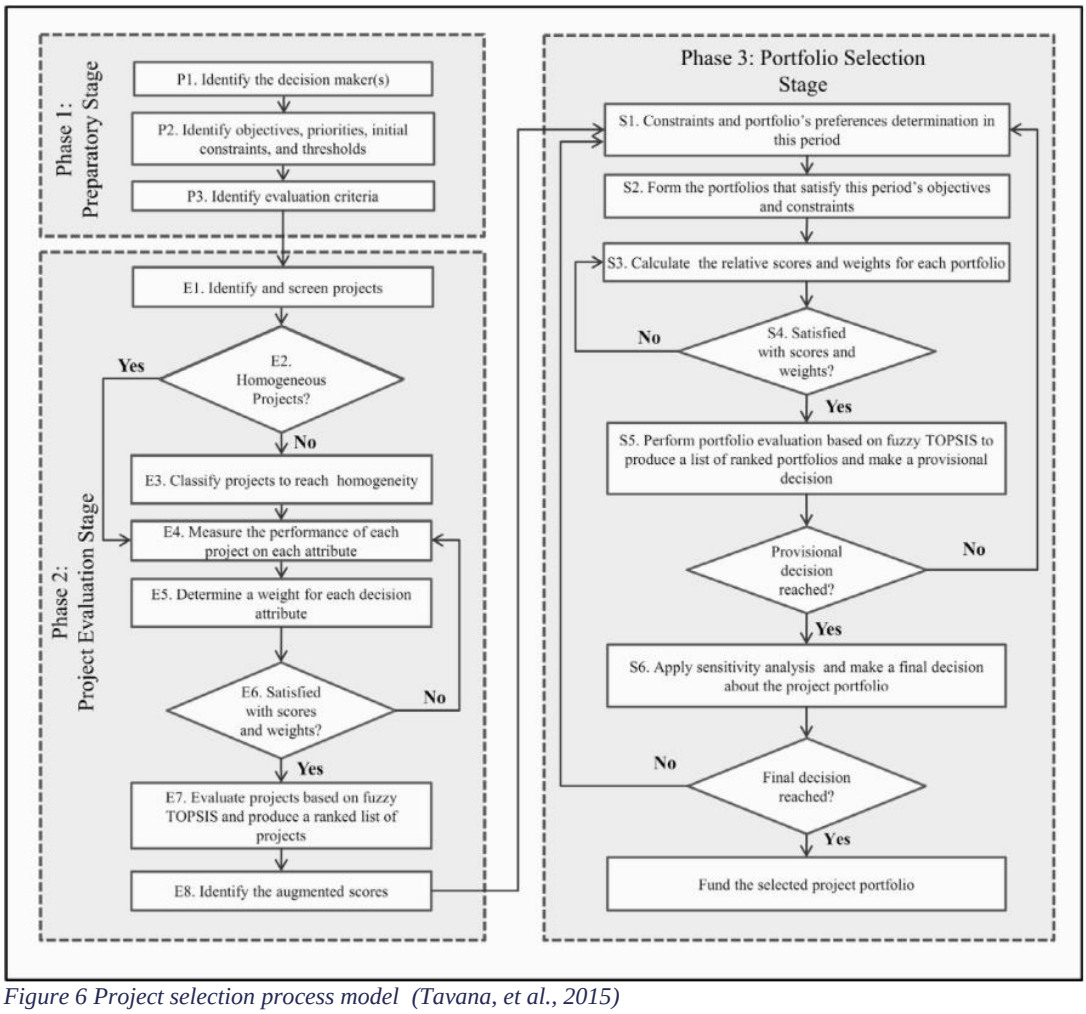

Figure 6 Project selection process model (Tavana, et al., 2015)

The three-stage approach introduced in the study is described in Figure 6. The framework is composed of three main phases involving: a preparatory stage, a project evaluation stage, and a portfolio selection stage. The first phase is the preparatory

stage aiming to prepare the needed resources for the further processes. This phase consists of three steps:

P1. Identify the decision maker(s). This step is to identify the relevant stakeholders as decision makers.
P2. Identify objectives, priorities, initial constraints, and thresholds. Step 2 is arranged to formulate the required information in the portfolio management.
P3. Identify evaluation criteria. The last step in phase 1 is to identify the criteria for the later projects evaluation.

After phase 1, following phase 2 is also a preparation of the project selection, but phase 2 puts emphases on the projects themselves by identifying project evaluation.

E1. Identify and screen projects. In this step, the inefficient projects should be figured out and screened.
E2. Homogeneity Projects. Step 2 is arranged as a gateway. In this step, the decision makers selected in step **P1** should check if all projects are homogeneously classified. There are two options: move to **E4** directly if all projects are homogeneously classified, or proceed to next step **E3** if there still projects need to be classified.
E3. Classify projects to reach homogeneity. According to the literature, projects could be classified by different criteria like research and development criteria, project size, project time, technology type. The classify criteria are identified by decision makers.
E4. Measure attributes & E5. Determine weights for attributes. These two steps are arranged to measure each project's value based on various criteria.
E6. Satisfaction with the scores and weights. E6 is a gateway to ensure the satisfaction with the weights and scores. Otherwise, steps E4 and E5 will be iterated until getting the approvals.
E7. Evaluate projects. The step is to evaluate the projects based on fuzzy TOPSIS and produce a ranked list of the projects.
E8. Identify the augmented scores. The step aims at strengthening the consistency between the results obtained from the linear IP model applied in the portfolio selection stage.

The last phase is to select the projects, which includes the following steps:

S1. Constraints and portfolio's preferences determination in this period. In S1, the DMs decide to remove or add constraints.
S2. Form the portfolios that satisfy this period's objectives and constraints: a large number of project portfolios can be created, particularly when the number of constraints is low.
S3. Calculate the relative weights and scores for each portfolio. The DMs can consider new weights for the criteria after creating the feasible models.

S4. Check satisfaction with the scores and weights. In the gateway, the DMs review the criteria weights and the portfolio score to ensure their satisfaction.

S5. Perform portfolio evaluation and make a provisional decision. The DMs select portfolios that are higher in the rank as a temporary decision. If the group agrees, continue to the next step; otherwise, return to steps S1 to S4.

S6. Apply sensitivity analysis and make a final decision about the project portfolio. In this step, measure the effect on the model results caused by a change in the variables. If a small shift leads to a significant change, the DMs must agree on whether to keep the current portfolio or make a new decision.

2.3 CBP

2.3.1 Searching Process

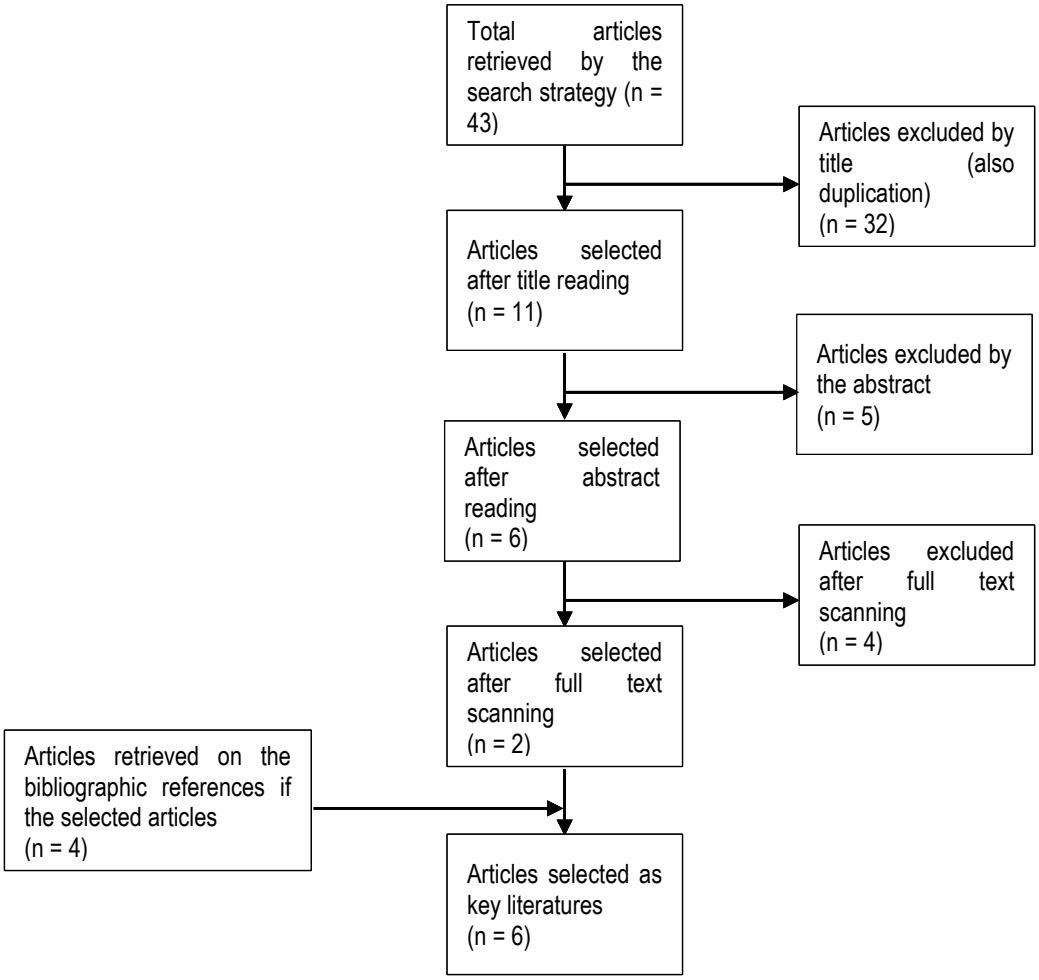

Figure 7 Searching process of CBP

The searching queries as "capability based planning" applied in ScienceDirect.com and Scopus in April, 2016 are:

Search results: 23 results found for pub-date > **1999** and ("**capability based planning**").

20 results for TITLE-ABS-KEY ("**capability based planning**") AND DOCTYPE (ar OR re) AND PUBYEAR > 1999 AND (LIMIT-TO (DOCTYPE, "**ar**"))

The searching process of this section is illustrated as Figure 7 with the action and the result of the filtered articles.

2.3.2 Definitions

In Oxford Dictionary, a capability is simply defined as "*the power or ability to do something*". However, this definition is over general for specific usages. Then, the Open Group defined "capability" in the context of enterprise architecture:

"An ability that an organization, person, or system possesses. (The Open Group, 2011)"

In the TOGAF book, "capabilities are expressed in general and high-level terms and typically require a combination of organization, people, processes, and technology to achieve, for example, marketing, customer contact, or outbound telemarketing" (The Open Group, 2011). Besides, from its context, capabilities are also able to be subdivided as pure business capabilities such as Process Claim or Order Management or as technical capability such as Service Mediation. The study of Papazoglou (2014) collected the definitions of the capability- related terms. The following Table 4 lists some of the definitions with the corresponding literature.

Table 4 Definitions about Capability

#	Literatures	Definition
1	(The Open Group, 2011)	**Capability:** is an ability, capacity or potential that an organization, person or system possesses. Capabilities are typically expressed in general and high-level terms and typically require a combination of organization and different assets (e.g. people, processes, and technology) to be achieved and thus realize their goal.
2.	(Azevedo, et al., 2015)	**Capability:** is an ability to employ resources to achieve some goal.
3	(Burton, 2013); (Bredemeyer et al., 2003)	**Business capabilities** are the ways in which enterprises combine resources, competences, information, processes and their environments to deliver consistent value to customers. They describe what the business does and what it will need to do differently in response to strategic challenges and opportunities.
4	(Brits et al., 2006); (Henry, 2011)	**Strategic business capabilities** are the business capabilities that offer a competitive advantage to the organization by being better than those owned by the organization's competitors and by being difficult to imitate or replicate and that also contribute in shaping and realizing the organization's business strategy.
5	(Acha, 2000); (Kim, 1999)	**Technological capability** is the ability of an organization to make use of technological know-how through identification,

		appraisal, utilization and development.
6	(Alizadeh, 2012)	**Strategic technological capability** is the generic knowledge intensive ability to jointly mobilize different scientific and technical resources which enables a firm to successfully develop its innovative products and/or productive processes, by implementing competitive strategy and creating value in a given environment.
7	(Helfat, 2003); (O'Regan & Ghobadian, 2004)	**Organizational capability** refers to the organizational ability to perform a coordinated task, utilizing organizational resources (tangible, intangible and personnel-based), for the purpose of achieving a particular end result in order to improve performance.

There have been literatures identifying business capability modeling as an essential element and stating that capabilities are applied in the large variety of tasks in EA management (Barroero, 2010; Brits & Botha, 2007; Klinkmuller et al., 2010; Weber & Schmidtmann, 2008).

2.3.3 CBP methodology with TOGAF and ArchiMate

The Open Group apply CBP in the context of EA, and define it as:

"a business planning technique that focuses on business outcomes, dealing with the planning, execution and delivery of the target strategic business capabilities."

The need for CBP in the context of organizations has become more apparent in the recent years. From an Enterprise Architecture and IT perspective, CBP is a powerful mechanism to ensure that the strategic business plan drives the enterprise from a top-down approach (The Open Group, 2011).

From the definition, we can see that CBP could serve as an approach for translating strategy into action. From the study of Papazoglou(2014), proposed a method for implementing CBP in TOGAF framework and Cheng(2015) practiced the method in the enterprise context. The method is proposed to formulate the strategy into a set of capabilities with defined input and output.

Figure 8 shows the CBP method proposed by Papazoglou(2014). It can be used in collaboration with TOGAF and modeled with ArchiMate for identifying, planning and implementing the strategies.

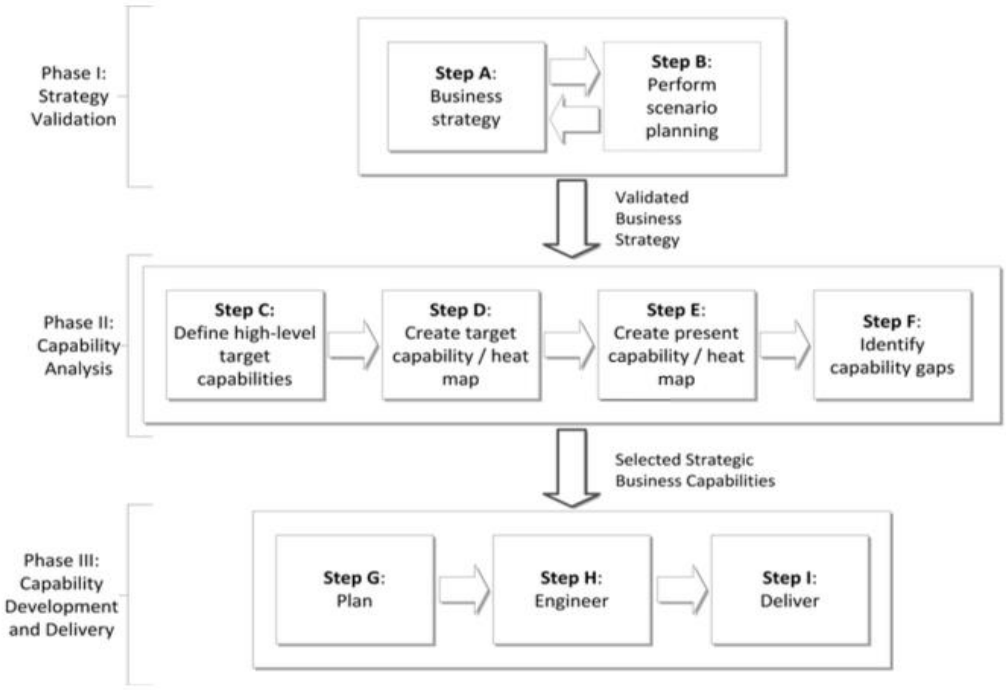

Figure 8 The capability-based planning method (Papazoglou, 2014)

After one year, Aldea, et al. developed their CBP methodology based on the research of Papazoglou(2014) with three main activities, Map Capabilities, Assess Capabilities, and Plan capability increments. Thus, the new CBP methodology can be used separately from other domains such as strategic management or EA, but also in collaboration with these domains. As described, the new CBP methodology follows the guidelines of TOGAF (Open Group, 2011), TTCP (Taylor, 2005) and the RAND (Davis, 2002). And in the research, the new CBP methodology is validated in a case modeled with ArchiMate 2.1. In the method, the strategies could be translated into a goal of building or optimizing specific capabilities to the desired performance level. Therefore, firstly, it is necessary to identify the existing or missing capabilities which contribute to realizing the strategy. According to the organization capability map that related to the strategies. Then identify the target performance of these capabilities. This step still follows the principles of CBP. Generally, the strategic capability could be identified according to the organization changing goals. And the changing goals (objectives) could be identified based on how the strategies fulfilled at the moment. The Figure 9 below shows the metamodel of motivation extension according to the CBP methodology (Aldea, et al., 2015).

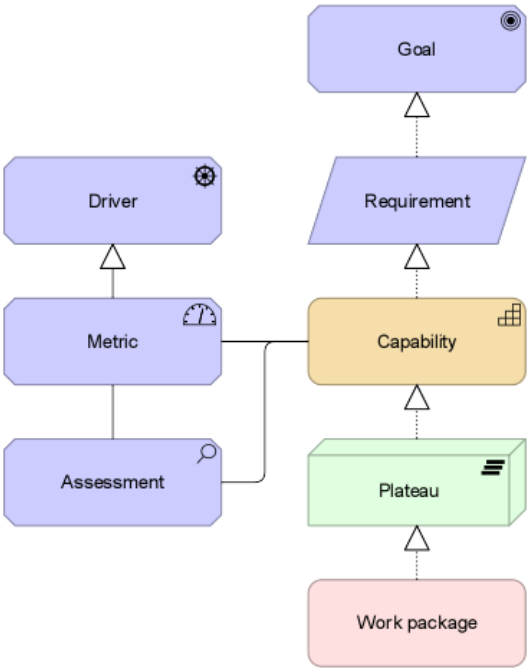

Figure 9 Motivation extension meta model (Aldea, et al., 2015).

The Open Group defined the capability could be realized by the capability increments, which could be separated into three dimensions, which has been is shown as Figure 10 (The Open Group, 2012).

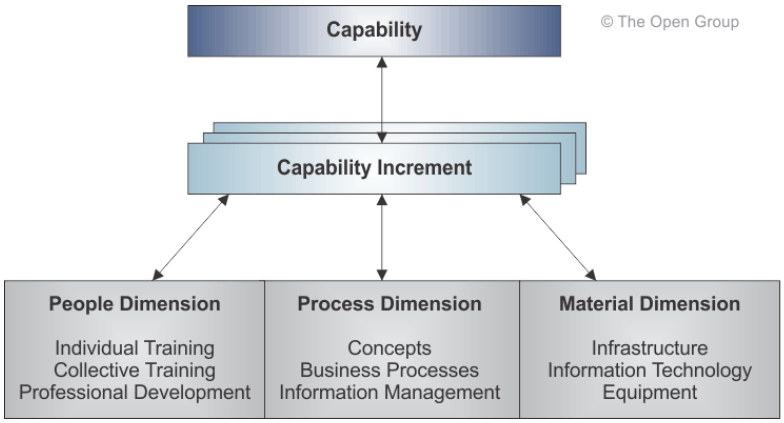

Figure 10 Capability increment

Apart from these three dimensions, the Open Group provided another perspective for identifying capability dimensions by analyzing the relationships between Strategy Elements and Motivation and Core Elements.

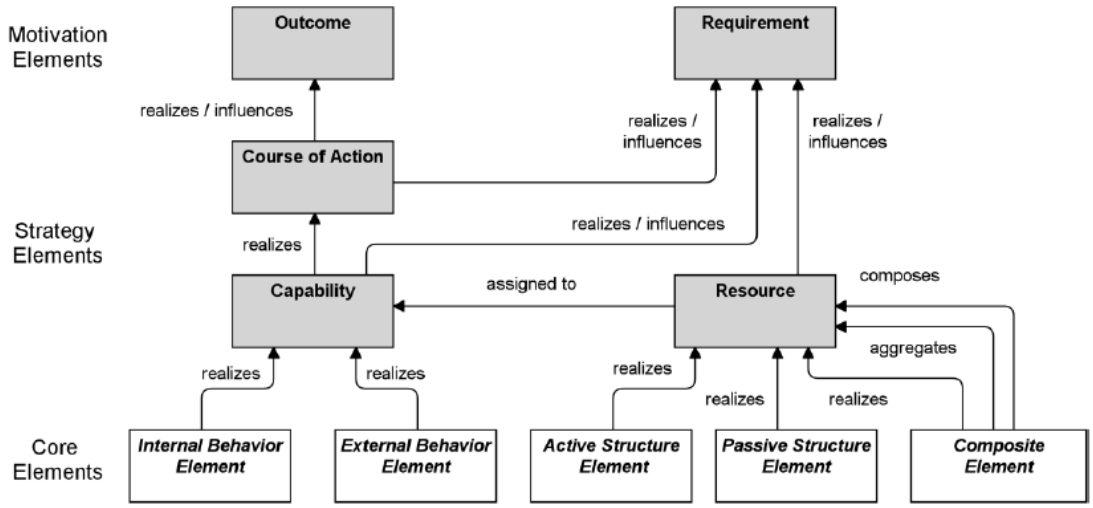

Figure 11 Relationships between "Strategy Elements", "Motivation" and "Core Elements"

As shown in Figure 11 capability is affected by behavior elements and resource which is assigned to the capability. And according to the Open Group, the resources can be classified into tangible and intangible assets, which include financial, physical, technology, and human assets.

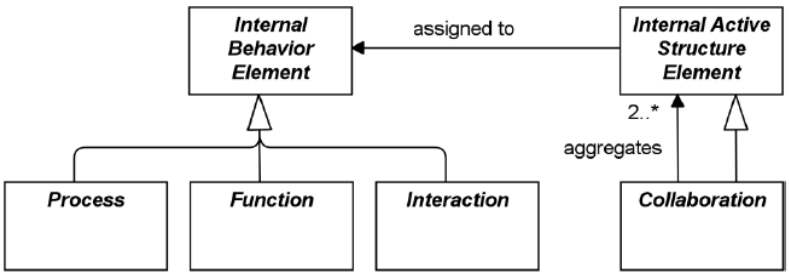

Figure 12 Specialization of "Internal Behavior Elements"

The three types of internal behavior element are defined: process, function, and interaction (Figure 12). However, by comparing the definitions, a *business interaction* is defined as "a unit of behavior similar to a business process or function, but which is performed in a collaboration of two or more roles within the organization." Thus, the interaction element could be identified as a KPI of the process. A *business function* is defined as a collection of business behavior based on a chosen set of criteria. And when the capability decomposed, one important reference is to identify the sub capability according to the business functions. Therefore, to identify the capability increments, The emphases should be put on the business process.

As shown in Figure 13, Aldea, et al. also provide an example of mapping the strategy "Centralized IS", in order to briefly outline how the related strategic capability identified.

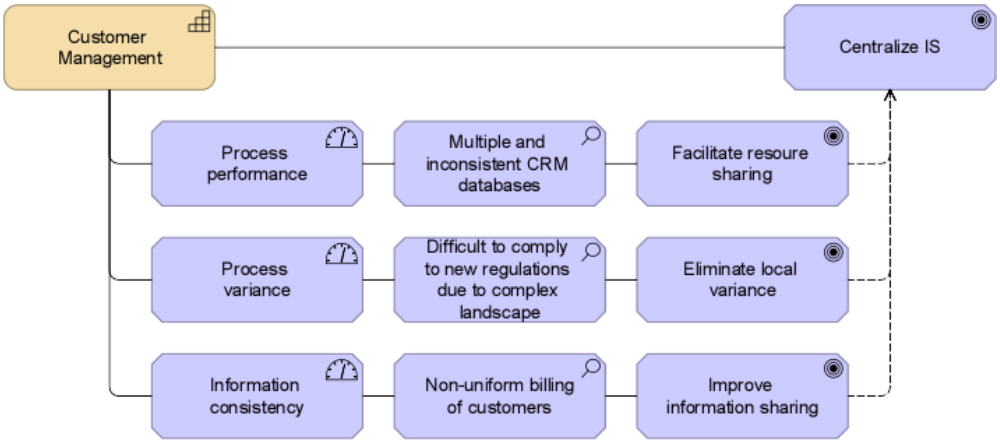

Figure 13 Strategy mapping of "Centralize IS" (Aldea, et al., 2015).

