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A METHOD FOR OPERATIONALIZING SERVICE-DOMINANT BUSINESS MODELS

Bambang Suratno

A Method for Operationalizing Service-Dominant Business Models

Bambang Suratno

The research described in this thesis is part of PhD program of the School of Industrial Engineering, Technische Universiteit Eindhoven. The author has successfully completed the educational program of TU/e Graduate School of Industrial Engineering. This research was supported by the Indonesian Ministry of Finance through the Indonesia Endowment Fund for Education (LPDP).

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A Method for Operationalizing Service-Dominant Business Models

PROEFSCHRIFT

ter verkrijging van de graad van doctor aan de Technische Universiteit Eindhoven, op gezag van de rector magnificus prof.dr.ir. F.P.T. Baaijens, voor een commissie aangewezen door het College voor Promoties, in het openbaar te verdedigen op dinsdag 17 maart 2020 om 16:00 uur

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Het onderzoek of ontwerp dat in dit proefschrift wordt beschreven is uitgevoerd in overeenstemming met de TU/e Gedragscode Wetenschapsbeoefening

Summary

Service-Dominant Logic (SDL) is a mindset that creates many opportunities for designing and innovating networked business models, in which multiple parties collaborate to deliver a specific value (called *value-in-use*) to a specific customer class. These business models are called *service-dominant* business models. One general problem in business model design and implementation is the limited methodological support that guides the operationalization of business models into business processes and information systems. This problem also exists in the SDL context – and is possibly greater than in non-SDL cases because service-dominant business models require business processes spanning a collaboration between multiple parties. It is this problem that is addressed in this thesis.

This thesis proposes a method (namely, SDBMOM) for the operationalization of service-dominant business models into conceptual business process models specified in the BPMN standard as the first step towards business model implementation. SDBMOM is developed as part of the BASE/X business engineering framework, which aims to provide conceptual and methodological support for adopting SDL in the end-to-end business design and operationalization.

In the development of the SDBMOM, we have followed the design-science research methodology. We have defined the problem and set of design objectives, developed and designed our artifact, and evaluated its validity and utility. SDBMOM is conceptualized and characterized in the BASE/X framework and presented as a stepwise method that relies on the concepts and elements of the well-known process modeling approach - BPMN.

The structured SDBMOM method ensures the operationalization of business models as a whole, and delineates the operational scope and boundaries for each value co-creating network party provides the basis for the specification of conceptual and executable process models, and eventually facilitate their implementation in process-aware information systems.

In this thesis, we use an illustrative business scenario from the travel industry domain to explain, illustrate and evaluate the method. The method is evaluated with the help of expert practitioners from various industry domains.

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Bambang Suratno
Eindhoven, the Netherlands
Spring 2020

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List of Abbreviations

A-A	:	Actor-to-Actor
BASE/X	:	Business Agility through Cross-Organizational Service Engineering
BM	:	Business Model
BMC	:	Business Model Canvas
BMO	:	