In order to assess how well the objective of Centralize IS can be fulfilled at the moment, several strategic KPIs are used, such as Process performance, Process variance, and Information consistency. Then the result shows there are several problems standing in the way of successfully centralizing IS. 1) The Process performance metric scores low because there are "Multiple and inconsistent CRM databases". 2) Process variance metric scores low because it is "Difficult to comply with new regulations due to complex landscape". 3) Information consistency metric scores low because there is a "Non-uniform way of billing customers". Then, the capability "Customer management" is identified that relate to implement to centralize IS.

2.3.4 Relationships Between Capabilities

Capabilities are normally modelled independently in the CBP methodology. But relationships between capabilities exist. In ArchiMate 3.0, there are 7 types relationships have been identified and defined between capabilities. Table 5 is generated based on the relationship matrix in ArchiMate 3.0 to represent all 7 types and their corresponding definitions.

Table 5 Relationship types between capabilities

Elements	Type	Description
Capability and Capability	Composition	A capability consists of one or more other capabilities.
	Flow	A transfer relationship from one capability to another.
	Aggregation	A capability groups a number of other capabilities.
	Association	For showing the unspecified relationship.

	Specialization	A capability is a particular kind of another capability.
	Triggering	A capability has a temporal or causal relationship with another capability.
	Serving	A capability provides its functionality to another capability.

Additionally, The Figure 14 shows all the relationship types and their classification in the ArchiMate 3.0.

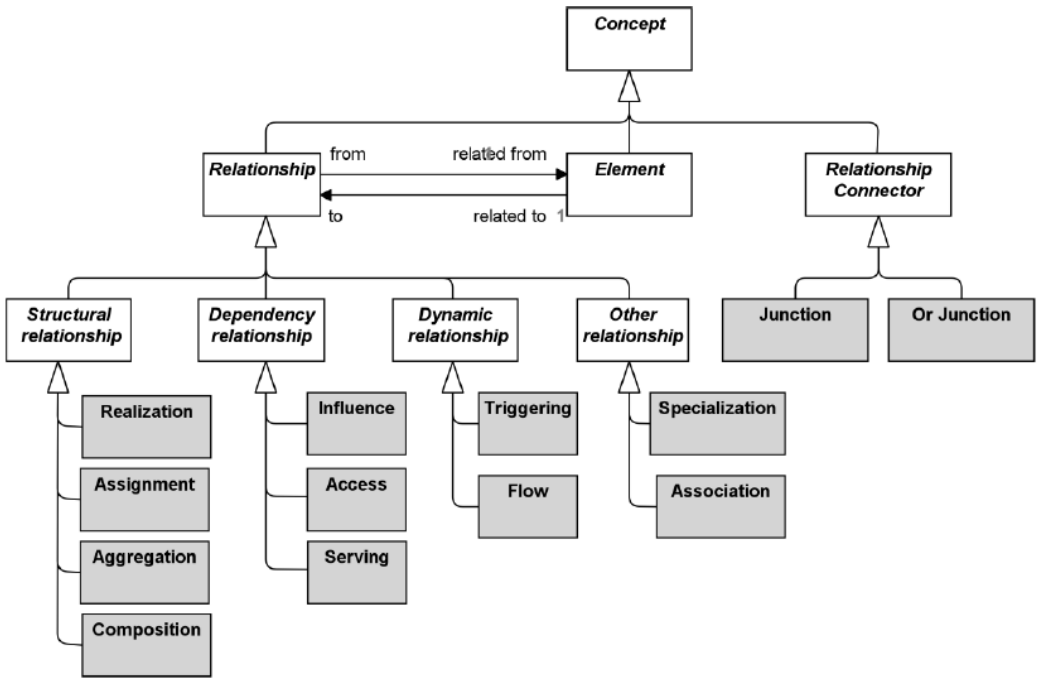

Figure 14 Overview of relationships in ArchiMate 3.0

Generally, the relationships are classified into four categories as:

- *Structural* relationships, which model the static construction or composition of concepts of the same or different types;
- *Dependency* relationships, which model how elements are used to support other elements;
- *Dynamic* relationships, which are used to model behavioral dependencies between elements;
- *Other relationships*, which do not fall into one of the above categories.

It is of importance to figure out the relationship between the capabilities. The composition relationships mean one capability consists of one or more capabilities. It could be identified based on the capability decomposing. A high-level capability composes of its low-level capabilities. Then, as shown, dynamic relationships are used to model the behavioral dependencies. It means that the two capabilities will have the behavior order rather than affect the performance of each other. Therefore, in this case, all the dynamic relationships between capabilities has little influence on each other. Then the specialization relationship means "A capability is a particular

kind of another capability". It hardly happens when building the business capability map. Therefore, only the composition relation and the serving relation will have a strong influence on the capability performance.

2.4 The IT4IT RA

As mentioned in the introduction, it is interesting to see if the IT4IT RA could contribute to the new method. Therefore, we also made a literature review of IT4IT RA.

2.4.1 IT4IT RA Overview

The IT4IT RA is a new standard reference architecture raised by the Open Group in order to face the challenge that managing the business of IT. And it is a value chain-based operating model of the functions that IT performs to help organizations to identify the activities that contribute to business competitiveness (The Open Group, 2015). Since it is a quite new topic, there is no scientific publications while the searching process arranged. The main references of the IT4IT RA are from the website of the open group. The IT4IT Reference Architecture uses both formal and informal notation style to depict the element. The related notations are list in the Appendix B. and the IT4IT RA Level 1 framework is shown in Figure 15.

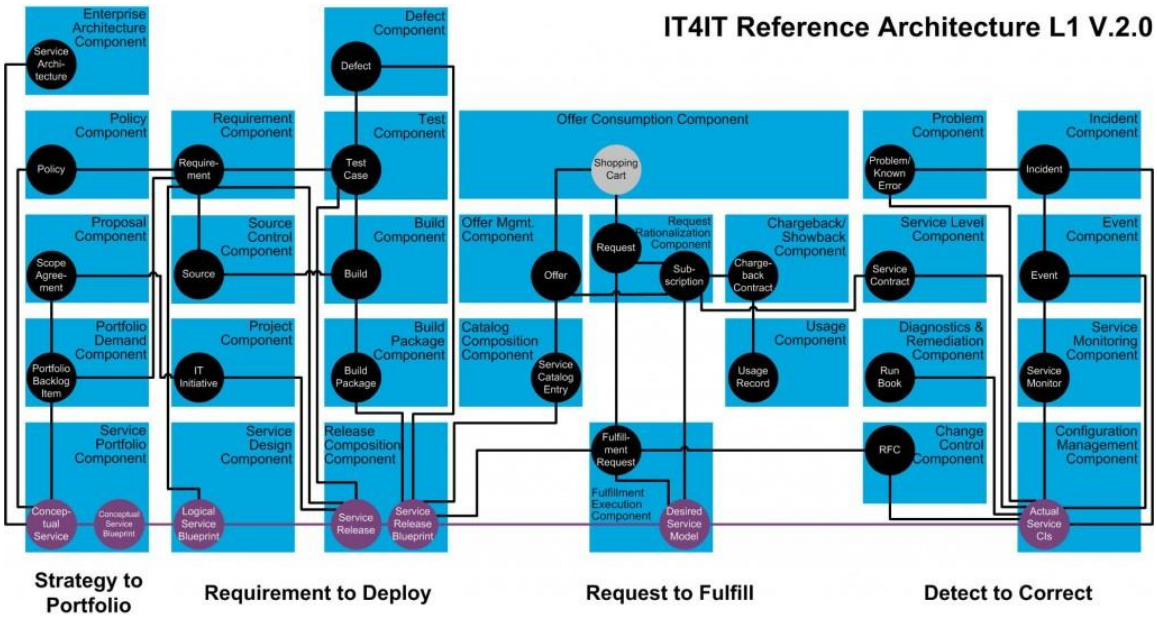

Figure 15 IT4IT RA level 1 framework version 2.0

The based IT Value Chain has four value streams (Strategy to Portfolio, Request to Fulfill, Requirement to Deploy, Detect to Correct) supported by a reference architecture to drive efficiency and agility. In each value stream, there are several functional components, showing as blue blocks, that support related functions.

Additionally, the framework also shows the required data objectives, represented as black and purple rounds.

Since the core concept of the IT4IT RA is to manage IT department as an individual enterprise, the IT services could be treated as the "product" of the "IT company". As aforementioned, there are four phases designed in the architecture model in order to achieve the "Strategy". Thus if the company runs with high reliance on IT, this model could also be referred to achieve the strategy of the company.

To enable financial tracking during the implementation, the IT4IT RA uses an information model to consistently manage all portfolios. Likewise, all the IT services are managed consistently across business units. Therefore, in each step, the cost and the business value could be recorded in its Portfolio Backlog. The following Figure 16 shows a process model of managing portfolios.

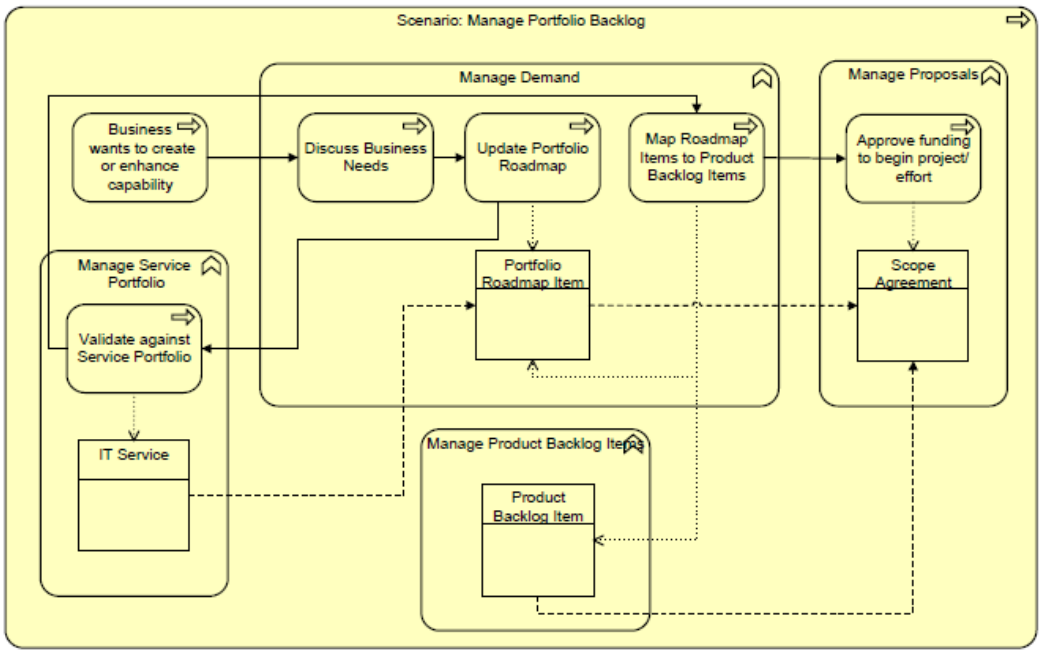

Figure 16 Process of project portfolio backlog management

From the models, we can see recording a business need in the portfolio backlog is required. The business identifies requirements during planning and records those efforts in the roadmap (portfolio backlog). Then IT links portfolio backlog items to one or more product backlog items. This allows traceability of product backlog items to the scope agreement when one or more portfolio backlog items are approved to work.

Therefore, one way to enable the financial tracking and the strategy alignment is to: 1. Standardize the implementation process of the projects; 2. cycling assess the project cost and updates the backlogs of ongoing project portfolios.

In this research, we found out that, IT4IT may help organization while implementing the projects. However, in this case, we focus on the strategy alignment of the projects and put emphases on assessing and adjusting the project. Therefore, there is little help from IT4IT that can bring to the new method after the literature review.

Since we suppose portfolio backlog is a good way to keep the key information of the projects. And mapping these backlogs to the related capability backlogs could trace and record the complete degree of strategy implementation. We would keep the form of the backlog as an approach to keep the project information. Following Table 6 shows a sample of a project portfolio backlog.

Table 6 Example of project portfolio backlog

Project Name		
Summary	This would represent the short description/ title/ summary of a given backlog item.	
Description	This would be the full description; ideally supports rich text.	
Backlog Priority	This priority is unique across all backlog items.	
Stakeholders	This would be used to link a portfolio backlog item to the stakeholders.	
Proposed Budget	This would be requirement, defect, or known error.	
Fiscal Year	This would indicate in which fiscal year the roadmap item (portfolio backlog item) is planned.	
Capability Goals	Capability name	Influence level
Backlog Status	The status shows the state of the backlog item. Status would be used by both the business and IT to determine whether it was an agreed roadmap item, proposed, in progress, etc.	
Financial Cost	Current/planned cost related to this backlog	

2.5 The relationship between PM and CBP

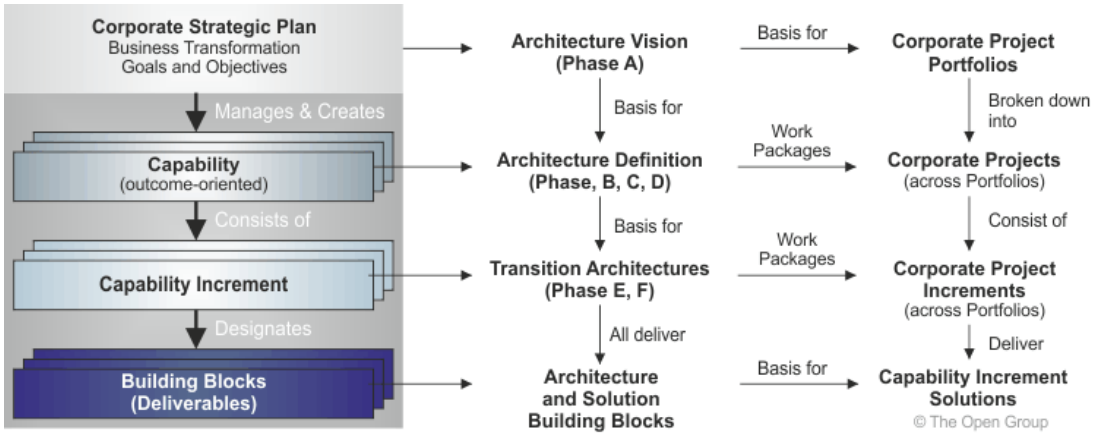

Figure 17 Relationship between capabilities, EA, and projects

The Figure 17 above from the Open Group shows the crucial relationships between Business Capabilities, Capability Increments, and the related work. We can see that

on the left side of the diagram, Capability Increments document the changes to Business Capabilities that are needed to implement the Strategies. Each Capability could be decomposed into one or more Capability Increments, representing a unit of change that could be implemented as a work package. And the work packages could be managed as project portfolios.

Therefore, the CBP methodology could support the strategy alignment of the project portfolios by transferring the strategies into required capability levels to achieve the improvements of assets like business processes and resources.

Chapter3: Portfolio Management Method

In this chapter, a new portfolio management method is proposed with a complete introduction. In section 3.1, an overview of the method is firstly documented. Then, all the details are exposed in the following sections.

3.1 Overview

The new proposed portfolio management method could support organizations to secure the strategy alignment of projects, especially when the strategy shifts. The method is proposed based on the research from Padovani & Carvalho (2016) and Cheng (2015). Padovani & Carvalho listed and validated the important activities in project portfolio management, which provides a complete overview of the project portfolio management. And the model designed by Cheng provided an operating process model to support strategy implementation by using CBP.

In the proposed method, the capabilities will bridge the gap between strategies and project portfolios. Figure 18 shows the conceptual model of the new methods.

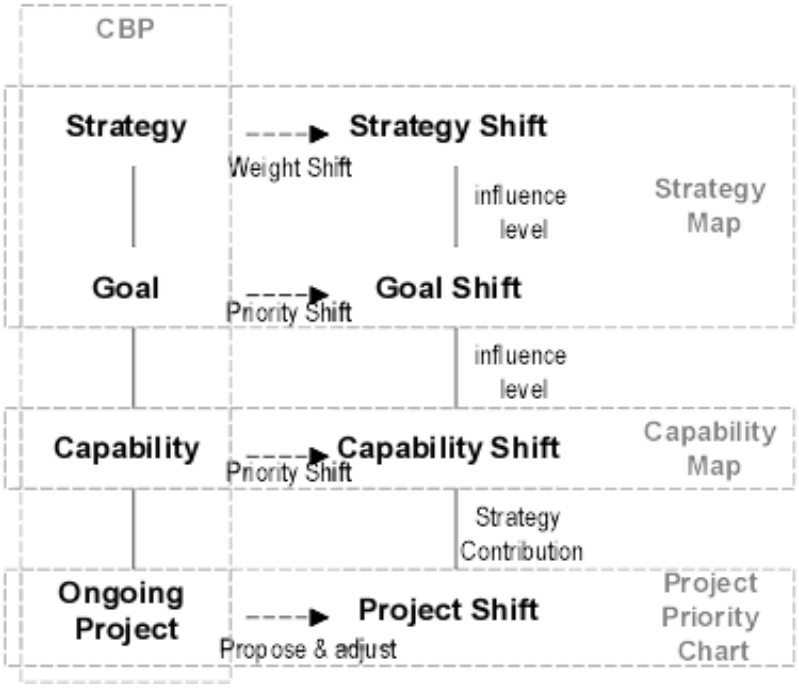

Figure 18 Conceptual model of the method

According to the CBP methodology, we could map the strategy to a set of capabilities. Therefore, the strategy priority of the capability could be measured. Then the strategy priority of the related projects could also be measured. While the strategy shifts occurred, a set of new strategic capabilities could be identified. By comparing with the previous strategic capabilities, we could find the strategy shift of the capabilities.

It could help stakeholders to re-weight the capabilities. Meanwhile, the related projects could be re-weighted or even adjusted. At last the strategy priority of the ongoing projects and the new proposed project could be identified, which supports the organization to select and arrange the project portfolios.

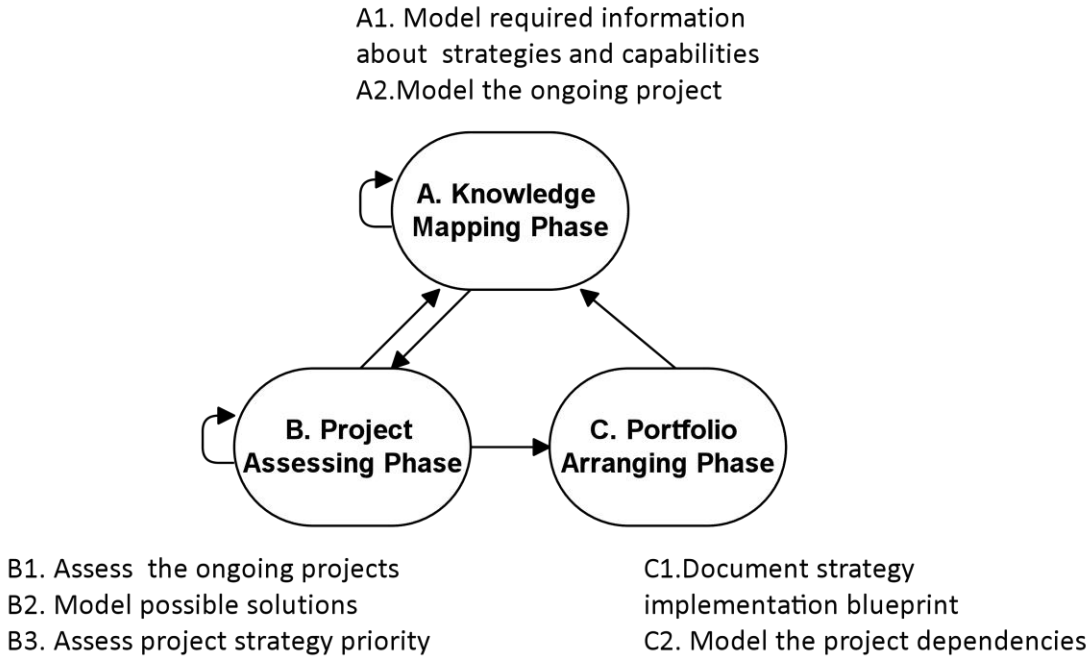

Figure 19 Capability-based project portfolio management

In order to achieve aforementioned idea, a new method is proposed based on the research from Padovani & Carvalho (2016) and Cheng (2015). As shown in Figure 19, there are three phases designed in the new proposed method:

1. *Knowledge Mapping Phase*

In Knowledge Mapping Phase, the related information about the current situation and the strategy could be collected and modeled. It could be self-iterated for correcting the capability map.

2. *Project Assessing Phase*

Based on the collected information, this phase is to assess the impacted ongoing projects and modeled possible solutions. What's more, the strategy priority of all the projects would be estimated to support the project selection. There could be iteration between B2 and B3 for modeling appropriate solutions. There could also be an iteration between Phase A and Phase B to adjust the identified strategic capabilities.

3. *Portfolio Arranging Phase*

The last phase Portfolio Managing Phase is to document how the strategy implemented and to provide a project map according to the project dependencies and the project strategy priority. Once there is a project implemented, the capability map should be updated.

In the following sections, for each phase, the related sub-processes are expanded to provide more detailed views and guidance. For each step, there also represent an operating process model which follows the standard of Business Process Modelling Notation (BPMN) 2.0. Besides, a brief of each phase provided in a table is at the beginning of subchapter. Additionally, we use the language ArchiMate 3.0 to model the deliverable examples. It is because ArchiMate has been used in the CBP methodology. This language contains a set of strategic concepts and the notations to present the Strategy, capability, and project concepts in this method. Then in chapter 3 and 4, we would like to use ArchiMate language 3.0 to demonstrate the proposed method in this research.

3.2 Phase A: Knowledge Mapping Phase

This section illustrates the knowledge mapping phase – the first of three phases in the process model. This phase aims to collect and model the necessary information about the organization. The knowledge should include strategies, capabilities, and ongoing projects.

The key information of the Knowledge Mapping Phase is shown in Table 7 below, including the goal of the phase, the required input from the stakeholders, the desired output, the adopted techniques and the reference literature.

Table 7 General view of knowledge mapping phase

Knowledge Mapping Phase		
Goal	Model required information about the organization to support further project portfolio management	
Input	Business capabilities, organization structures(optional), Strategy Ongoing projects and related projects documents	
Deliverables	1. Strategy map 2. Organization capability map 3. Ongoing project map	
Benefits	Provide senior manager an overview of the organization. Based on the strategy priority score of the capability. A decision-making activity could be arranged to select the key capabilities and assign the budgets to the capabilities	
Activities/Techniques	1. Model the capability map and the strategy	Business Capability Map; CBP; Strategy map
	2. Model Ongoing Projects	CBP; the IT4IT RA portfolio backlog
References	Ulrich & Rosen, 2011; Aldea, et al., 2015; Azevedo, et al., 2015; The Open Group, 2016; The Open Group, 2011; Padovani & Carvalho, 2016; Kudryavtsev, et al., 2014	

This phase is designed according to the "knowledge about the organizational context (KOC)" part of the construct model described in section 2.2.4. The information that could strongly affect the decision-making in the project portfolio management should be identified and collected.

Generally, there are two activities designed in this phase. They are illustrated separately in the following two subsections.

1. Model the capability map and the strategies. The first step is to model the capability map of the organization. Then identify the strategic capabilities and translate the strategies into the changing requirements of these capabilities.
2. Map the ongoing projects. The second step is to modeling the ongoing projects in order to support the further assessment.

To arrange the knowledge mapping phase, it is necessary to make the step of modelling organization capability map in front. Because by doing that, stakeholders could feel facilitated while identifying the strategic capabilities and modeling the ongoing projects by having capability map as a baseline.

3.2.1 A1. Model the capability map and the strategy

The first step of "Knowledge mapping" phase is to model the status of the organization with the capability map and to map the strategies and ongoing projects. The following table 8 provides essential information, including purpose, relevant staff, deliverable and the suggested guidance of this step.

Table 8 Overview of step A1

Phase A. Model the capability map and the strategy		
Step Goal	Build or update the capability map of the organization and map the strategy to the capability map	
Stakeholders	Enterprise Architect (may need support from departments)	
Deliverable	Current organization capability map	
Guidance	Build capability map	The Open Group - business capability management
	Map strategies	Cheng, 2015; Kudryavtsev et al., 2014

In order to build the capability map, the guideline from the Open Group named "business capability management" could be adopted. The process of capability map modelling is shown in the Figure 20.

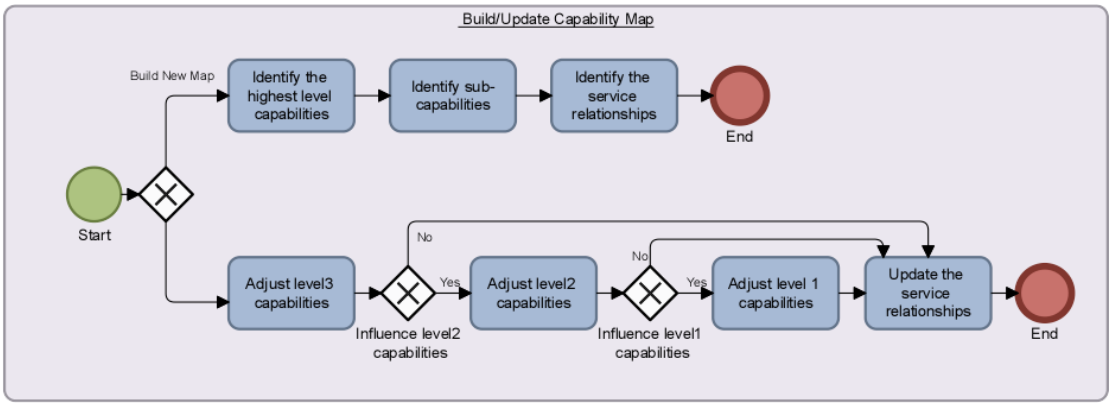

Figure 20 Process of Build/Update Capability Map

If the organization already has a capability map, the step could become updating the capability map. Here suggested using a bottom-up approach to support the updating. Because, by using the bottom up approach, users do not need to update the high- level capability if there is no change with its sub capabilities. The example of a capability map is shown in Figure 21.

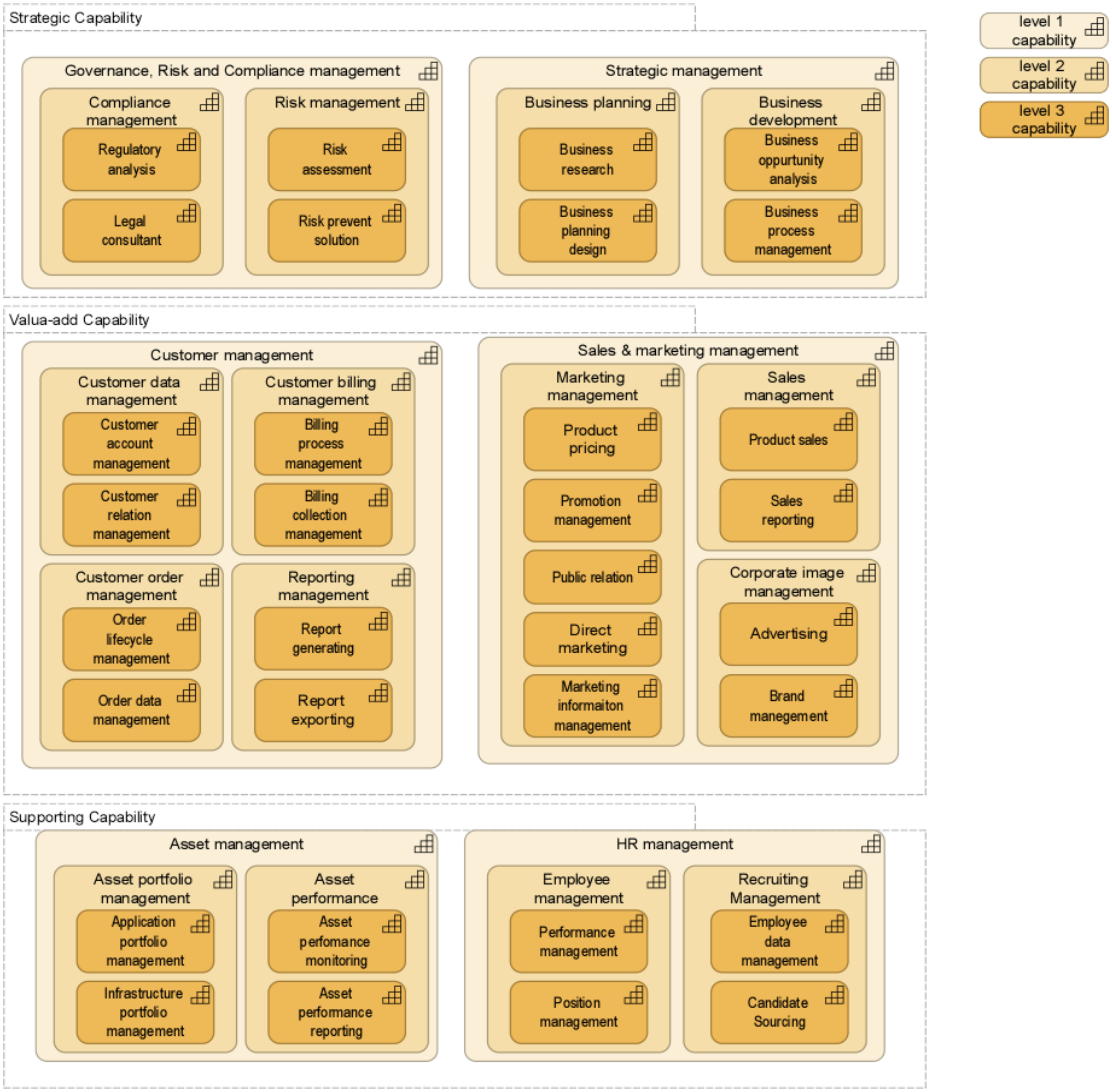

Figure 21 Example of capability map

The color of the "capability" element is same as the color of level 2 capability. And the reason to lighten the level 1 capability and deepen level 3 capability is to distinctly show the capabilities at different levels.

Then, we need the input from stakeholders to identify the serving relationships between capabilities by filling the matrix shown in Table 9.

Table 9 Example of capability serving relationship matrix

Serving ↓ From / → To			L1 Capability N			
			L2 Capability I		L2 Capability J	
			L3 Capability A	L3 Capability B	L3 Capability D	L3 Capability E
L1 Capability N	L2 I	L 3 capability A	-	X		
		L 3 capability B		-		X
	L2 J	L 3 capability D			-	
		L 3 capability E				-

As defined, serving relation represents that a capability provides its functionality to another capability. Therefore, the capability that provides functionality will affect the performance of the served capability. Stakeholders can mark the serving relationships based on the organizational business process. In considering the complexity of the matrix, it is possible to reduce capabilities has low concerns. And the identified result could support stakeholders to identify the strategic capabilities accurately.

Once the capability map is modeled, the strategies could be mapped to the capabilities. And the process of modeling the strategies is shown as Figure 22.

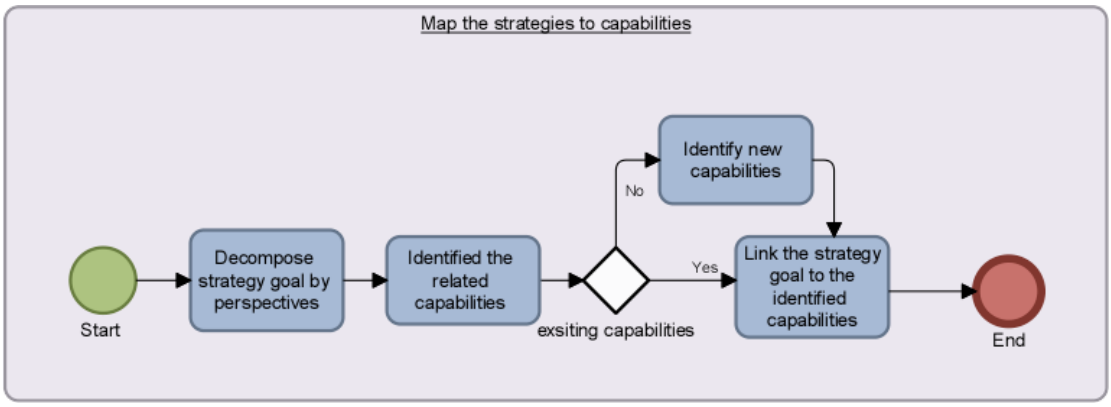

Figure 22 Process of mapping the strategies to capabilities

For more operating details, the report of Cheng (2015) is recommended. The step of "**Decompose strategy goal by perspectives**" could be optional if the organization has already made a strategy map. What's more, the capabilities should be selected from the level 3 capabilities. An example of strategy mapping is shown in Figure 23.

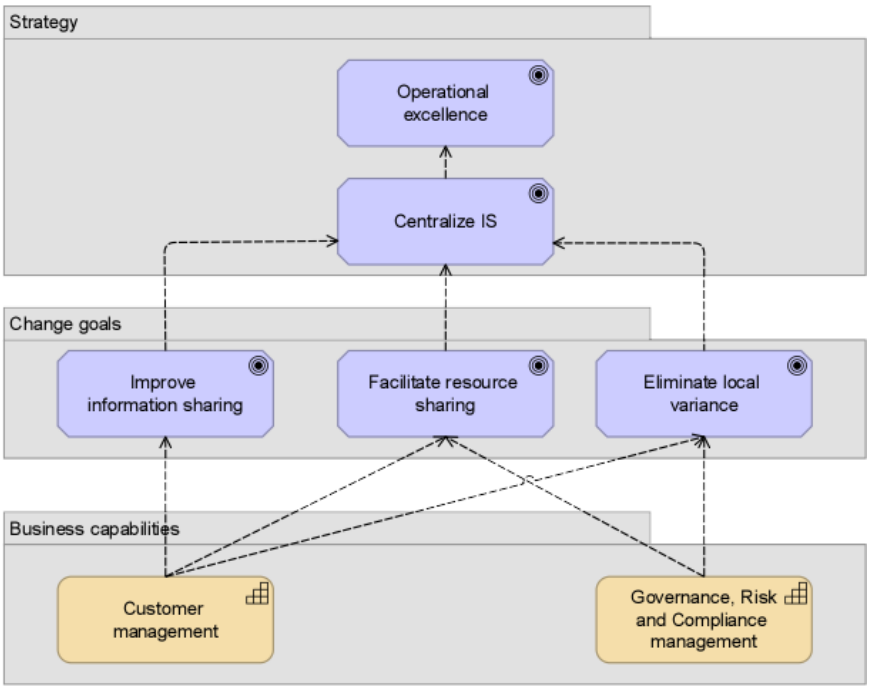

Figure 23 Example of strategy mapping

Assess the strategic capabilities

This step could be fully achieved by following the CBP methodology. The study of Cheng is recommended as the guideline of this step. The operating process could be concluded as Figure 24.

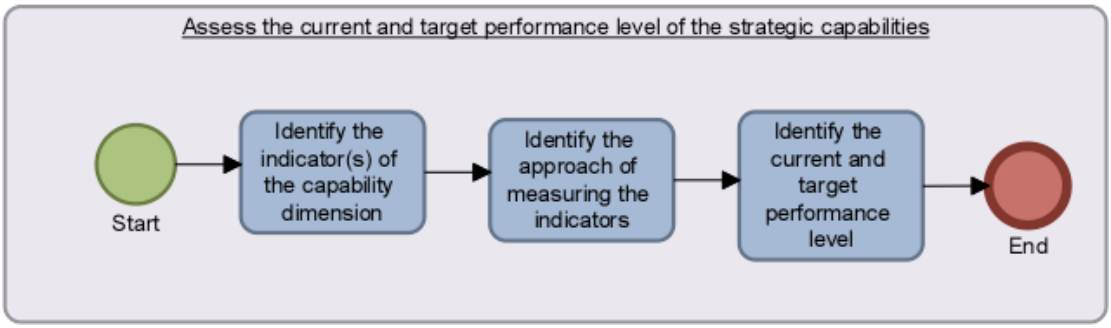

Figure 24 Process of identifying the current and target performance level of capabilities

As the Open Group defined that capability is affected by behavior elements and assigned by resources (Figure 11). The behavior elements have three types: process, function, and interaction (Figure 12). Then, by comparing the definitions, a *business interaction* is defined as "*a unit of behavior similar to a business process or function, but which is performed in a collaboration of two or more roles within the organization*". Thus, the interaction element could be identified as a special type of process or function. A *business function* is defined as "*a collection of business behavior based on a chosen set of criteria*". And since the capability is decomposed according to the business functions, one identified dimension is "process". And

according to the resources and external behavior element, the other dimensions are identified as “financial”, “physical”, “technology”, “human” and “external” (Figure 25).

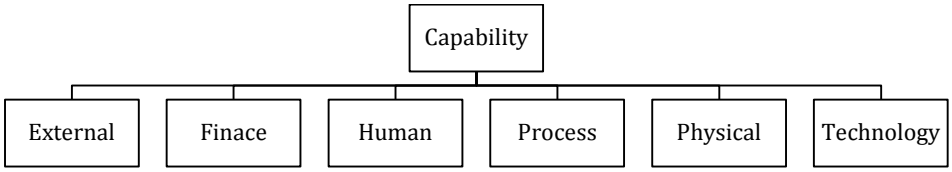

Figure 25 Capability dimensions

Stakeholders could identify the KPIs of each capability dimension. Nevertheless, if there are several KPIs identified, it is also necessary to set the weight of each KPI for amending the calculation.

There is a dimension that is different from the guideline. Cheng identified the organizational dimension that focuses on the communication between different units that could be treated as business interaction. As mentioned before, a *business interaction* could be represented as an indicator of process performance. And the dimension model modeled from Cheng ignored the dimension regarding the external elements. Therefore, the organizational dimension is replaced by “external dimension”. The performance level of the new dimension “external dimension” could be identified as:

Level 0: No capability. The capability could not identify the external (customer or environment) expectations or changes
Level 1: Initial. Get low sensitivity to the external changes, but has no idea about fulfilling the external requirements.
Level 2: Under Development. Could identify the external expectation and changed to adapt the new environment but not in time or cannot reach the target.
Level 3: Defined. Clear identify the external expectations or changes then planned and implement itself to fulfill the requirements.
Level 4: Managed. Could be optimized agilely to fulfill the requirements.
Level 5: Optimizing. Could be flexibly to the external changes and analyses and predict the changes that may occur.

Stakeholders could also identify the mature performance level of each capability dimension themselves. The outcome of this step could be presented as Table 10, which shows the capability performance level in dimensions.

Table 10 Example of performance level of strategic capability

Billing process management						
Indicator	Skill level	Time	Budget	Equipment performance	Use of application	Adaptability of changing
Capability dimension	human	process	finance	physical	technology	external
Indicator specification	The skill level of employee	The average time of the	The budget for the	How well to support the capability	How well to fulfill the requirement	How well to adapt the changes

		process	capability			
Current level	3	3	3	2	2	2
Target level	3	4	3	2	3	3

3.2.2 A2. Model the ongoing projects

The purpose of this step is to map the ongoing projects to the capability map. Then, the impacted ongoing projects could be identified once the related capabilities are selected as the strategic capabilities. The technique adopted in this step is CBP methodology. The basic information is concluded in Table 11.

Table 11 Overview of step A2

Phase A. Modelling ongoing project		
Step Goal	Map all the ongoing projects to the capability map	
Stakeholders	Enterprise Architect (may need support from project owner)	
Input	Related project documents	
Deliverable	Capability project matrix, project dependency matrix	
Techniques	Identify related capabilities	CBP
	Identify project dependencies	-

According to the motivation extension model (Figure 9) from Aldea, et al. (2015), working packages(projects) could realize or enhance a capability which could realize one or several specific strategies. The process of modeling ongoing projects is shown in Figure 26.

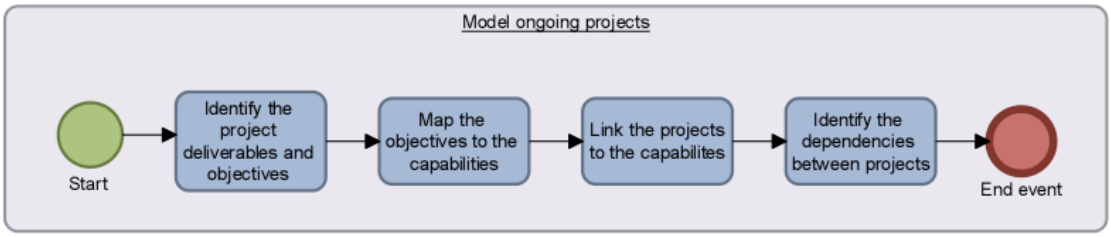

Figure 26 Process of modeling ongoing project

To map the ongoing projects to the specific capabilities, firstly, identify the planned deliverable and the project objective by reviewing the project documents. Then, identify the related capabilities according to the project objective. In this step, we recommend to map to the level 3 capabilities in order to support further assessment. At last, link the project with the identified capability. An example is shown as Figure 27.

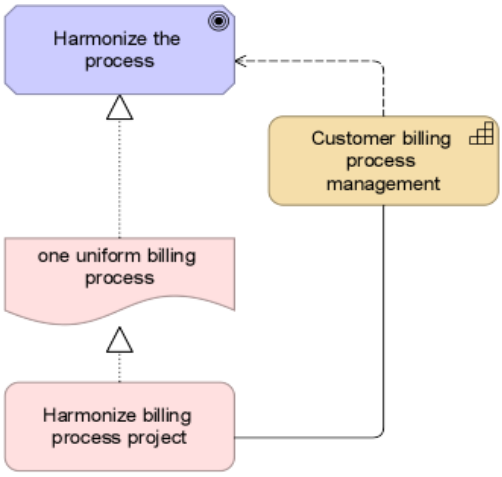

Figure 27 Example of modeling ongoing project

By reviewing the relevant project documents, the ongoing project "Harmonize billing process" will deliver a uniform billing process in order to harmonize the customer billing process since the organization has different ways of billing customers in different locations. Then, according to the objective that the organization wants to optimize the billing process, the capability "customer billing process management" is identified. At last, the capability is linked with the project. As the figure shows, the relationship between capability and project is modeled as "association relation". It is because the identified capability is the business capability instead of the capability increment. Therefore, the relationship should not be "implementation relation". According to the project scope, it is possible that the project may contribute to several capabilities.

The dependency relationship within projects, as described in the literature review, has two types. One is according to the resources limitation to run the projects. This dependency relationship may disappear if there are enough resources to support project running at the same time. Therefore, this kind of dependence will not be taken into account at the moment. Another dependency type is due to the information requirement from the output of the projects. This dependency will always exist if project A requires the output of project B. Table 12 shows the template of project dependency matrix which requires the input from the stakeholders.

Table 12 Example of project dependency matrix

Trigger ↓ From / → To		Info Receiving				
		Project A	Project B	Project C	Project D	Project E
Info Providing	Project A	-				
	Project B	X	-			
	Project C			-	X	
	Project D				-	
	Project E		X			-

While filling the project matrix, according to the mapping result from projects to capability map, the projects that linked to the same capabilities should be

recommended to the stakeholders. According to CBP, working packages are made to implement the capability increment. Therefore, the projects relating to same capability would have dependency relationship or even should run in parallel.

3.2.3 Recommendations

1. Stakeholders could use a sample capability map as the baseline to build the organization capability map since the organizations in the same industries may have similar structures.
2. Usually, in the capability map, the bottom tier is the "Supporting" tier that typically represents the essential elements of the business to function but is more behind-the-scenes playing a supporting role. Therefore, more service relationships could be identified from "Supporting" tier to the upper tiers.
3. Project card of each project could be generated to provide an overview of each ongoing project. The example of project card is shown in Table 13.

Table 13 Example of ongoing project card

Project Name			
Summary	This represents the short description/ title/ summary of a given backlog item.		
Description	This would be the full description; ideally supports rich text.		
Stakeholders	People who is taking the responsibilities		
Proposed Budget	The total budget required by this project		
Capability Goals	Capability name	Priority level	Influence level
Status	The status shows the state of the backlog item (proposed, agreed, in progress, etc. if the project is in progress, the percentage of completion should be recorded.		
Required implementation Resources	It is optional to fill. If it is filled. It will support building the roadmap		
Project dependencies	The projects which rely on the output of this project		
Financial Cost	Current cost related to this backlog		

4. In order to link the projects to capability more accurately, the stakeholders should identify the objectives or the strategies as much detailed as possible.
5. The linking result could also be adopted to check and adjust the business capability map. It may help the stakeholder to realize that some important capabilities are missed while building the capability map.

3.3 Phase B. Project Assessing

This section is to illustrate the second phase of the method. The project assessing phase is designed to assess the strategy alignment and strategy contribution of the ongoing projects and the new proposed projects. The following Table 14 is to show the general information of the project assessing phase.

Table 14 General view of project assessing phase

Project Assessing		
Goal	Align projects to the strategies	
Input	Proposed project	
Output	Capability implementation solution radar Strategy priority chart of the projects	
Benefits	The enterprise architect could propose the capability implementation solution according to the project contribution radar and the assigned budget. The project dependency map could help enterprise architect to quickly identify the related project while he wants to adjust or abandon the project. Could support senior manager to select the project to implement the strategic capabilities.	
Steps/Techniques	Step1. Assess the strategic capabilities	CBP
	Step2. Assess ongoing projects	-
	Step3. Model the possible solutions	-
	Step4. Identify project strategy priority level	-
References	Aldea, et al., 2015; Azevedo, et al., 2015; The Open Group, 2016; The Open Group, 2011	

In this phase, we assumed that all the ongoing projects could run and provide the deliverables as it is planned.

Generally, there are four activities designed in this phase and they are illustrated separately in the following subsections.

1. Assess the strategic capabilities. The first step is to identify the current level and the target level of the strategic capabilities.

2. Assess ongoing projects. The second step is to assess the ongoing project to see if they could fully realize the target level of the capability.

3. Model the possible solutions. Then, according to the assessed result from previous steps, enterprise architect could propose and model possible solutions.

4. Identify project strategy priority. At last, the strategy priority of the ongoing project and proposed new project could be identified to support manager's decision making.

3.3.1 B1. Assess the ongoing projects

The second step of "Project Assessing" phase is to assess the ongoing projects to see if they align with the strategies. The following Table 15 provides essential information for this step.

Table 15 Overview of step B1

Phase B. Assess the ongoing projects	
Step Goal	Assess the planned deliverables of the ongoing projects to see if they align to the strategy.
Stakeholders	Enterprise Architect, project manager
Input	Related project documents
Deliverable	Capability-project radar chart

The main idea of this step is to translate the project deliverables to the enhancement of capability dimensions. Then the project deliverables could be modeled into capability performance radar to check if the project aligns with the strategy. The operating process could be concluded as:

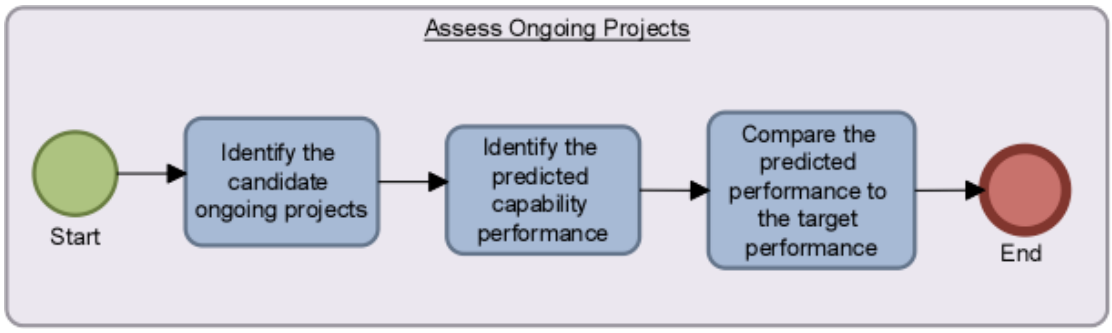

Figure 28 Process to assess ongoing projects

For one strategic capability, the candidate ongoing projects are identified according to two parts:

1. All the ongoing projects that linked to this strategic capability.
2. According to serving relationship, the projects linking to the capability which will serve to this strategic capability are also selected.

Then, stakeholders could analyze the deliverables of each candidate project. Analyze how the related capability could be enhanced by these deliverables and identify if the deliverables could improve the performance level of the capability dimension.

Table 16 Example of anticipated performance level

Billing process management						
Indicator	Skill level	time	Budget	Equipment performance	Use of application	Adaptability of changing
Capability dimension	human	process	finance	physical	Technology	external
Indicator specification	the skill level of employee	The average time of the process	The budget for the capability	How well to support the capability	How well to fulfill the requirement	How well to adapt the changes
Current level	3	2	2	2	3	3
Project A	3	4	2	2	3	4
Project B	3	4	2	4	3	3
Consolidation level	3	5	2	4	3	4
Target level	3	5	2	4	4	4

As shown in Table 16, there are two projects that will contribute to the capability "billing process management". Firstly, the stakeholders should separately identify the capability dimension performance level when each project delivered. Then, the stakeholders should consolidate these anticipations in order to get the final capability performance level while all the related ongoing project delivered.

For one capability dimension, if there is only one project contributing to this dimension, then the consolidation result could be as same as this project. However, if multiple projects are working on one dimension, the consolidation should be identified by anticipating the performance level while all the projects delivered.

Model the radar chart

Once stakeholder identified the current level and the project delivering level, a complete radar chart could be drawn automatically to provide a view of related ongoing project strategy alignment. For example, as shown in Figure 29, the current performance level is marked in yellow. The target performance level (capability increment performance) is plotted out with a red round-dot outline. And the performance level according to the project's contribution, could be modeled in blue.

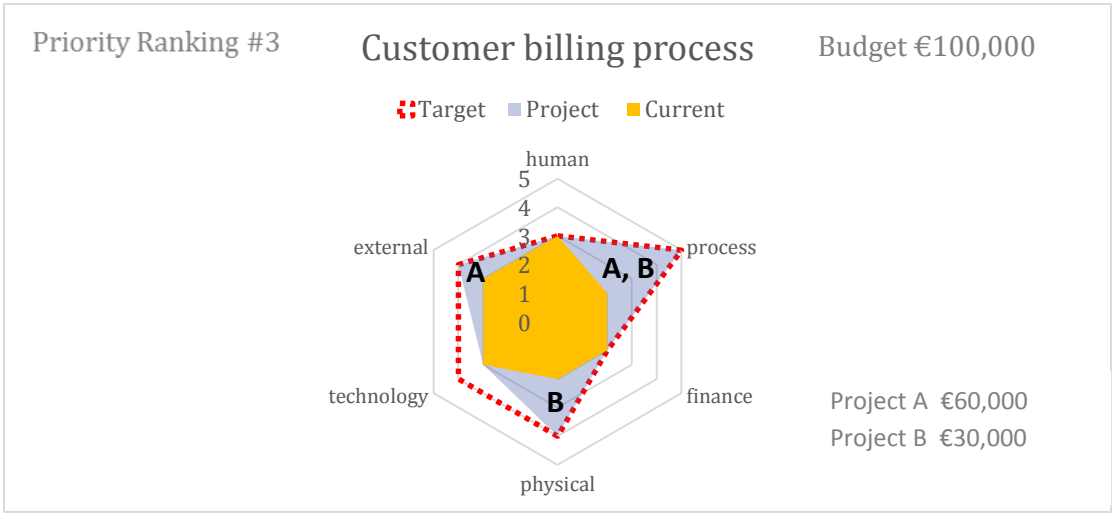

Figure 29 Example of customer billing process related projects

Since the project delivering performance level shows the consolidation result of all related projects. The project name could be marked to show where the contribution comes from. What's more, stakeholders may have a more comprehensive view by listing out some key attributes they concerned, like project cost, capability priority level, and planned budget.

In the radar chart, the area between the target performance level and the project delivering performance level represents the gap that needs to be noticed. The enterprise architect could narrow or close the gap by adjusting the related projects or proposing new projects.

3.3.2 B2. Model possible solutions

If there is no gap, it means the running projects could bring desired change to the capability dimensions. Then the project could continue running as planned. Otherwise, organizations should provide solutions to achieve the capability increment.

Table 17 Overview of step B2

Phase B. Model possible solutions	
Step Goal	Assess the planned deliverables of the ongoing projects to see if they align to the strategy.
Stakeholders	Enterprise Architect, project manager
Input	-
Deliverable	Proposed solutions in radar chart

As shown in Table 17 Overview of step B2 step B2 is designed with the purpose of proposing possible solutions. Generally, enterprise architect could propose new projects, adjust ongoing projects or abandon ongoing projects.

Propose New Project

Enterprise should choose to propose new projects for the strategic capabilities that are without related ongoing projects. The suggestions for this condition to follow the suggestion from Cheng's paper (Cheng, 2015), in the Step "Creating the capability development projects".

Since the projects are proposed to implement the changing requirements of the capabilities, the deliverable of these proposed projects could be modelled in the capability performance radar.

Enterprise could model the solutions from a capability perspective. Figure 30 shows an example of new proposed projects. The capability should be optimized from "process" and "technology" dimensions to close the gap between the current performance and the target performance. Then, the enterprise architect proposes two projects: project "revision of billing process" and project "rationalization of application". The two projects are marked with different patterns.

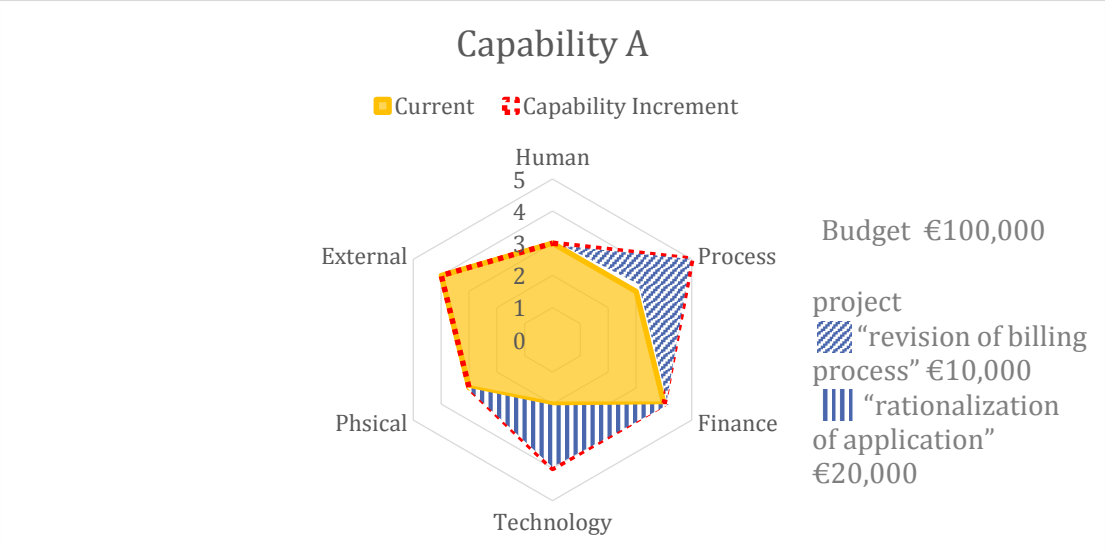

Figure 30 Example of modeling proposed projects a

Figure 31 is another example of modeling the proposed projects. In the figure, the capability has two ongoing projects. Then enterprise proposed another one to optimize the "External" and "Finance" dimension.

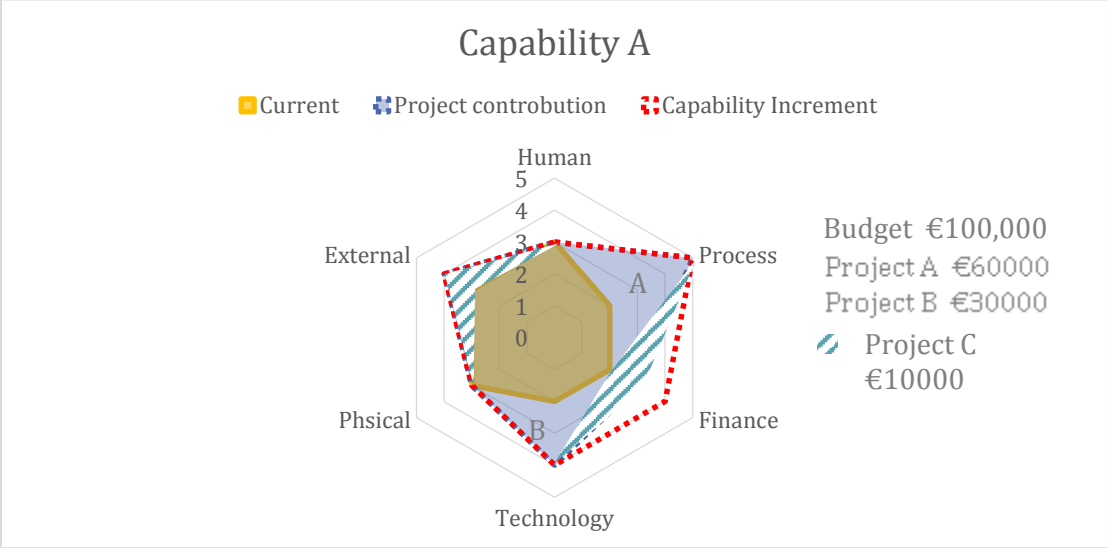

Figure 31 Example of modeling proposed projects b

Abandon Ongoing Project

The step is taken under certain circumstance when the ongoing projects will make a negative contribution to the latest strategy implementation. Although these situations are not common, they technically exist. For example, the stakeholders of a manufacturing think the related payment process are not the key business and want to make outsourcing of their payment process from a supplier company and put more emphases on their key business like product innovation. Therefore, with this strategy shift, the performance level of capabilities that relate to "payment process" may decrease. Since the organizations don't need the skilled employee, related technologies or equipment. In this case, it is possible to stop the ongoing project that related to this capability.

Adjust Ongoing Project

It may happen that the project deliverable strengthens a capability dimension. However, according to the performance assessment result, the strengthened capability dimension may still not reach the target level. In this case, the solution could be to adjust the related project. For example, the deliverable from the projects may enhance the capability from the process dimension. However, the organization recognized that the "process" should be improved as the most important topics. And in the latest strategy, the target performance level of process dimension is improved. Then one solution is to propose a new project, and another solution is to adjust the project to improve the deliverable quality.

Project Dependencies

While adjusting or abandoning ongoing projects, it is important to notice if other capabilities or projects would be affected by this projects. To support the decision making, the method provides a list to show the affected projects and capabilities of the project. The example of the project dependency card is shown in Table 18. The row "related capability" shows the capabilities this project could affect and the degree of project influencing other projects.

Table 18 Example of project dependency card

Project Name				
Summary	This represents the short description/ title/ summary of a given backlog item			Filled according to the project document
Stakeholders	People who is taking the responsibilities			
Completion	The percentage of the project completion			
Related Capability	Capability Name	Influence Level	Serving Capability	Sub capability project matrix & capability serving relationship matrix
Supporting projects	Project name	Project Owner	Required output	Project dependency matrix

As mentioned, the complete radar chart could facilitate stakeholders to identify the changing requirements of the strategic capabilities. Therefore, stakeholders could generate some proper solutions like proposing new projects or adjusting ongoing projects. While new projects proposed, the capability-project matrix and the project dependency matrix should be updated. Then, all the candidate projects could be modeled into radar chart.

3.3.3 B3. Assess project strategy priority

The last step of phase B is to assess the strategy priority of the proposed projects and the ongoing projects. The following Table 19 provides essential information of this step.

Table 19 Overview of step B3

Phase B. Assess project strategy priority		
Step Goal	Build or update the capability map of the organization and map the strategy to the capability map	
Stakeholders	Enterprise Architect (may need support from departments)	
Deliverable	Current organization capability map	
Guidance	Calculate capability strategy priority	Kudryavtsev et al., 2014
	Calculate project strategy priority	-

The using approach to calculate the strategy priority of the capabilities is called Goal-cascading matrices, referring to the literature by Kudryavtsev et al. and there are two matrices picked:

"Strategy – Subgoal" matrix.

The first matrix is to evaluate the priority value of the sub-goals. As shown in Table 18, all the strategies and the sub-strategy goals are listed out. The stakeholders should assign one score to all the strategies in the "Strategy Priority" column according to the concerns. Then for each sub-strategy goal, the influence power of subgoal could be identified by stakeholders. According to the approach, there are three levels of influence power. The highest level is named as "Strong" with the weight of 9 points. The second level is called "Medium", with the weight of 3 points. And the lowest level is named as "Weak", with 1 point. In the literature, Kudryavtsev et al. didn't illustrate the principle to identify the weight. However, from opinion, it is better to identify the weight of "Strong" level much higher, because it is much more effective to achieve the strategy by achieving its subgoal with a strong influence on it.

Table 20 Example of Strategy-Subgoal matrix

Strategy Goal	Goal Priority	Subgoal 1	Subgoal 2	Ongoing project objective 3
Goal 1	0.7	Strong (9)	Medium (3)	
Goal 2	0.3		Weak (1)	Strong (9)
Subgoal Priority		6.3	2.4	2.7
Related Priority		55%	21%	24%

After filling the table, the priority value of the subgoal could be calculated automatically by the equation:

$$SP_n = \sum_{k=1}^{m} GP_k \times I_{k,n}$$

which has these variables:
SP stands for the Subgoal Priority value;
n means the nth subgoal;
m means there are m strategy goals in total;
GP stands for the Goal Priority value;
And ***I*** stands for the Influence Power score.
Therefore, the priority value of subgoal 1 should be: $SP_1 = 0.7 * 9 + 0.3 * 0 = 6.3$

In the Related Priority row, the total 1 point is assigned to the subgoals according to the Subgoal Priority value. The calculation follows the equation:

$$RP_n = \frac{SP_n}{\sum_{k=1}^{m} SP_k}$$

which involves these variables:
RP stands for the Related Priority value;
n means the nth subgoal;
SP stands for the Subgoal Priority value;
m means there are m subgoals in total.

Therefore, the Related Priority value of subgoal 1 should be: $RP_1 = \frac{6.3}{6.3+2.4+2.7} \approx 55\%$

"Goal – Capability" matrix.

It helps to evaluate the priority value of the Capability. Table 21 shows the example of the Goal- Capability Matrix. The values in the column "Goal Priority" are from the calculation results in Table 20. Then for each level 3 capability, stakeholders could identify the influence power.

Table 21 Example of Goal-Capability matrix

Sub strategy Goal	Subgoal Priority	Capability 1	Capability 2	Capability 3
Subgoal 1	0.65	Strong (9)	Weak (1)	
Subgoal 2	0.07		Medium (3)	Strong (9)
Subgoal 3	0.28	Medium (3)		Strong (9)
Capability Priority		6.69	0.86	3.15

While linking the level 3 capability to the subgoals, it may happen that there is the only capability identified has a weak or medium influence to the subgoal. As shown in Table 22, this means the organization misses a capability to implement this subgoal. Then, the stakeholder should define a new capability and add this new capability as one of the strategic capabilities that need to be implemented. The default influence level of the new capability is "Strong".

Table 22 Example of identifying capability priority

Sub strategy Goal	Subgoal Priority	Capability 1	Capability 2	Capability 3	Identified New capability
Subgoal 1	0.65	Strong (9)	Weak (1)		
Subgoal 2	0.07		Medium (3)	Strong (9)	
Subgoal 3	0.28	Medium (3)		Strong (9)	
Subgoal 4	0.28				Strong (9)
Capability Priority		6.69	0.86	3.15	2.52

After filling the table, the priority value of the capability could be calculated automatically by the equation:

$$CP_n = \sum_{k=1}^{m} SP_k * I_{k,n}$$

with the following variables:
CP stands for the Capability Priority value;
n means the n^{th} capability;
m means there are m subgoals in total;
SP stands for the Subgoal Priority value;
And ***I*** stands for the Influence Power score.

Therefore, the priority value of Capability 1 should be:

$$CP_1 = 0.65 * 9 + 0.07 * 0 + 0.28 * 3 = 6.69$$

During the linking step, one thing should be paid attention. The relationship between strategy goals and capabilities is "many to many", which means one goal might be affected by changing several capabilities. Vice versa, one capability could be changed to affect several goals.

Different organizations may have different concerns of the projects, which means organizations may set multiple criteria while ranking the projects. In this method, the emphases are on the strategy alignment and a clear strategy related score would be calculated and provided. The strategy priority score would also be one criterion if organizations set multiple criteria to identify the project priority. Then, the last step of the phase should be set to identify the strategic priority of the projects. Stakeholders could keep updating the capability project matrix table and project dependency matrix table while they are proposing new projects or adjusting the ongoing projects. Then the priority could be calculated automatically according to the information from the capability project matrix table.

First, it is important to identify the contribution of the project to a capability. It is calculated according to the capability increment, capability current performance level, and the increasing level that the project can provide. Here we assume that all 6 dimensions in the capability have equal weight. This means, improving "process" dimension from level 2 to level 3 will bring the same value as improving "Technology" dimension from level 1 to level 2. Then the contribution from a project to a capability could be calculated as how much percentage the project will implement the strategic goal.

Table 23 Example of project contribution

Project 1-Capability 1						
Dimension	process	human	technology	physical	external	financial
Target performance level	4	3	4	4	4	4
Project provide performance	4	2	4	4	3	4
Current performance level	2	2	3	4	3	4
Strategy performance Gap (Target-Current)	2	1	1	0	1	0
Contribution (Project-Current)	2	0	1	0	0	0
Total Contribution	(2*1+0*1+1*1+0*1+0*1+0*1) = 3					
Total Gap	(2*1+1*1+1*1+0*1+1*1) = 5					
Contribution percentage	60%					

For example, in Table 23, we can see that the gap between the current capability and the capability increment could be concluded as improving 2 performance level in process dimension, 1 level in "human" dimension, 1 level in "technology" dimension and 1 level in "external" dimension. And the project will achieve the changing requirements of process dimension and technology dimension, which means this project could produce 60% of the all requirements. Then, the contribution percentage of the project to a capability will be adopted in for the strategic priority calculation.

The following Table 24 is built to calculate the project strategic priority. And this table could be filled by combine the tables of capability project matrix, strategy capability matrix, and the capability dimension performance table mentioned before. The cells in the table show the percentage of the contribution to the capability from the project.

Table 24 Example of identifying project priority

Sub capability	Capability Priority	project 1	project 2	…
Sub capability 1	0.69	60%		…
Sub capability 2	0.18	10%	57%	…
Subgoal Priority		0.432	0.10	…

Then, the equation is identified as:

$$PP_n = \sum_{k=1}^{m} CP_k * P_{k,n}$$

- which has these variables:
- ***PP*** stands for the Project Priority value;
- ***n*** means the n^{th} project;
- ***m*** means there are m sub capabilities in total;
- ***SP*** stands for the Sub capability Priority value;
- And ***P*** stands for the contribution percentage of the project to the capability.

After calculation, there could be a projects list with its strategy priority score. And with the budget proposed by the enterprise architect, we could build a chart to shown the project priority. Like the template shown in Figure 32, Y-axis shows the strategy priority score of the project and X-axis shows the required budget of the project. Then stakeholders could add more criteria like risk level to support the project selection, if they want. The extra criteria could be marked as different colors or sizes of the project bubbles.

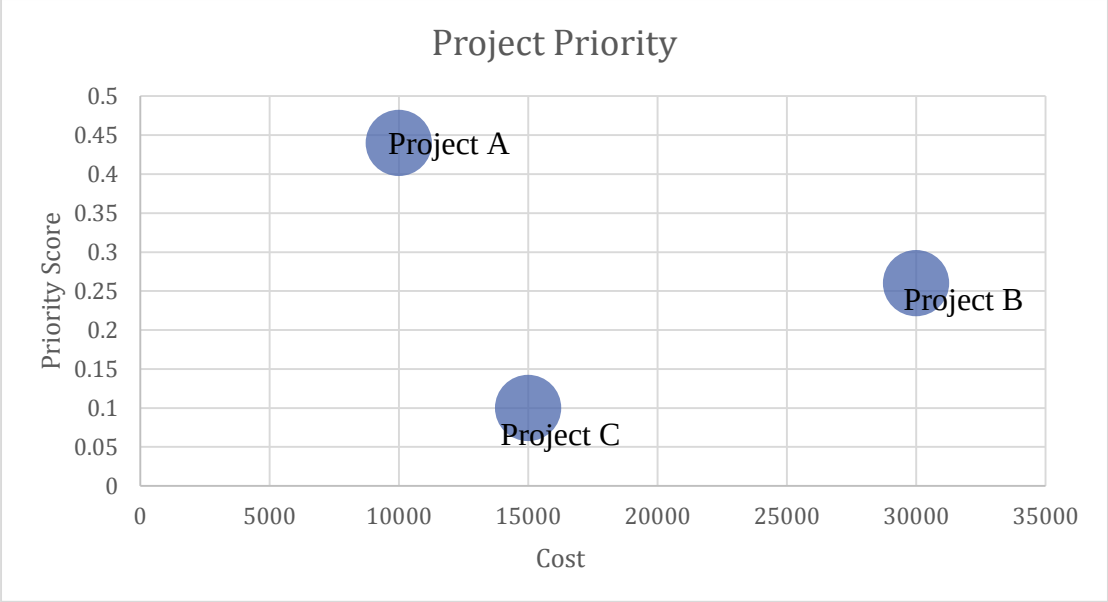

Figure 32 Example of project strategy priority

3.3.4 Recommendations

1. While identifying the target performance level of the capabilities, it may happen that a strategy may not refer to some dimensions of the capability. Then, these dimensions could be identified as same as their current performance level.
2. It is recommended to firstly assess the strategic capabilities served by other capabilities. Then it will help to identify the target performance level of the capability which provides the service.
3. The project card could be built for representing important details of the proposed projects to support the manager to make the decision. The card is similar to the ongoing project card which shown in Table 13.
4. From a project perspective, the capabilities that are contributed by one project could be modeled together to show the deliverables of the project.

Project A Budget					
Capability A	Priority 1	Budget 5000	**Capability B**	Priority 2	Budget 10000

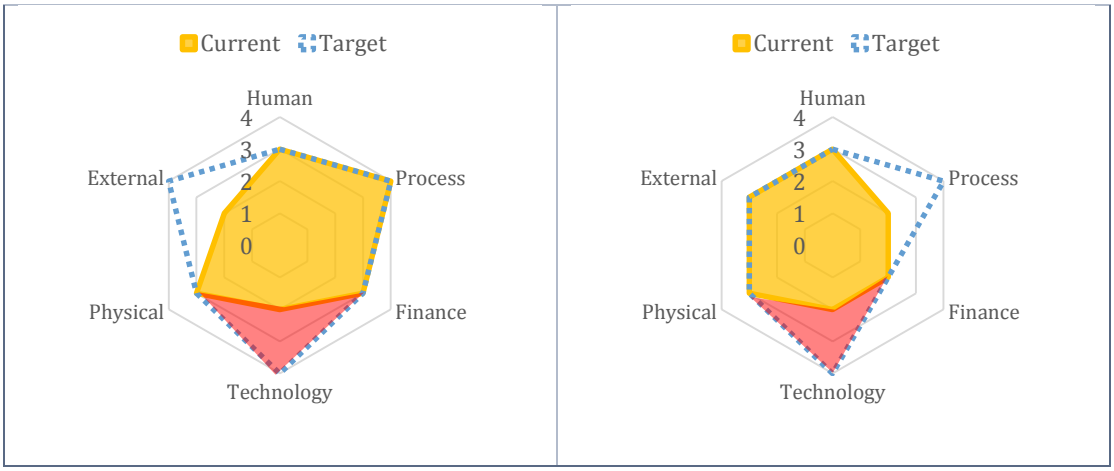

Figure 33 Example of radar chart from a project perspective

For example, in Figure 33, the project A could contribute to both capabilities A and capability B. Modeling the two capabilities together could clearly show how the project contributes.

3.4 Phase C. Portfolio Arranging

Once the proposed projects have been selected and approved. The Blueprint could be clearly identified. In the last phase, the main goal is to generate the blueprint card and propose the road map of the projects implementation.

Table 25 General view of portfolio arranging phase

Portfolio Arranging		
Goal	Document the strategy implementing plan and propose the draft project priority map	
Input	Selected project	
Output	Strategy implementation blueprint Project map	
	The enterprise architect could propose the strategy implementation solution according to the project contribution radar and the assigned budget. The project dependency map could help enterprise architect to build the roadmap.	
Steps/Techniques	Step1. Build strategy implementation blueprint	CBP
	Step2. Model the project dependencies	-
References	Aldea, et al., 2015;	

3.4.1 C1. Build strategy implementation blueprint

Table 26 Overview of step C1

Phase C. Build strategy implementation blueprint	
Step Goal	Model the blueprint of the strategy/ capability implementation
Stakeholders	Enterprise Architect, project manager
Input	Chosen projects
Deliverable	Strategy implementation blueprint

The blueprint is to provide an overview of the strategy implementation. In this step, we model the blueprint based on the motivation extension mode (Figure 9) from CBP.

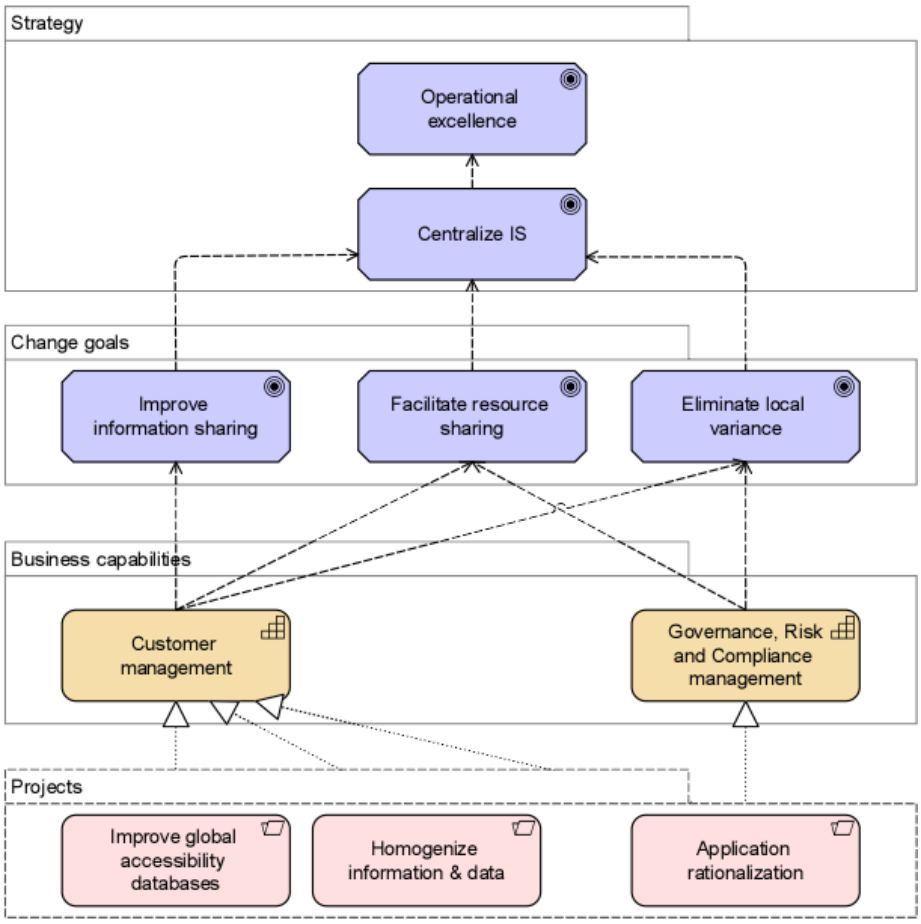

Figure 34 Example of strategy implementation blueprint

As we can see in Figure 34, the blueprint should include at least three parts, the strategies, the identified strategic capabilities, and the projects which could contribute to these capabilities.

3.4.2 C2. Model the project dependencies

This section illustrates the last step in this new method, building the dependency map of all the projects.

Table 27 Overview of step C2

Phase C. Model the project dependencies	
Step Goal	To provide an overview of the project dependencies
Stakeholders	Enterprise Architect, project manager
Input	
Deliverable	Project dependencies map

The dependency relationship, as described in the literature review, has two types. One is according to the limited resources to run the projects. This dependency relationship will exist if projects using common resources. Another dependency type is due to the requirement of the output from another project. This dependency will always exist. And it could be identified according to the project dependencies that filled by

stakeholders. The last step is to build a draft of the roadmap for the stakeholders. An example is shown in Figure 35.

The example roadmap includes all the approved projects and the strategic capability which these projects contribute to. What's more, the project dependencies could be marked out with the triggering relationship and the resource limitations are represented by grouping the projects that require same resources.

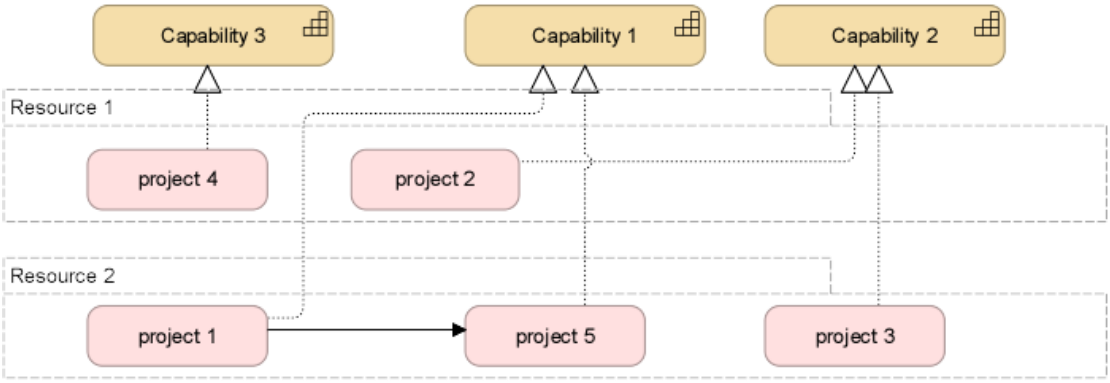

Figure 35 Example of the projects dependencies

3.4.3 Recommendations

Apart from the blueprint, it is also possible to provide a clear overview of strategies implementation in a table. And it will support the further assessment if there is new strategy shift occurred during the strategy implementation.

Table 28 Example of blueprint card

Strategy Name			
Capability Name		Influence level	
Current / Blueprint capability	Current and blueprint radar chart		
budget	The total budget of capability development		
projects	name	Stakeholders	Contribution
	Project name	Project owner	Deliverable radar chart

Table 28 shows the template of the blueprint card, involving the essential information about how the strategy is implemented. It could also be modeled as a strategy implementation architecture.

Chapter4: Case Study

In this chapter, a case study is arranged to practice the proposed method with the purpose of demonstration. The case named "ArchiPharma" is a real case of a pharmaceutical manufacturer. "ArchiPharma" is a pseudonym of the organization because of the confidential issue. The ArchiPharma case is from BiZZdesign, used as a sample of enterprise architecture modeling and portfolio management in the BiZZdesign Enterprise Studio.

In the case study, the method is applied to close the gap between the projects and the latest strategies by identifying the related capabilities, mapping the strategies and projects and proposing appropriate solutions. With the help of method, ArchiPharma could have a better performance of their portfolio management by having a more precise insight into the projects.

Due to the data limitation, we make some assumptions while implementing the case study. But in a real case, all the required information should be determined from related stakeholders or documents.

4.1 Introduction

4.1.1 Strategy Shift

As a large international pharmaceutical manufacturer, ArchiPharma consists of many mergers and take-overs that turn out to have multiple geographically spread locations including New York, London, and Amsterdam. The end mission of the organization is to become a global leading service provider in the pharmaceutical industry. And they identified this ambitious mission as the result of providing the most innovative pharmaceutical services with a quick and reliable solution.

Then, they made a complete focus on operational excellence as shown in Figure 36. And now in the latest meeting, they switched it by putting a focus on product leadership. And the operational excellence could be continuing in the background if the budget is enough, which means, the goal of having excellent operations has much less priority than before. The Figure 37 below shows the new version of the mission, the vision, and strategy of ArchiPharma.

Figure 36 Previous Mission, vision, strategy of ArchiPharma

Figure 37 New strategy of ArchiPharma

4.1.2 Ongoing Projects

Last few years, in order to achieve "Operational excellence", ArchiPharma currently has two plateaus involving four ongoing programs and they are shown in Figure 38.

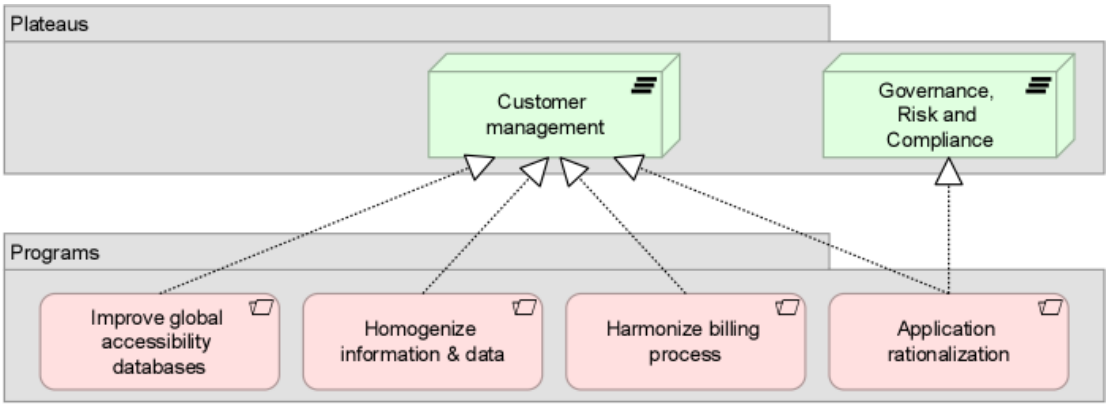

Figure 38 Realization relationship between plateaus and programs in ArchiPharma

According to the figure, all four programs contribute to improving "customer management" and the program Application rationalization could also improve "Governance, Risk, and Compliance." And then, within each program, there is a series of ongoing working packages, which are treated as projects:

Improve global accessibility database

- Analyze data sources
- Develop database authentication protocols
- Develop integrated reporting
- Install database authentication
- Install federated database management system (FDMS)
- Prepare and adapt database
- Publish database information

Harmonize billing process

- Analyze billing process variance
- Choose, develop, test and run global, test and run global finance
- Harmonize process variants
- Phase out Amsterdam billing applications
- Phase out London billing applications
- Phase out New York billing applications

Application Rationalization

- Define Valuation Model
- Develop application rationalization roadmap
- Identify obsolete applications
- Inventory application
- Migrate and eliminate identified applications
- Valuate application

Homogenize information & data

- Design data architecture
- Analyze heterogeneous data sources
- Data mapping
- Data cleaning
- Consistent data model development
- Analyze heterogeneous information sources
- Information harmonization
- Information mapping
- Information cleaning

4.2 Phase A: Knowledge Mapping

In the first phase, strategy mapping phase, we need to transfer the strategy into capability changing requirements. Therefore, we should start with building the current capability resources map.

4.2.1 Modelling capability map and strategies

Before mapping the latest strategy, the first step is to model the current capability resources map of ArchiPharma. As described in chapter 3. The capability map could act as a bridge to help organizations managing projects and strategies.

According to the organization structure of the enterprise, the high-level capabilities map could be identified. Since within the same industries, the organization structures are similar. To model efficiently, Archipharma could build the capability map based on samples. As shown in the Figure 39 below, it is the level 3 capability map of the ArchiPharma. For the capability which organization has less focus than others. We suggest to model it until level2 to decrease the complexity.

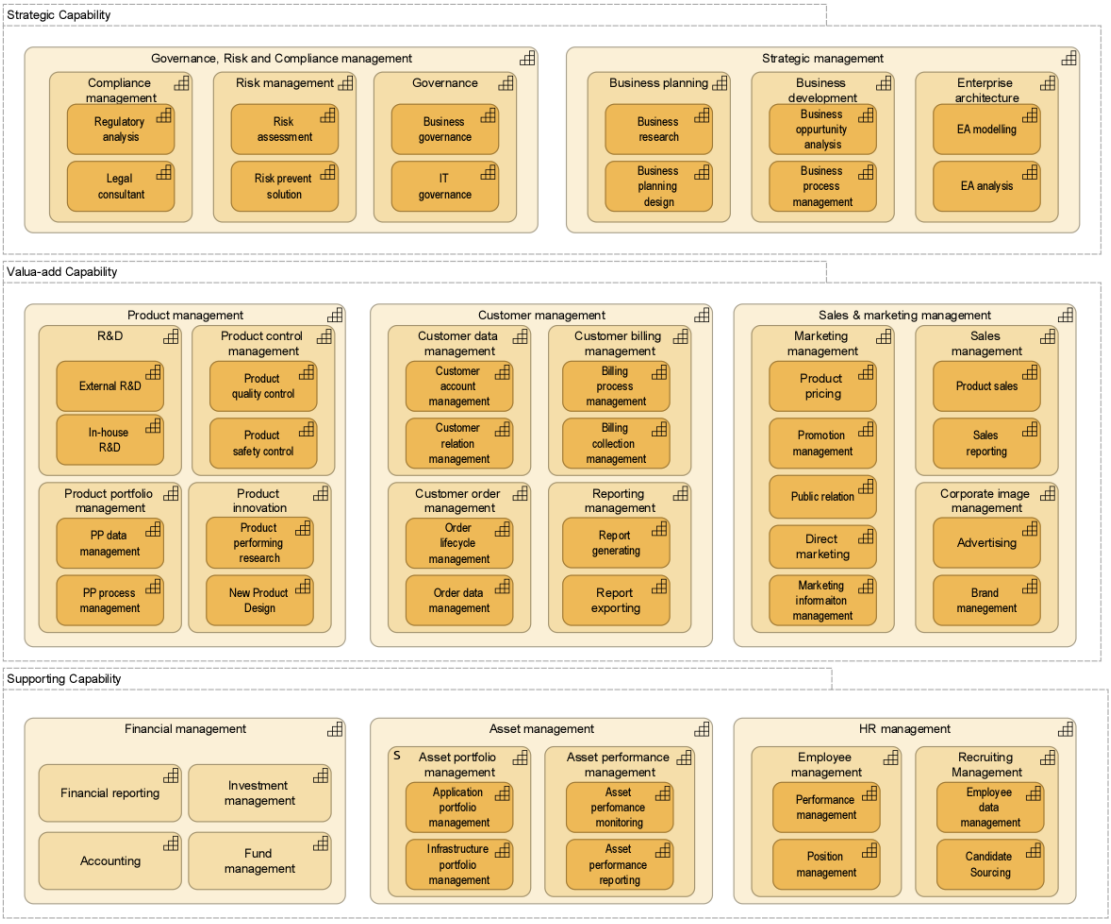

Figure 39 Capability map of ArchiPharma

Since there is no input from enterprise architect about the capability service relationship, we make an assumption to list several service relationships and marked in the matrix below.

Table 29 Capability service relationship matrix

Serving ↓ From / → To			Customer management			
			Customer order management		Reporting management	
			Order lifecycle management	Order data management	Reporting generating	Reporting exporting
Customer mgmt	Customer billing mgmt	Billing process mgmt				
		Billing collection mgmt			X	
	Customer order mgmt	Order lifecycle mgmt			X	
		Order data mgmt	X			

After generating the capability map, the next step is to map the strategies to capabilities. According to the method, it can be done by identifying strategic capabilities and determining the capability increment.

Identify strategic capabilities

ArchiPharma identified their strategy goal as "Optimize price quality ratio" to remain as a product leader. ArchiPharma has made an assessment to identify how well the "price quality ratio" performs by assessing three drivers: innovation, time to market and Margin (Figure 40). Stakeholders could set these drivers according to their concerns.

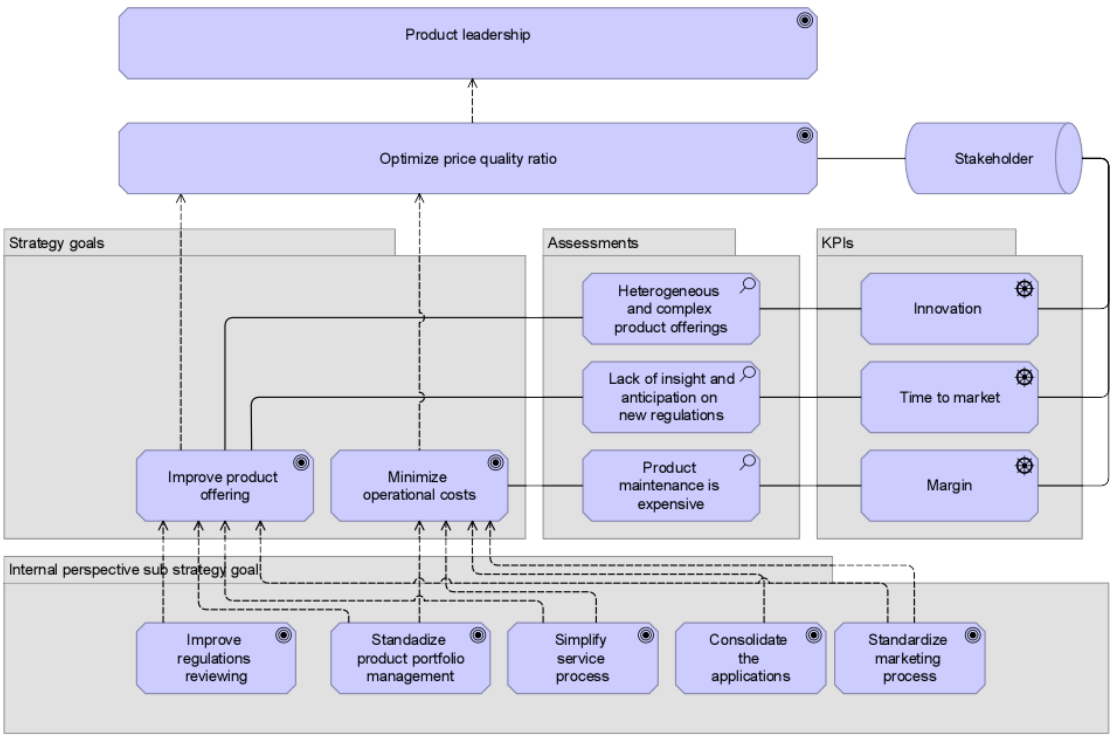

Figure 40 Strategy assessment of product leadership

Then the assessment result shows the identified problems involving:

1. "Innovation" scores low because of "Heterogeneous and complex product offerings."
2. "Time to market" scores low because of "Lack of insight and anticipation on new regulations."
3. "Margin" scores low because "Product maintenance is expensive."

For addressing the problems, strategy goals are identified by ArchiPharma as "improve product offering" and "minimize operational costs" from financial and customer perspective. However, these two goals are still too general to map the level 3 capability. Therefore, we decompose the strategy goals into four sub level strategy goals from the internal perspective.

Once the sub strategy goals are identified, the *"Goal – Subgoal" matrix* could be filled by stakeholders to ensure the influence level of each sub strategy goal to the main strategy goal. As shown in Table 30, both new goals and old ones are involved since ArchiPharma still put the goals of "operational excellence" working in background.

Table 30 Goal -subgoal matrix

Strategy Goal	Goal Priority	Improve regulations reviewing	Standardize product portfolio management	Simplify service process	Consolidate the applications	Standardize marketing process	Centralize information
Improve information sharing	0.1						Strong (9)
Facilitate resource sharing	0.1				Strong (9)		Strong (9)
Eliminate local variance	0.1				Strong (9)	Strong (9)	
Improve product offering	0.5	Strong (9)	Strong (9)	Medium (3)	-	Medium (3)	
Minimized operational costs	0.2	-	Weak (1)	Medium (3)	Strong (9)	Medium (3)	
Subgoal Priority		4.5	4.7	2.1	3.6	3.0	1.8
Related Priority		0.23	0.24	0.11	0.18	0.15	0.09

After filling the Goal- Subgoal matrix, next step is to identify the level 3 capabilities that relate to achieving these strategies. By filling the Subgoal-capability matrix, the missing capability could be identified if current capabilities could not deliver the strategy. By reviewing all the level 3 capabilities, we listed the related capabilities in

Table 31. After filling this matrix, enterprise architect could also check the accuracy of the capability map to see if they missed some capabilities while modeling.

Table 31 Sub-goal capability matrix

Sub-strategy Goal	Subgoal Priority	Regulatory analysis	Product portfolio data management	Product portfolio process management	Billing process management	Order lifecycle management	Application portfolio management	marketing process management
Improve regulations reviewing	0.23	Strong (9)						
Standardize product portfolio management	0.24		Strong (9)	Strong (9)				
Simplify service process	0.11				Strong (9)	Medium (3)		
Consolidate the applications	0.18				Strong (9)		Strong (9)	
Standardize market process	0.15							Strong (9)
Centralize information	0.09		Strong (9)					
Capability Priority		2.07	2.97	2.16	2.7	0.33	1.62	1.35

According to the result of Table 31, a new capability should be built. And it is identified as "marketing process management" which classified as the sub capability in "marketing management". The new capability is shown in Figure 41. The missing capability is marked in white color, which means it doesn't exist at the moment.

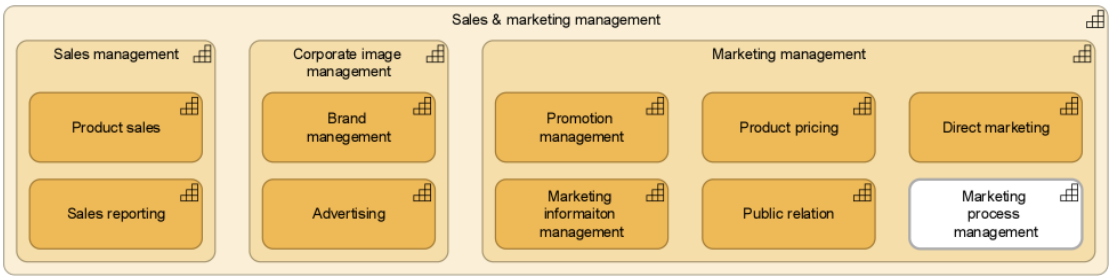

Figure 41 Sales & marketing management

And the Strategic capabilities of ArchiPharma are marked out with red color from the capability map and shown as Figure 42.

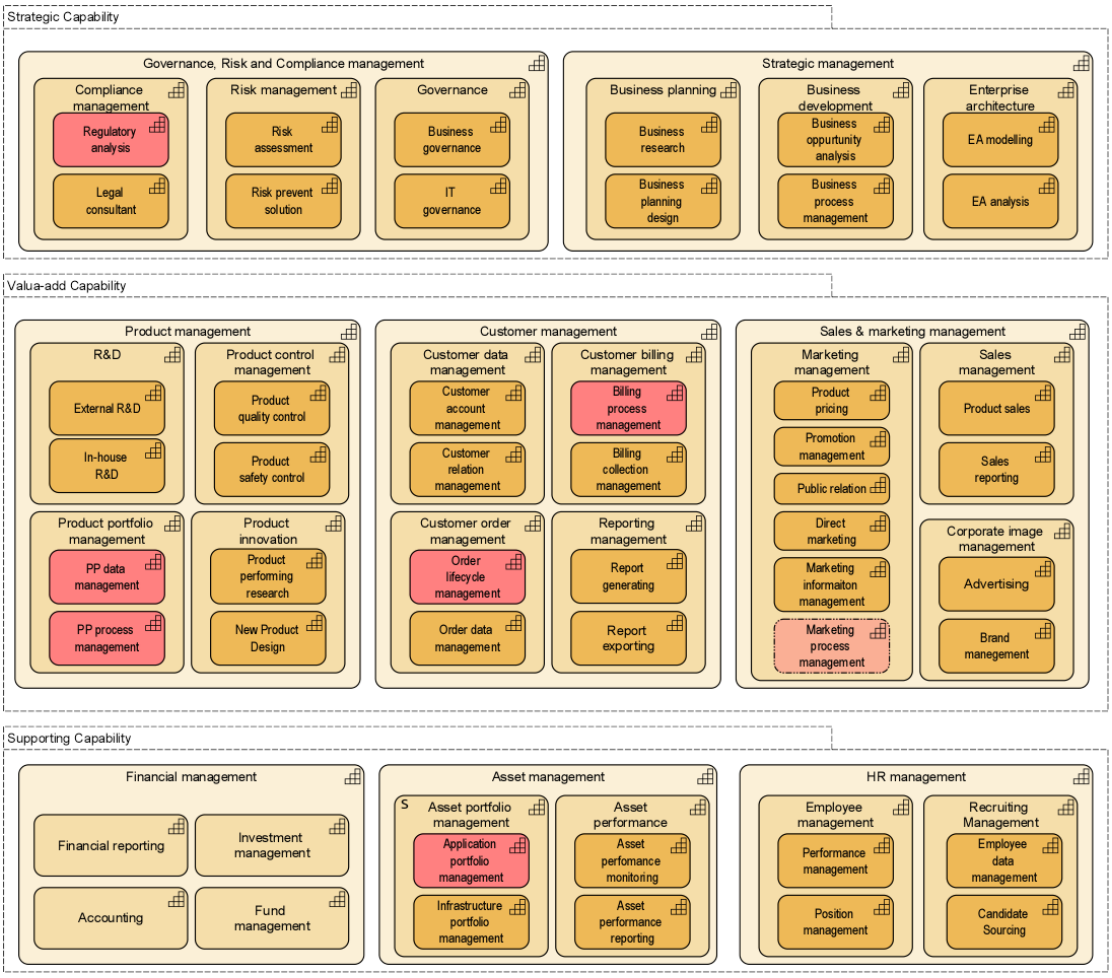

Figure 42 Identified strategic capabilities

Identify the capability increment

As what we discuss before, the organization requires specific capabilities to translate their strategic into actions. Moreover, it is also necessary for the organization to determine the target performance level (capability increments) of these capabilities.

The capability performance level could be assessed by measuring its dimensions. As described, the dimensions are finance, external, physical, human, process, and technology. For each dimension, stakeholders could set one or several indicators. Then, stakeholders could determine the target performance level by identifying the desired status of these indicators. In this case, we made the assumptions of the target performance as:

Table 32 Target performance level of the strategic capabilities

Regulatory analysis						
Indicator	Skill level	time	Budget	Equipment performance	Use of application	Adaptability of changing
Capability dimension	human	process	finance	physical	Technology	external
Indicator	the skill	The	The	How well the	If the	How well to

specification	level of employee to perform the work	average time of finish regulatory analysis	budget for the regulator analysis	equipment performs to support the work	application could fulfill the requirement	anticipate the regulatory changes
Target	3	4	3	3	4	5
Product portfolio data management						
Indicator	Skill level	time	Budget	Equipment performance	Use of application	Adaptability of changing
Capability dimension	human	process	finance	physical	Technology	external
Indicator specification	the skill level of employee	The average time of the process	The budget for the capability	How well to support the capability	How well to fulfill the requirement	How well to adapt the changes
Target	4	4	5	4	3	3
Product portfolio process management						
Indicator	Skill level	time	Budget	Equipment performance	Use of application	Adaptability of changing
Capability dimension	human	process	finance	physical	Technology	external
Indicator specification	the skill level of employee	The average time of the process	The budget for the capability	How well to support the capability	How well to fulfill the requirement	How well to adapt the changes
Target	4	5	2	4	4	3
Billing process management						
Indicator	Skill level	time	Budget	Equipment performance	Use of application	Adaptability of changing
Capability dimension	human	process	finance	physical	Technology	external
Indicator specification	the skill level of employee	The average time of the process	The budget for the capability	How well to support the capability	How well to fulfill the requirement	How well to adapt the changes
Target	3	5	3	3	4	2
Order lifecycle management						
Indicator	Skill level	time	Budget	Equipment performance	Use of application	Adaptability of changing
Capability dimension	human	process	finance	physical	Technology	external
Indicator specification	the skill level of employee	The average time of the process	The budget for the capability	How well to support the capability	How well to fulfill the requirement	How well to adapt the changes
Target	3	4	3	2	4	5
Application portfolio management						
Indicator	Skill level	time	Budget	Equipment performance	Use of application	Adaptability of changing
Capability dimension	human	process	finance	physical	Technology	external
Indicator specification	the skill level of employee	The average time of the	The budget for the capability	How well to support the capability	How well to fulfill the requirement	How well to adapt the changes

		process				
Target	5	4	3	2	4	2
marketing process management						
Indicator	Skill level	time	Budget	Equipment performance	Use of application	Adaptability of changing
Capability dimension	human	process	finance	physical	Technology	external
Indicator specification	the skill level of employee	The average time of the process	The budget for the capability	How well to support the capability	How well to fulfill the requirement	How well to adapt the changes
Target	3	4	3	3	4	4

There is only one indicator identified to assess each dimension performance level in this case. Nevertheless, it is possible for organizations to set multiple indicators to assess the performance level more accurately. Then, the organization should set a weight for each indicator to consolidate the results.

4.2.2 Map ongoing project.

By analyzing the deliverable of each ongoing project, we can identify the goals that the project could achieve. As shown in Figure 43, project "harmonize billing process" is to eliminate the local variance of the billing process. Project "Homogenize information & data" and "Improve global accessibility databases" aim to improve the information and resource sharing of the customer. The project "Improve global accessibility databases" also aims to facilitate resources sharing in governance, risk management, and Compliance management. The project Application rationalization is to eliminate the local variance of the applications used in governance, risk management, and compliance management.

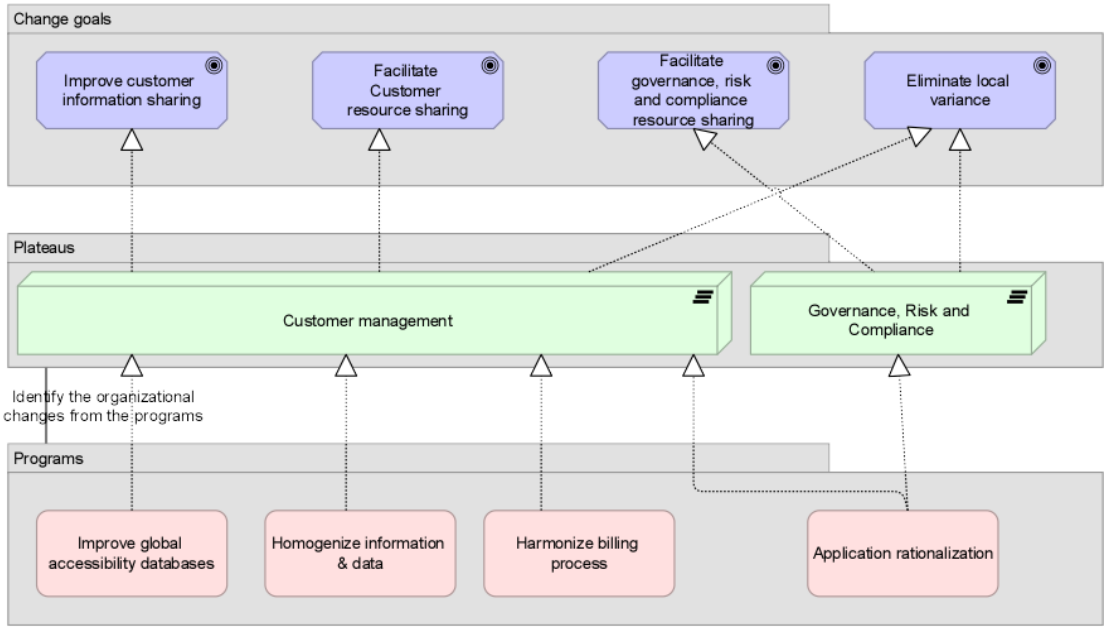

Figure 43 Identify ongoing project objectives

Then, according to these goals, the related capability could be identified. Then, the last step is to link the project to the particular capability shown in Figure 44.

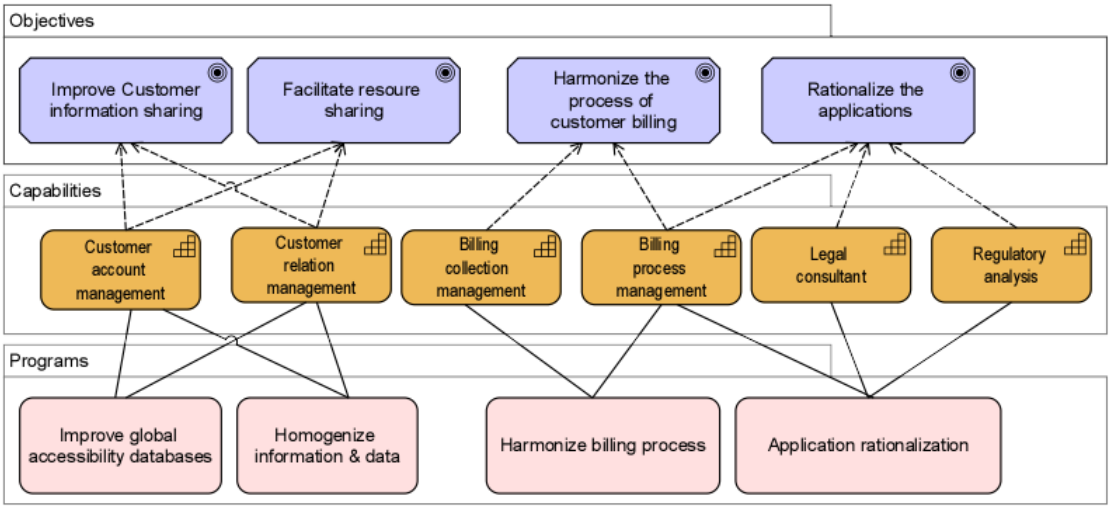

Figure 44 Link projects to capabilities

Therefore, there are 9 level-3 capabilities identified. And they listed and grouped in the Figure 45.

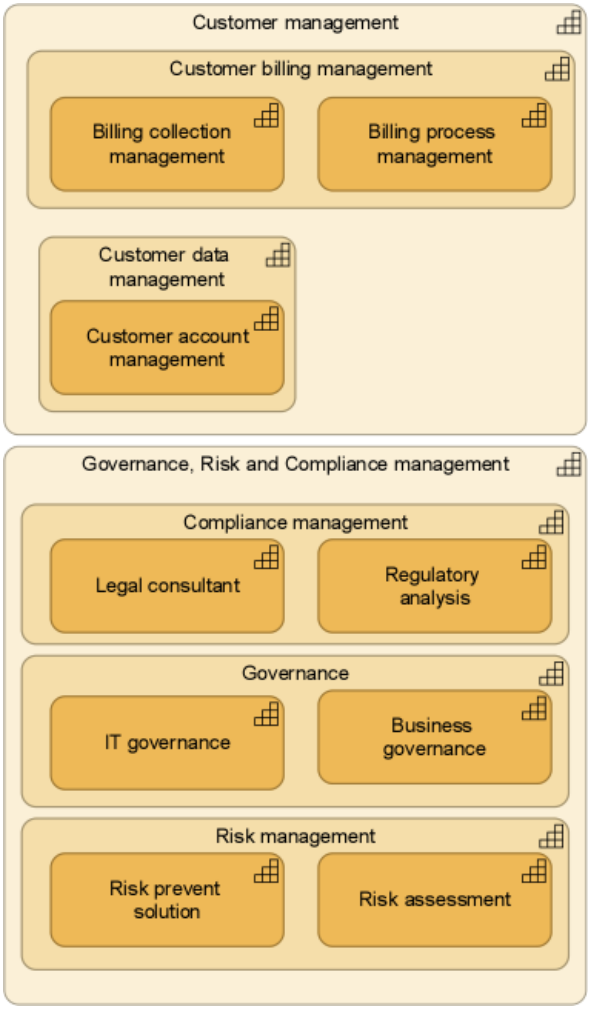

Figure 45 Identified capabilities that relate to ongoing project

Then the final part of this step is to identify if there are any dependencies between these projects. According to the capability map of the organization, projects with shared capabilities should have dependency relationships and could be proposed to stakeholders while filling the table.

Table 33 Ongoing projects dependencies matrix

Trigger ↓ From / → To		Receiving			
		"Homogenize information & data"	Improve global accessibility databases	Harmonize billing process	Application rationalization
Providing	"Homogenize information & data"	-	X		
	Improve global accessibility databases		-		
	Harmonize billing process			-	X
	Application rationalization				-

By filling the matrix as Table 33, it is identified that the project "Improve global accessibility databases" requires the output from the project "Homogenize information & data"; the project "Application rationalization" should start when "Application rationalization" is done. The result could be modeled as Figure 46.

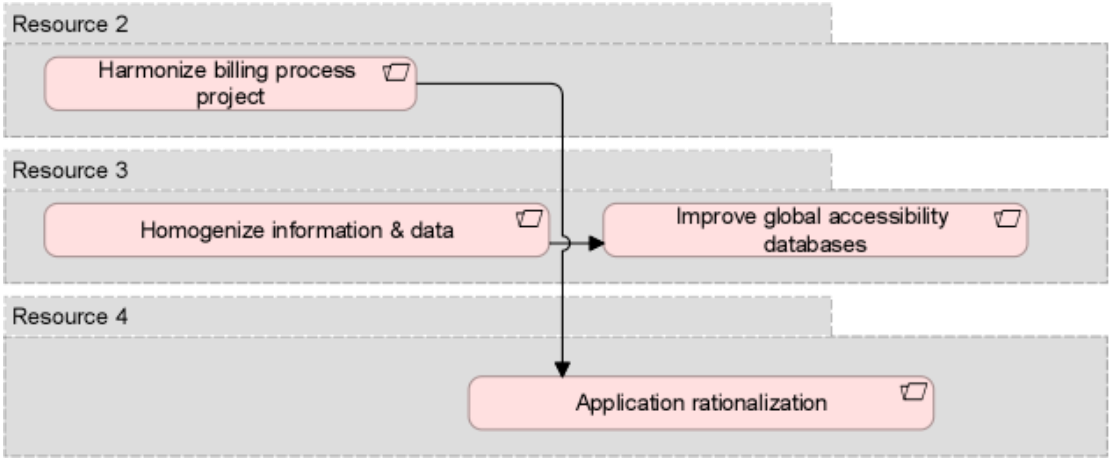

Figure 46 Ongoing project dependencies

4.3 Phase B: Portfolio Assessing

The main principle function of phase B is to propose new projects and adjusting ongoing projects to ensure the strategy alignment.

4.3.1 Assess and adjust projects

The first capability is "Billing process management". From the analyses result, the related ongoing projects are the project "harmonize billing process" and the project

"Application rationalization". Then assess the current performance level and the performance level contributed by these two ongoing projects in Table 34.

Table 34 Anticipate project contribution of billing process management

Billing process management						
Indicator	Skill level	time	Budget	Equipment performance	Use of application	Adaptability of changing
Capability dimension	human	process	finance	physical	Technology	external
Indicator specification	the skill level of employee	The average time of the process	The budget for the capability	How well to support the capability	How well to fulfill the requirement	How well to adapt the changes
Target Level	**3**	**5**	**3**	**3**	**4**	**4**
Current level	**3**	**3**	**3**	**2**	**2**	**2**
harmonize billing process	3	5	3	3	3	2
Application rationalization	3	3	3	3	3	2
Projects Consolidation	**3**	**5**	**3**	**3**	**4**	**2**

According to the project assessment result, the capability related projects could be modeled as a radar chart shown in Figure 47.

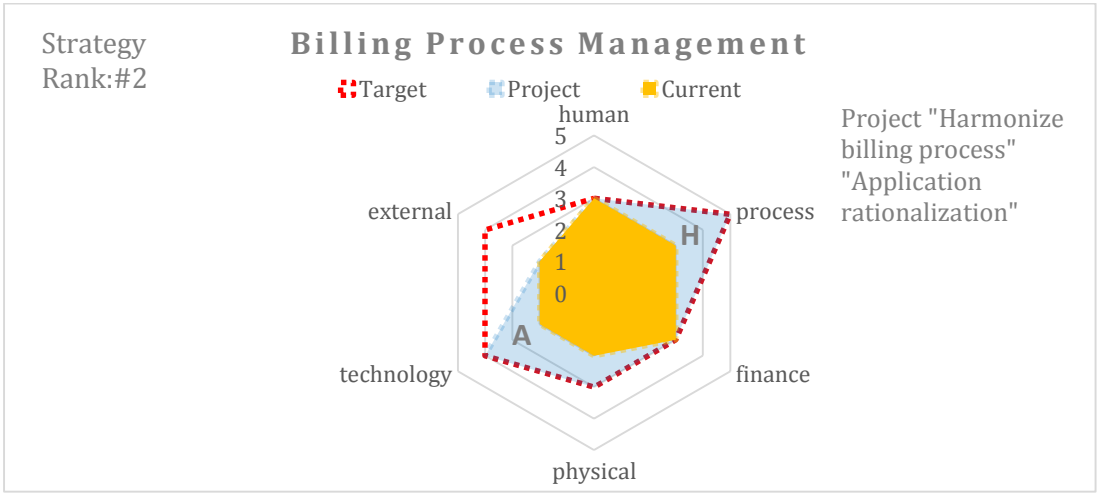

Figure 47 Billing process management related ongoing project radar

From the figure, we can see that the projects will deliver to strengthen the process technology and physical dimension. However, from the new strategy, the external dimension is also required to be enhanced to have enough adaptability to deal with customers' expectations. Therefore, the current ongoing projects related to capability "billing process management" cannot fully achieve the strategy.

Enterprise architect could make a solution as proposing an additional project to strengthen the external dimension. Or, adjust the project "Harmonize billing process"

to enhance the external dimension of the billing process management capability. In the case study, we skipped the sub-activities of project proposing since they are not the focus of this research.

Here we assume that there are two projects proposed by the enterprise architect with different deliverables and cost, which are shown in Figure 48.

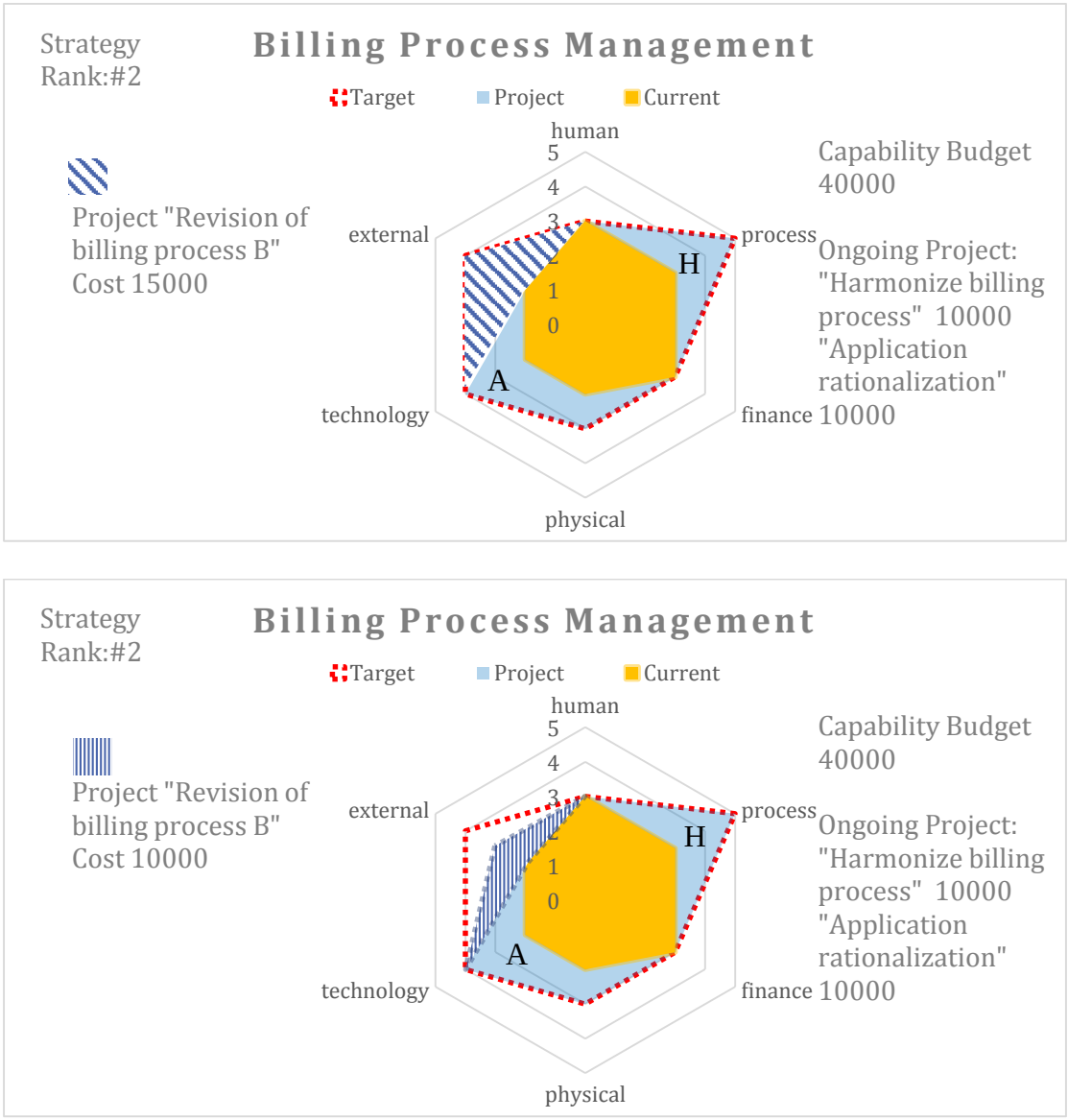

Figure 48 Proposed projects of billing process management

In the figure, the above solution could fulfill the requirement of enhancing the capability “business process management”. The second project is proposed with lower cost and could achieve part of the requirements. Then the manager could make the decision later by comparing the project cost and strategy achievement of these two solutions.

For the capability “Regulatory Analysis”, the process is the same, first assess if the related ongoing project needs to be adjusted or not.

Table 35 Anticipate project contribution of Regulatory analysis

Regulatory analysis						
Indicator	Skill level	time	Budget	Equipment performance	Use of application	Adaptability of changing
dimension	human	process	finance	physical	Technology	external
Indicator specification	the skill level of employee	The average time of the process	The budget for the capability	How well to support the capability	How well to fulfill the requirement	How well to adapt the changes
Target Level	4	3	3	3	4	5
Current level	4	3	3	3	3	3
Application rationalization	3	3	3	3	4	4

According to the assessment result, the capability radar could be shown as:

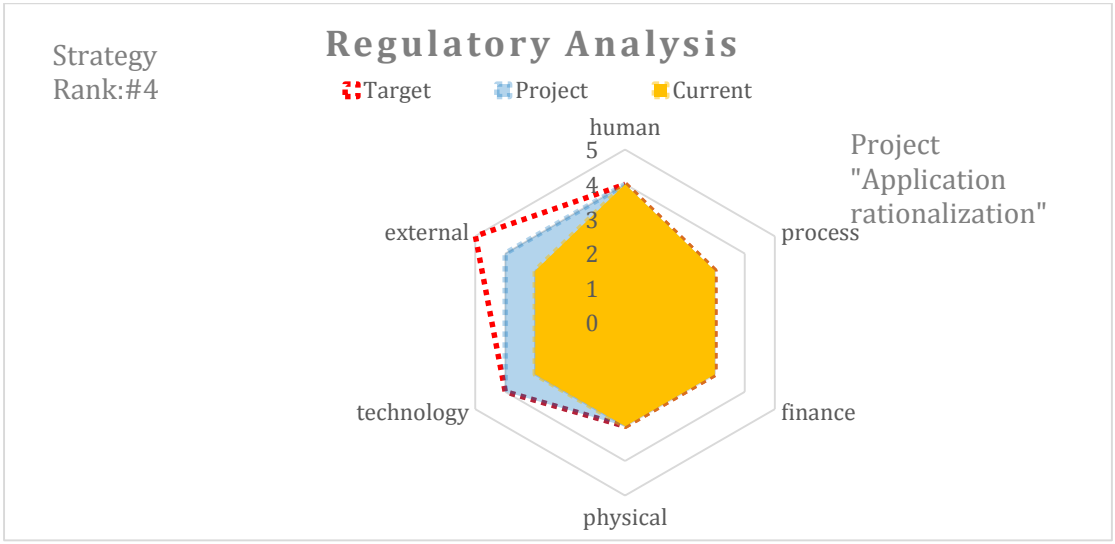

Figure 49 Capability radar of regulatory analysis

According to the radar chart, the related ongoing projects could strengthen process dimension and technology dimension when they are delivered. But compared with the capability increment. The process, human and external and physical dimensions of the capability still need to be improved. For the project "Application Rationalization", there is a project dependency card, shown as Table 36, provided to support enterprise architecture to make the decision.

Table 36 Project dependency card of Application Rationalization

Application Rationalization			
Summary	Rationalize the applications used in customer billing process and regulatory analyzing.		
Stakeholders	Project manager A		
Completion	Approved		
Related Capability	Capability Name	Influence Level	Serving Capability
	Regulatory analysis	Strong	-
	Billing process management	Strong	-
	Customer data management	Strong	-
Required by projects	Project name	Project Owner	Required output
	-	-	-

According to the given information, we found out that project "Application Rationalization" is arranged to separately rationalize the applications that used in the billing process, customer management, and regulatory analysis and the project does not rely on any other projects. Therefore, adjusting this project will not affect other projects or capabilities. Then, the project "Application Rationalization" could be adjusted.

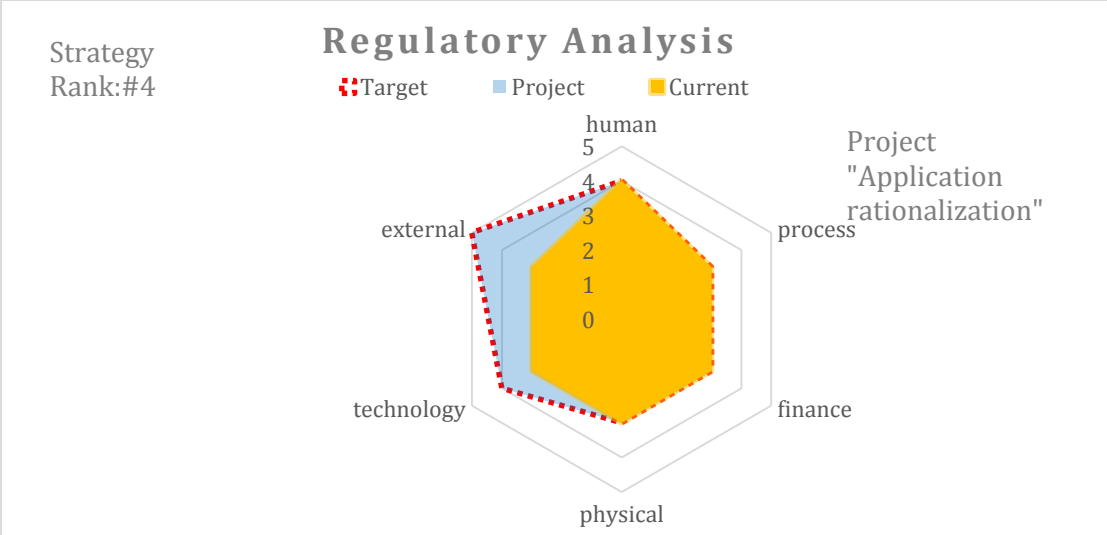

Figure 50 Proposed solution of regulatory analysis

4.3.2 Propose projects to the capability that has no ongoing project related

After assessing the capability related ongoing projects, we could propose new projects to achieve the other strategic capabilities. For these capabilities, the current performance level of each capability would be analyzed.

Table 37 Gap analysis of capabilities without related ongoing projects

Product portfolio data management						
Indicator	Skill level	time	Budget	Equipment performance	Use of application	Adaptability of changing
Capability dimension	human	process	finance	physical	Technology	external
Indicator specification	the skill level of employee	The average time of the process	The budget for the capability	How well to support the capability	How well to fulfill the requirement	How well to adapt the changes
Target Level	4	4	5	4	4	5
Current Level	3	3	5	4	3	3
Product portfolio process management						
Indicator	Skill level	time	Budget	Equipment performance	Use of application	Adaptability of changing
Capability dimension	human	process	finance	physical	Technology	external
Indicator specification	the skill level of employee	The average time of the process	The budget for the capability	How well to support the capability	How well to fulfill the requirement	How well to adapt the changes
Target Level	4	5	2	4	4	4

Current Level	3	3	2	4	4	3
Order lifecycle management						
Indicator	Skill level	time	Budget	Equipment performance	Use of application	Adaptability of changing
Capability dimension	human	process	finance	physical	Technology	external
Indicator specification	the skill level of employee	The average time of the process	The budget for the capability	How well to support the capability	How well to fulfill the requirement	How well to adapt the changes
Target Level	3	4	3	2	4	5
Current Level	3	2	3	2	3	3
Application portfolio management						
Indicator	Skill level	time	Budget	Equipment performance	Use of application	Adaptability of changing
Capability dimension	human	process	finance	physical	Technology	external
Indicator specification	the skill level of employee	The average time of the process	The budget for the capability	How well to support the capability	How well to fulfill the requirement	How well to adapt the changes
Target Level	3	4	3	2	4	2
Current Level	3	4	3	2	2	2

According to CBP, the projects could be proposed to close these gaps. Enterprise could also provide all the proper solutions to one capability in order to support the further project evaluation and selection. For each proposed project, a project card could be generated according to the project proposal. Totally, there are six projects proposed to achieve the strategy.

Project Revision of PPM Process:

- Choose, develop and install enterprise-wide PPM software
- Develop real-time portfolio monitoring
- Develop real-time portfolio reporting
- Harmonize local PPM approaches
- Install enterprise-wide PPM approach
- Inventory all PPM processes

Table 38 Overview of proposed project Revision of PPM process

Project Revision of PPM Process			
Summary	Professionalize the product portfolio management process		
Description	-		
Stakeholders	Manager A		
Proposed Budget	10,000		
Capability Goals	Capability name	Priority level	Contribution
	Product portfolio process management	2.16 (#3)	75%
Required Resources	Resource group 4		

Project Professionalize marketing:

- Align marketing processes
- Identify current marketing processes
- Consolidate marketing applications
- Install necessary applications for monitoring competitors

- Install process for monitoring competitors
- Integrate marketing processes

Table 39 Overview of proposed project Professionalize marketing

Project Professionalize marketing			
Summary	Professionalize the marketing process		
Description	-		
Stakeholders	Manager B		
Proposed Budget	15,000		
Capability Goals	Capability name	Priority level	Contribution
	Market process management	1.35 (#6)	100%
Required Resources	Resource group 2		

Project Product Rationalization

- Analyze current product portfolio
- Expand customer channels with internet
- Harmonize ordering process
- Identify products for termination, migration and consolidation
- Rationalize project portfolio
- Redesign portfolio into limited set of highly configurable projects

Table 40 Overview of proposed project product rationalization

Project Product Rationalization			
Summary	Rationalize the product type		
Description	-		
Stakeholders	Manager B		
Proposed Budget	10,000		
Capability Goals	Capability name	Priority level	Contribution
	Product portfolio data management	2.07 (#4)	100%
	Order lifecycle management	0.33 (#7)	100%
Required Resources	Resource group 1		

Project Installment of APM process

- Choose, configure, test and install APM applications
- Design and populate application portfolios
- Design enterprise-wide APM process

Table 41 Overview of proposed project installment of APM process

Project Installment of APM process			
Summary	Optimize the application portfolio management		
Description	-		
Stakeholders	Manager C		
Proposed Budget	10,000		
Capability Goals	Capability name	Priority level	Contribution
	Application portfolio management	1.62 (#5)	75%
Required Resources	Resource group 1		

Project Revision of Billing Process

- Version A:

- Inventory all PPM processes
- Develop real-time process monitoring
- Develop real-time process reporting
- Harmonize all billing process related applications

Table 42 Overview of proposed project revision of billing process version A

Project Revision of Billing Process Version A			
Summary	Optimize the flexibility of customer billing process		
Description	-		
Stakeholders	Manager A		
Proposed Budget	10,000		
Capability Goals	Capability name	Priority level	Contribution
	Billing process management	2.7 (#1)	29%(2:7)
Required Resources	Resource group 2		

- Version B:
  - Inventory all PPM processes
  - Develop cycling process monitoring
  - Develop cycling process reporting
  - Harmonize the entire ordering process related applications

Table 43 Overview of proposed project revision of billing process version B

Project Revision of Billing Process Version B			
Summary	Optimize the flexibility of customer billing process		
Description	-		
Stakeholders	Manager A		
Proposed Budget	10,000		
Capability Goals	Capability name	Priority level	Contribution
	Billing process management	2.7 (#1)	14%(1:7)
Required Resources	Resource group 2		

4.3.3 Projects Strategy Priority Score

Once all the projects proposed, we made a calculation of project strategy priority score according to the project contribution to the strategy. The strategy priority score could become a criterion to support the project selection.

Table 44 Project strategy priority

Sub capability	Regulatory analysis	Product portfolio data management	Product portfolio process	Billing process management	Order lifecycle management	Application portfolio management	marketing process management	Subgoal Priority
Capability Priority	2.07	2.97	2.16	2.7	0.33	1.62	1.35	
Professionalize marketing							100%	1.35
Harmonize Billing process				43%				1.16
Application rationalization	67%			43%				2.55

Installment of APM process						100%		1.21
Product rationalization		100%			100%			3.30
Revision of billing process A				29%				0.78
Revision of billing process B				14%				0.38
Revision of PPM process			75%					1.62

Figure 51 shows the project priority referring to project budget and project strategy priority.

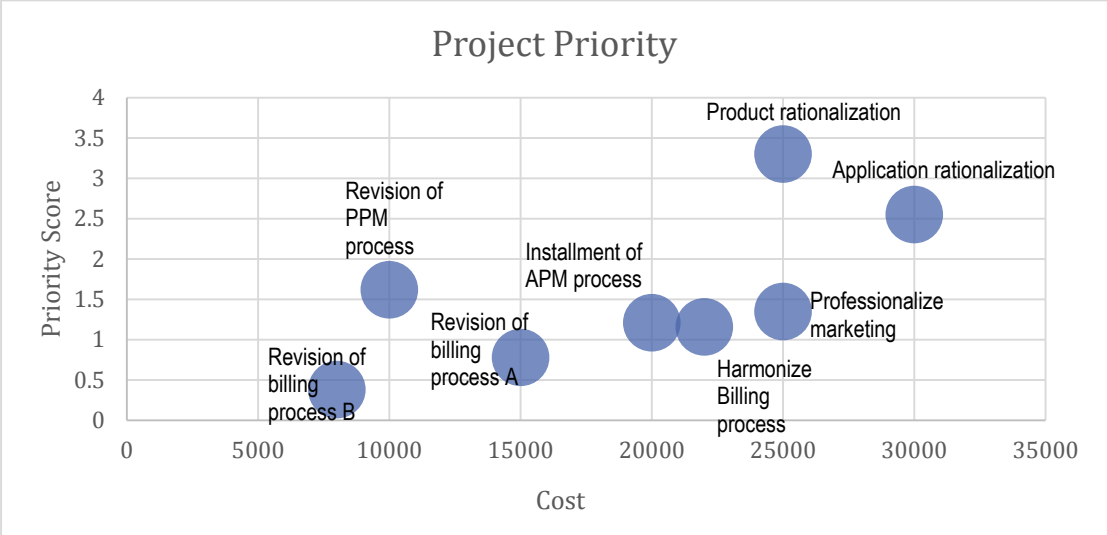

Figure 51 project strategy priority chart

4.4 Phase C: Portfolio Arranging

In the last phase, ArchiPharma could have a clear overview by having the strategy implementation blueprint and project dependency map which could also facilitate building the roadmap.

4.4.1 Strategy implementation blueprint

After the manager making the decisions, we could build the strategy implementation blueprint to provide an overview of how the strategy implemented.

As shown in Figure 52, the blueprint involves the strategy map, the related strategic capabilities, and the corresponding projects. The model could also support the further assessment. Once a new strategy shift occurs, stakeholders could quickly identify the affected ongoing projects without mapping all the projects to the capability map.

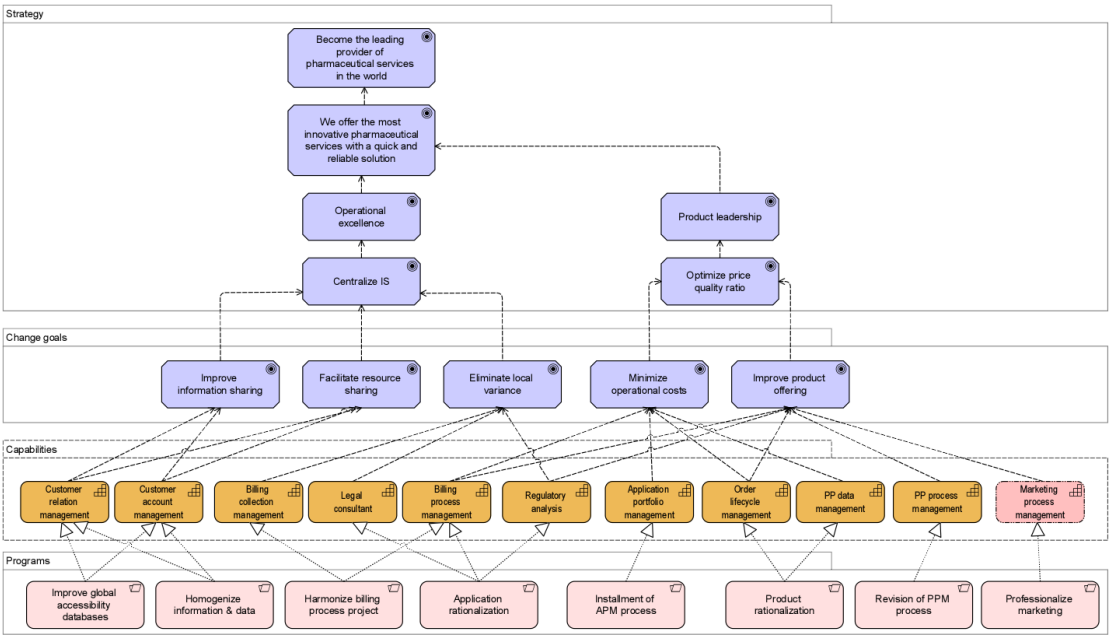

Figure 52 Strategy implementation blueprint

4.4.2 Project Dependencies

There are two key attributes that will affect the order of the project implementation: strategy priority and project dependency. According to the Subgoal capability matrix, the project “product rationalization”, “Harmonize billing process”, “Revision of PPM process” and “Professionalize marketing” has the priority. The new project dependency map is shown in the Figure 53 below.

As shown in the figure, the arrow shows the triggering relationship of the projects. The project “Revision of PPM process” and the project “Application rationalization” require the outcome of the project “installment of APM”. Therefore, it should be arranged in front; even it has low priority. And the projects that required same resources could be ordered by strategy priority.

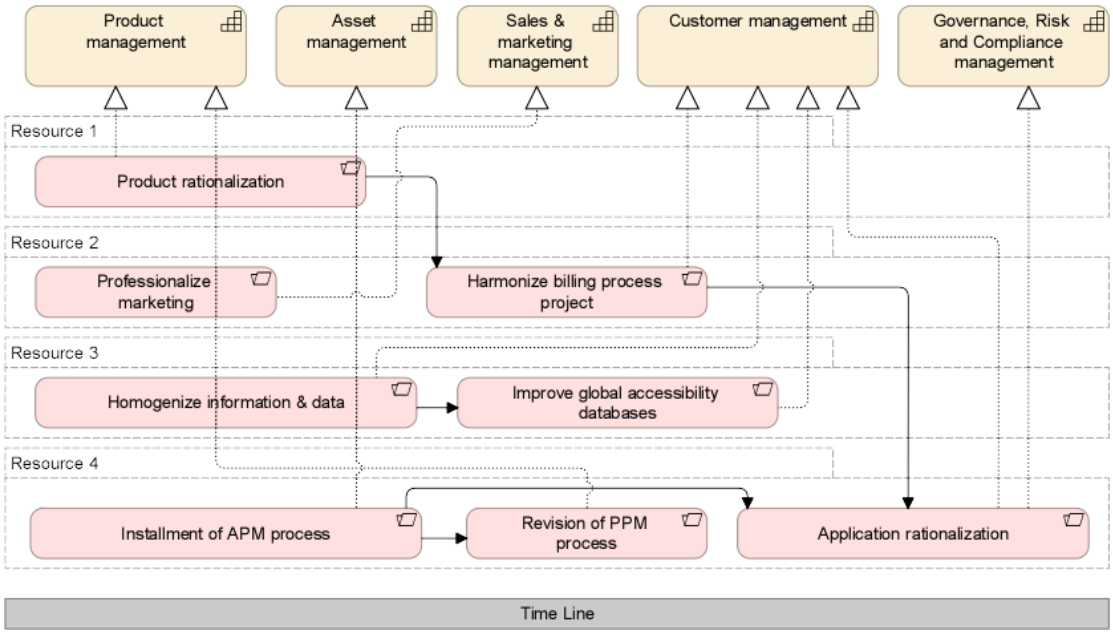

Figure 53 Project dependencies

Chapter5: Evaluation

Evaluation is one main step of DSRM. The observation and measurement about the quality of the solution will be done in this step. And the evaluation process was done by performing a small workshop and in the end of the workshop each participant filled a survey as the feedback about the workshop. This chapter states how the survey created and discusses the results of the workshop.

5.1 Survey

In order to collect feedback for the new proposed method, a survey is built as the tool to do the qualitative analysis. While formulating the survey, the model (shown as Figure 54) from Unified Theory of Acceptance and Use of Technology (UTAUT) is adopted as the guideline to analyze user acceptance of the new method.

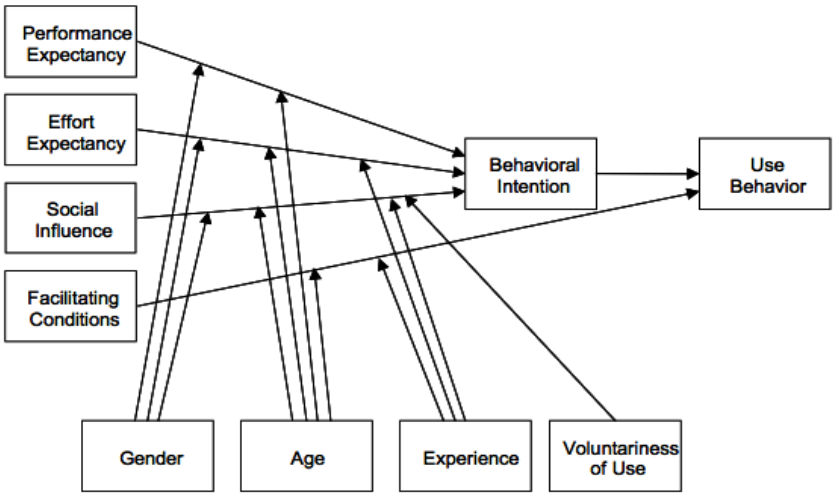

Figure 54 UTAUT Research model (Venkatesh, et al., 2003)

In the research, UTAUT integrates fragmented theory and research on individual acceptance of information technology into a unified theoretical model that captures the essential elements of eight previously established models (Venkatesh et al., 2003). And the summarized as a list of survey which shown as Table 45.

Table 45 List of survey items use for estimating UTAUT (Venkatesh, et al., 2003)

Constructs	Definition	Items	Root Constructs
Performance expectancy	"the degree to which an individual believes that using the system will help him or her to attain gains in job performance."	U6: I would find the system useful in my job. RA1: Using the system enables me to accomplish tasks more quickly. RA5: Using the system increases my productivity. OE7: If I use the system, I will increase my chances of getting a	Perceived usefulness (TAM/TAM2 and C-TAM-TPB), Extrinsic motivation (MM), Job-fit (MPCU), Relative advantage (IDT), and Outcome expectations (SCT)

		raise.	
Effort expectancy	"the degree of ease associated with the use of the system."	EOU3: My interaction with the system would be clear and understandable. EOU5: It would be easy for me to become skillful at using the system. EOU6: I would find the system easy to use. EU4: Learning to operate the system is easy for me.	Perceived ease of use (TAM/TAM2), Complexity (MPCU), and Ease of use (IDT)
Facilitating conditions	"the degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system."	SN1: People who influence my behavior think that I should use the system. SN2: People who are important to me think that I should use the system. SF2: The senior management of this business has been helpful in the use of the system. SF4: In general, the organization has supported the use of the system.	Perceived behavioral control (TPB/ DTPB, C-TAM-TPB), Facilitating conditions (MPCU), and Compatibility (IDT)
Attitude toward using technology	"an individual's overall affective reaction to using a system."	PBC2: I have the resources necessary to use the system. PBC3: I have the knowledge necessary to use the system. PBC5: The system is not compatible with other systems I use. FC3: A specific person (or group) is available for assistance with system difficulties.	Attitude toward behavior (TRA, TPB/DTPB, C-TAM-TPB), Intrinsic motivation (MM), Affect toward use (MPCU), and Affect (SCT)
Self-efficacy	"Judgment of one's ability to use a technology (e.g., computer) to accomplish a particular job or task."	I could complete a job or task using the system... SE1: If there was no one around to tell me what to do as I go. SE4: If I could call someone for help if I got stuck. SE6: If I had a lot of time to complete the job for which the software was provided. SE7: If I had just the built-in help facility for assistance.	Self-efficacy (SCT)
Behavioral Intention to use the system	"a person's perceived likelihood or subjective probability that he or she will engage in a given behavior"	BI1: I intend to use the system in the next <n> months. BI2: I predict I would use the system in the next <n> months. BI3: I plan to use the system in the next <n> months.	Attitude Toward Behavior (TRA, TPB/DTPB, C-TAM-TPB), Perceived behavioral control (TPB/ DTPB, C-TAM-TPB), Intrinsic motivation (MM)

The survey that used in the workshop is created based on the UTAUT and the questions are formulated based on Table 45. The entire survey is attached as Appendix C.

5.2 Discussion of the result

A one-hour workshop has been conducted to evaluate the method in BiZZdesign. There were 5 participants who are all experts from BiZZdesign. The workshop included a presentation of the method introduction, a discussion and a short survey. In this section, we did a data analysis of the survey in order to obtain some valuable insights.

5.2.1 Background information

The survey started with three background questions including participant's positions at BiZZdesign and the frequency of using the two key techniques in the method.

1. **Participant positions**

There were total 5 participants from BiZZdesign joining the workshop. Three of them are Research Consultants, one is Customer Success Consultant, and the last one is Interaction Designer. Most of them are under the Research and Development Department of BiZZdesign.

2. **Frequency of using techniques**

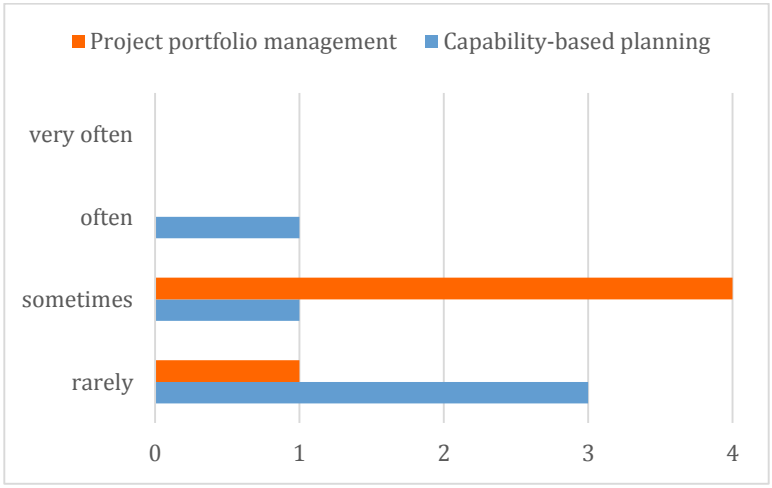

Figure 55 Frequency of using CBP and PPM

As can be seen in Figure 55, three of five participants rarely use the CBP during their work; one occasionally uses the technique; and the last one often uses the technique. There are four participants use PPM sometimes and the other one rarely use the technique of PPM. It is reasonable since some of them have no work that needs these techniques.

5.2.2 *Acceptance of the method*

Then the following part is the user acceptance analysis of the proposed method. Generally, there are five constructs, which are performance expectancy (PE), effort expectancy (EE), attitude towards using technology (AT), self-efficacy (SE), and behavioral intention (BI). There are total 13 questions related to user acceptance analysis. The overview of the descriptive statistic result is shown as Table 46. The related questions could be found in Appendix C.

Table 46 Descriptive statistic of the result

Question	N	Min	Max	Sum	Ave	SDEV
PE1	5	5	6	27	5.4	0.48989795
PE2	5	4	5	22	4.4	0.48989795
PE3	5	2	4	15	3	0.89442719
EE4	5	3	6	22	4.4	1.0198039
EE5	5	4	6	24	4.8	0.74833148
EE6	5	2	6	23	4.6	1.356466
AT7	5	4	6	27	5.4	0.8
AT8	5	2	6	21	4.2	1.83303028
AT9	5	4	6	26	5.2	0.74833148
SE10	5	5	6	29	5.8	0.4
SE11	5	6	6	30	6	0
SE12	5	4	6	27	5.4	0.8
BI13	5	3	6	22	4.4	1.0198039
Average PE	-	3.66667	5	21.33333	4.266667	0.44221664
Average EE	-	3	6	23	4.6	1.5011107
Average AT	-	3.33333	6	24.66667	4.933333	1.34219279
Average SE	-	5	6	28.66667	5.733333	0.51783023
Average BI	-	3	6	22	4.4	1.5011107

The items in the table above refer to:

- N: the number of participants who answer this question.
- Min: the minimum score of this question.
- Max: the maximum score of this question.
- Sum: the total amount from all participants of this question.
- Ave: the average score of this question.
- SDEV: the standard deviation of all results. It is used to measure the spread of the values around the central tendency. Large SDEV means the answers are dispersed.

There are 7 options of each question, which are counted from 1 to 7. Then the value between 1 to 3 means negative feedback (“Strongly disagree”, “Disagree”, “Somewhat disagree”), 4 is neutral feedback (“Strongly disagree”, “Disagree”, “Somewhat disagree”), and 5 to 7 means positive feedback (“Somewhat agree”, “Agree”, “Strongly agree”)

The analysis focused on the average score and the standard deviation of each result. The following chart shows the average sore and standard deviation of each question.

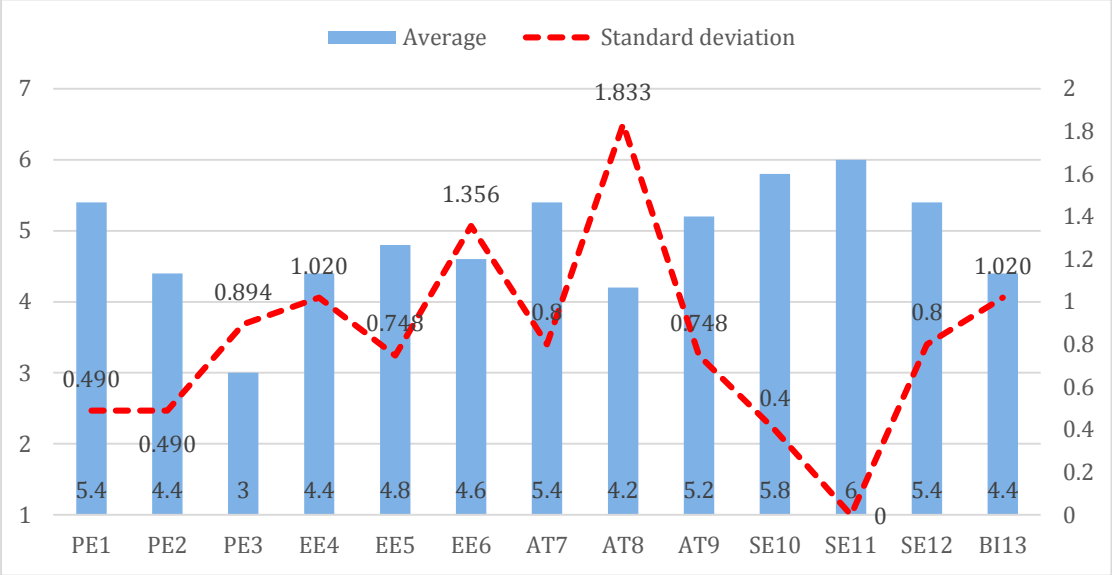

Figure 56 Overview of average score and the standard deviation

According to the Figure 56, the average score of each question is between 3 and 6. Most of the questions have mean above 4.5 which means generally participants have positive attitude towards the method.

Within the 13 questions, the one with the most positive result is SE11. All 5 participants, including the one without necessary knowledge to apply the method, agreed that they could complete the task by using the new method if they have someone for help. It means the method could be adopted with the support from consultants. Then, the most negative feedback is for PE3 with 3 point only. It means that participants think it is a complex method to be adopted in the task. One participant thought it would be much better to build a tool for the method in order to make some steps automated. Another participant suggested to breakdown the method in levels with different scenarios as in some case organizations don't need to do everything. Then, the average scores for the other questions are all between 4.2 and 5.8.

For the questions that have the average score below 5, we can see that there are participants giving negative feedback, as the min value of these questions are between 1 and 4. It could be analyzed with the standard deviation together. The SDEV shows the dispersion of feedback from 5 participants. The SDEV below 1 means the scores given by the participants are grouped in certain value, between 4 and 6.

But there are also 4 questions with the SDEV above 1 which means answers are so dispersed. The first one is question EE4. One participant thought the method is not easy to apply in the case. This participant also gave the minimum score to the

question PE3. It could be understood that this participant thought method is too complex to be applied in a case.

The question EE6, AT8, and BI13 also have a large SDEV. BI13 is to ask if the participant wants to use the method in the future. Two participants showed the willingness. Two participants gave neutral answers and the last one thought he would not use it. The result could be analyzed with their positions together. The participants who had positive result are the customer success consultant and one research consultant. Their work involves the area of project portfolio management. As a result, they showed the interests in implementing the method in the future. The interaction designer thought he would not use the method as it out of his scope.

AT8 is to analyze if the participant has all necessary knowledge to use the method. The interaction designer and the customer success consultant stated that they lacked knowledge, while all the research consultants mentioned they had all necessary knowledge, so the SDEV is above 1.

EE6 is about the interaction with the method. One participant gave a core 2 while the others gave 5 or 6, because the participant had questions about measuring the capability performance. He thought the success of the method is highly depending on the ability to measure the capability performance. As capability performance assessment is a part of CBP, we directly use the approach within CBP instead of designing a new approach to assess the capability performance.

At last, based on the survey result and experts' opinion, there are some conclusions generated:

1. The proposed method could improve the performance of project portfolio management. With the method, organizations could have more transparency and better control of their ongoing projects.
2. The proposed method could be adopted smoothly if there is a consultant or a guideline.
3. However, the proposed method is complex. Therefore, it suggests that the next step could be simplify the method.

Chapter6: Discussion and Conclusion

In the previous chapters, we firstly proposed a project portfolio management method to facilitate organizations for the purpose of dealing with the strategy shift; then, we did a case study for demonstration and held a workshop as evaluation.

This chapter aims to make a conclusion about the entire research, involving the answers to the research questions, the contributions, the limitations, and the recommendations for the future research.

6.1 Answers to Research Questions

The main research question has been formulated as:

How to support effective portfolio management using the Capability-based Planning in a dynamic environment?

We answered this question by proposing a new method to assess the affected ongoing projects. Before designing the method, we did a literature review to answer the two sub-questions firstly.

RQ1: What is the relationship between portfolio management and CBP?

As defined, the portfolio management is to manage the portfolios to achieve the strategy. In the portfolio management, the focus is how projects are selected, prioritized, integrated, managed and controlled in the multi-project context. And CBP is a business planning technique that helps to plan the strategy implementation. Therefore, CBP has no overlap with portfolio management, but it provides the relevant information that required in the portfolio management.

RQ2: How could CBP help to optimize portfolio management?

The projects and portfolios could be treated as the working packages in the CBP, aiming to achieve the capability increment and to realize the strategy. Therefore, conversely, CBP could be adopted as an approach to the portfolio management that contributes to project proposing and project strategy aligning.

To be more detailed, by using CBP, strategies could be translated to the changing requirements to the capabilities. Then, firstly, projects could be proposed as the working package to achieve these demands. Secondly, while strategy changed, which means the capabilities may have new requirements, the impacted ongoing projects should be quickly identified. Thirdly, with the CBP, the strategy alignment of the

projects could be measured more easily by assessing if the project delivers the desirable outcome that could fulfill the changing requirements of the capability.

6.2 Contribution

The biggest contribution of this research is providing a method that enables strategy alignment in the project portfolio management, especially in the case of the strategy shift. What's more, according to the evaluation results that discussed in chapter 5, the key contributions of this research can be summarized and classified into the theoretical contributions and the practical contributions, which are:

Theoretical Contributions:

1. Link projects to capabilities in different levels. The first contribution of this research is using the CBP to describe how the ongoing projects contribute to the organization by identifying the objectives of the projects and mapping the goals to the high-level capabilities. Then determine the appropriate level of the capabilities and link the projects to the capabilities.
2. Analyze the relationship between capability dependencies and the project dependencies. In the research, we analyzed all seven types of relationship between capabilities and identified the relationship that could cause the performance dependencies between capabilities. Then according to the identified capability dependencies, some dependency relationship between projects could be identified automatically.
3. Propose an approach to calculate the strategy priority score of the capabilities and projects with the related equations. In this study, we identify the strategy priority of the projects by calculating the completion percentage of the capability increment and then combining them with the priority score of the capability. It helps in a situation that a capability is contributed by several projects or a project contributes to several capabilities.

Practical Contributions:

1. Model the proposed method in ArchiMate 3.0 language. Since the CBP is a main technique adopted in the proposed method and the projects could also be modelled as working package. The proposed method in this research is close to the usage of ArchiMate. It could also facilitate combining the proposed method with other methods which follow the principles of ArchiMate 3.0.
2. Based on linking the projects to the capabilities, analyze the relationship between capability dependencies and project dependencies. The proposed method could help the users identified the affected projects while strategy shifts or projects are adjusted or abandoned.

3. Model the project deliverables into capability performance chart. As shown in Figure 25, the capability is decomposed into six dimensions. The project deliverables could be modeled as the enhancement of one or some dimensions of the capabilities. It facilitates the enterprise architect.

6.3 Research Limitation

6.3.1 Limitations of literature review

Although SLR method is designed very comprehensively, in this research, there are still some limitations due to both the SLR method itself and the situation of this research:

- Searching Database

Based on the order of SLR steps, there is a limitation because the selected databases may not include all the relevant studies. This limitation is controlled by reviewing the references of the selected papers.

- Literature Selection

For the selected studies, the limitation is about selection bias. Normally, in a systematic literature review, the literature selection is done by several researchers with several round selections to avoid selection bias. In this SLR, since there is only one researcher, the studies selection and data extraction could have introduced bias. Personal preferences might be involved when selecting the studies.

6.3.2 Limitations of the Proposed Method

According to the case study in chapter 4, several limitations are identified of the new proposed method.

Firstly, the method limits the input data type. While collecting the required information, the adopted techniques are strategy map and capability map. This limits the input data type. Therefore, it needs extra steps to translate the related information into strategy map and capability map if the organization doesn't have them. The operating guidelines for modeling the strategy map and capability map have been listed in Chapter 3.2.1.

Secondly, in the case study, capability performance related assessments are skipped because of the data limitation, the performance level of each capability dimension is directly assumed.

Lastly, in this research, we focus on how to make project align with the strategy. However, in the project portfolio management, strategy alignment is not the only criterion. As other criteria like risk analysis are out of the research scope, it requires further development to extend the method to involve more criteria like risk, time to market. Further research could keep optimizing the equation to identify the priority of the projects

6.3.3 Limitations according to the evaluation

Based on the survey result, there are two limitations identified.

1. Assessing the capability performance need to be improved. The data accuracy will highly affect the success of the method. It is critical to have an appropriate approach to evaluate the capability performance. Although there are already some capability performance assessment frameworks proposed, it still lacks detailed guideline. It could be a research direction in the future.
2. The method is complex and users need time to apply the method. As mentioned in the discussion of the evaluation, it does require time and effort to use the entire method as the method covered the areas of strategy, capability, and projects. It suggests to simplify the method in different aspects or levels with different scenarios. It also suggests to implement the method in tools with the guidance to different scenarios.

6.4 Recommendation for Future Work

Considering the limitations, we suggest further study to improve the method. Apart from limitations, there are also some possible directions for the future research.

Firstly, in this method, the focus is on the business perspective. The capability map is mainly including the business capabilities. Further research could consider involving more details for the supporting capabilities; then the method could not only support the strategy implementation but also support bottom- up innovation.

Secondly, the project deliverable could be modeled as the capability enhancement in this research. If we want to show more details about the project deliverable, we could model the deliverable as a plateau in the enterprise architecture. Then there is a challenge that, in the enterprise architecture, it is hard to present the enhancement of human skill or the financial level.

Thirdly, in this research, we study the IT4IT RA which enables the real-time monitoring and recording the important information about the project. Future research could move the emphases on the project implementation. With the support of IT4IT

RA and CBP, cycling monitor the strategy alignment and business value during the project implementation.

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Appendixes

A. Alignment among constructs, indicators and its references of portfolio management

Construct	Indicator	Reference
Knowledge of the organizational context (KOC)	KOC1:Existence of a formal planning process, reflecting internal and external stakeholders perspectives	Archer and Ghasemzadeh (1999), Beringer et al. (2013).
	KOC2:Knowledge about constraints, capabilities, uncertainties and interdependencies	Artto and Dietrich (2004), Cañez and Garfias (2006), Martinsuo and Lehtonen (2007), Buys and Stander (2010), Voss and Kock (2013), Teller and Kock (2013), Patanakul (2015)
	KCO3: To have strategic performance measure systems	Barczak and Sultan (2006)
Opportunity identification (OI)	OI1:Preparation of a list of proposed projects and single ongoing projects	PMI (2013a), Lacerda et al. (2011), Englund and Grahm (1999)
	OI2: Garner minimum data for each project from the list, such as scope, value, market, etc. and the objectives of each project	PMI (2013a), Lacerda et al. (2011), Englund and Grahm (1999)
Decision criteria (DC)	DC1: Criteria for evaluate individual projects	Chien (2002)
	DC2: Decision criteria for project selection and prioritization	Cooper et al. (1997), Hart et al. (2003), Girotra et al. (2007), Hart et al. (2003)
	DC3:Giving weights for each decision criteria	Coldrick et al. (2005), Agresti and Harris (2009)
	DC4:Alignment of decision criteria with stakeholder desires	Shenhar and Dvir (2007), Buys and Stander (2010)
	DC5:Definition of decision criteria occur in a multidisciplinary committee	Chien (2002)
Classification (CL)	CL1:Classification of project criteria for engineering systems aimed at better decision making	Agresti and Harris (2009), Dye and Pennypacker (2000), PMI (2013a), Lager (2002), Jolly (2003)
	CL2: Classification of projects is used to compare similar projects	Shenhar (2001), Liesio and Salo (2008), Floricel and Ibanescu (2008)
	CL3:Budget is allocated to projects with the same classification	Shenhar (2001), Shenhar and Dvir (2007)
	CL4: Projects with the same classification are compared and have concurrent resources	Shenhar (2001)
Selection, prioritization, optimization and sequencing (SPOS)	SPOS1: Project selection model	Coldrick et al. (2005), Lawson et al. (2006), Liesio and Salo (2008)
	SPOS2:Methodology and easy to use decision tools (AHP, ANP, DEA)	Greiner and Fowler (2003), Joshi and Lambert (2009), Linton et al. (2007), Mavrotas et al. (2008), Linton, et al. (2002), Coldrick et al. (2005), Wallenius et al. (2008)
	SPOS3: Stakeholder participation in the decision criteria definition	Chien (2002)
	SPOS4: Constraints are considered in the resource allocation	Angelou and Economides (2008), Bitman and Sharif (2008), Danilovic and Sandkull (2005)
	SPOS5: Environment and socio-environmental constraints applied to project selection	Liesio and Salo (2008), Angelou and Economides (2008), Trappey et al. (2009), Danilovic and Sandkull (2005)
	SPOS6: Project prioritizations and selection consider interdependencies and synergies between projects	Liesio and Salo (2008), Angelou and Economides (2008), Trappey et al. (2009), Danilovic and Sandkull (2005)

	SPOS7: Optimization tools are used in allocation resources and prioritization of projects	Mavrotas et al. (2008), Blau et al. (2004), Angelou and Economides (2008)
	SPOS8:Postpone deadline is considered in allocation of resources activity	Jonas (2010), Englund and Grahm (1999), Archer and Ghasemzadeh (1999), Cooper et al. (1999)
Balancing (BAL)	BAL1: Alignment of portfolio with strategy	Archer and Ghasemzadeh (1999), Cooper et al. (1999), Greiner and Fowler (2003)
	BAL2:Balancing of portfolios from different areas considering different criteria: innovation, financial risk, etc., and balancing techniques.	Bitman (2005), Caron et al. (2007), Chao and Kavadias (2008);
Approval (APP)	APP1:Formal approval process of projects in the portfolio	PMI (2013a)
	APP2:Centralization of the decision making in respect to the approval process of projects	PMI (2013a)
Resource allocation (RA)	RA1: Effective use of resources	Al-Fawzan and Haouari (2005), Mohanty and Deshmukhb (1997), Varma et al. (2008), Chen and Wei (2009), Cheng et al. (2006), Lin and Hsu (2010), Ngo-The and Ruhe (2009)
	RA2: Impact of litigation due to the allocation of shared resources to the project	Elonen and Artto (2003)
	RA3: Clarity about human resources available	Chen and Wei (2009), Jonas (2010), Engwall and Jerbrant (2003), Ngo-The and Ruhe (2009)
	RA4: Clarity about budget available	Chen and Wei (2009), Jonas (2010), Engwall and Jerbrant (2003), Ngo-The and Ruhe (2009)
	RA5: Clarity about technological resources available	Chen and Wei (2009), Jonas (2010), Engwall and Jerbrant (2003), Ngo-The and Ruhe (2009)
	RA6: The responsibility to define the project management is concerned to a PMO (project management office)	Chen and Wei (2009), Jonas (2010), Engwall and Jerbrant (2003), Ngo-The and Ruhe (2009)
	RA7: Partial allocation of human resources with matrix structure of resources	Elonen and Artto (2003)
	RA8: Leverage of resources	Trappey et al. (2009), Kendall and Rollins (2003)
	RA9: Political negotiation of resources	Jonas (2010), Elonen and Artto (2003)
Formation of portfolio (FP)	FP1: Planning and programming of projects in the portfolio	Cohen et al. (2004), Kao et al. (2006), Stouffer and Rachlin (2003), (PMI, 2013a)
	FP2: Measurements of physical progress of projects and portfolios	PMI (2013a)
	FP3: Existence of portfolio management support tools	Artto and Dietrich (2004), Hui et al. (2008)
	FP4: Existence of tools of portfolio management	Reyck et al. (2005)
Evaluation (EV)	EV1—The inclusion of projects in the portfolio takes into account the fact that its scope is aligned with the organization's strategic plan.	Englund and Graham (1999), PMI (2013a), Lacerda et al. (2011), Crawford (2002)
	EV2—The organization evaluates projects according to strategic priorities.	Englund and Graham (1999), PMI (2013a), Lacerda et al. (2011), Crawford (2002)
	EV3—All projects are compared with each other and compete for the same resources, regardless of classification.	Archer and Ghasemzadeh (1999), Cooper et al. (1998), Greiner and Fowler (2003), Jonas (2010), Englund and Graham (1999), Edwards et al. (2003)
	EV4—Projects belonging to the same classification are compared to each other and compete for the same resources, however, they are not compared or compete for resources other classification	Archer and Ghasemzadeh (1999), Cooper et al. (1998), Greiner and Fowler (2003), Jonas (2010), Englund and Graham (1999), Edwards et al. (2003)

Project portfolio management infrastructure (PPMI)	Project Management Office Structure (PMO) PMO: Influence of the types of PMO on portfolio management	Dai and Wells (2004); Patah and Carvalho (2009); Lopes (2009)
	Organizational Project Management Maturity (OPM) OPM: Influence of the stages of maturity in organizations	Cooke-Davis and Arzimanow (2003), Martinsuo and Lehtonen (2007), Beringer et al. (2013)
	Information Technology for Project Support (IT) IT: Impact of the use of IT on project success	Froese (2010), Barczak et al. (2007), Salem and Mohanty (2008), Browning (2010), Artto and Dietrich (2004), Hui et al. (2008), Lam et al. (2010), Shenhar (2001), Vaccaro et al. (2010), Martinsuo et al. (2014)

B. Capability performance assessment framework (Cheng, 2015)

Capability dimensions	Level 0: No capability	Level 1: Initial	Level 2: Under development	Level 3: Defined	Level 4: Managed	Level 5: Optimizing
Process	Not established or does not exist.	Processes are ad hoc and chaos.	Basic processes are organized. The processes are standardized and repeatable. They are built based on the experience from the similar projects, which are not unique.	The processes are well defined and communicated to the owner and the related staffs while the business is running. The processes are defined based on specific requirements.	There are quantitative goals for the processes execution. The processes are part of the business culture. Quality metrics are associated with the processes. In this performance level, the organization can predict the trends of the processes.	The organization addresses the processes variation and the processes improvement as the most important topics. To improve the performance of the processes and achieve the quantitative objectives.
Financial	No financial support for executing the related business.	Limited budget to support the business process.	Enough budgets with a little governance for the spending to support the related business.	Enough budgets with good governance of the spending for the related business.	Sufficient budgets. All the spending is planned and guided by the business requirements. Furthermore, the spending is under control, which is based on the feedback received from the implementation.	Sufficient budget. All the spending is planned and guided by the business requirements and the feedback of the implementation. It supports the variation of the business process and allows the organization to make the improvement of the capability.
Physical	No required equipment is involved in business process.	Difficult to use or/and with a high repair rate of the equipment.	The organization has the basic equipment and plant to support the related business.	Specific equipment and location for the related business.	The organization understands all the potential capacity of the equipment and uses them to create business value.	The physical resources are contributing to the efficiency of the related business.
Technology	No intellectual property and the required application are involved in business process.	Limited intellectual properties or/and application is not good enough to support the business.	The organization has the knowledge and/or application to support the related business.	Specific knowledge and/or application for the related business.	The knowledge and/or the applications of the organization are updated. They improve the business value of the organization.	The knowledge and/or applications are updated. They have been sufficiently used and they are contributing to the efficiency of the related business.
Organizational	None. No communication exists between different business units.	Limited communication with both internal and external business units and/or no standards for the business units to implement their tasks.	Documented standards and some sort of communication exist between the internal and external business units	The way of the internal collaboration becomes a specific organizational culture. And the communication with internal and external business units works well.	Standards become a business culture. The culture encourages the employees to work with each other. And the relationships with the internal and external environment contribute to the business value.	The formal or informal standards are update regularly in order to adjust the change of internal or external environment. And the relationships with the internal and external environment become a competitive advantage of the organization.
Human	No participants involved in the business process.	The operating units do not have adequate skill. And/Or no enough participants are involved in the business process.	The organization has adequate skilled and motivated people to support their business.	Adequate skilled and motivated people are specifically assigned to the specific task.	Experienced, motivated and high skilled employees are assigned to the related business. There is an efficiency training system to improve the knowledge and skill of the employee to adapt the change of the environment.	The experts and experienced, motivated employees are facilitating the improvement of the business performance.

C. Survey for the workshop

Survey

Thank you for your participation in this workshop. The survey is intended to get your feedback in order to collect the information about the acceptance of the proposed method. You are expected to answer the survey questions based on your skill and your experience during the workshop. It will take you approximately 10 minutes to complete the survey.

Background information

1. What is your current position in your organization?

2. How often do you use capability-based planning techniques?
   □ rarely □ sometimes □ often □ very often

3. How often do you use project portfolio management techniques?
   □ rarely □ sometimes □ often □ very often

Acceptance of the method

		Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
Performance expectancy	PE1: I would find the method is useful in helping me with the portfolio management.	□	□	□	□	□	□	□
	PE2: Adopting the method will increase my productivity.	□	□	□	□	□	□	□
	PE3: Using the system enables me to accomplish tasks more quickly.	□	□	□	□	□	□	□
Effort expectancy	EE4: I would find the method is easy to apply in a case.	□	□	□	□	□	□	□
	EE5: Learning to use the method is easy.	□	□	□	□	□	□	□
	EE6: My interaction with the method would be clear and understandable.	□	□	□	□	□	□	□
Attitude toward using technology	AT7: I like to work with the method	□	□	□	□	□	□	□
	AT8: I have the knowledge necessary to apply this method.	□	□	□	□	□	□	□

	AT9: The method is compatible with other method	□	□	□	□	□	□	□
Self-efficacy	SE10: If I had a lot of time, I could complete the job using the method.	□	□	□	□	□	□	□
	SE11: I could use the method to complete a job or task if I could call someone for help when I got stuck.	□	□	□	□	□	□	□
	SE12: I could use the method to complete a job or task if I had the built-in help facility for assistance.	□	□	□	□	□	□	□
Behavioral Intention	BI13: I intend to use the method in the future for helping me managing portfolios.	□	□	□	□	□	□	□

Additional comments or suggestions

Thank you so much for your time.

D. Survey result

	N	ID	CSC	RC1	RC2	RC3	Min	Max	Sum	Average	SDEV
CBP	5	1	1	2	3	1	1	3	8	1.6	0.8
PPM	5	1	2	2	2	2	1	2	9	1.8	0.4
PE1	5	5	5	6	5	6	5	6	27	5.4	0.48989795
PE2	5	4	4	5	4	5	4	5	22	4.4	0.48989795
PE3	5	4	2	2	3	4	2	4	15	3	0.89442719
EE4	5	5	4	3	4	6	3	6	22	4.4	1.0198039
EE5	5	6	5	4	4	5	4	6	24	4.8	0.74833148
EE6	5	6	2	5	5	5	2	6	23	4.6	1.356466
AT7	5	5	6	6	4	6	4	6	27	5.4	0.8
AT8	5	2	2	6	5	6	2	6	21	4.2	1.83303028
AT9	5	6	4	5	5	6	4	6	26	5.2	0.74833148
SE10	5	6	5	6	6	6	5	6	29	5.8	0.4
SE11	5	6	6	6	6	6	6	6	30	6	0
SE12	5	4	6	6	6	5	4	6	27	5.4	0.8
BI13	5	3	5	6	4	4	3	6	22	4.4	1.0198039
Average PE		4.3333333	3.666667	4.3333333	4	5	3.66667	5	21.33333	4.266667	0.44221664
Average EE		5.6666667	3.666667	4	4.3333333	5.3333333	3	6	23	4.6	1.5011107
Average AT		4.3333333	4	5.6666667	4.6666667	6	3.33333	6	24.66667	4.933333	1.34219279
Average SE		5.6666667	3.666667	4	4.3333333	5.3333333	5	6	28.66667	5.733333	0.51783023
Average BI		3	5	6	4	4	3	6	22	4.4	1.5011107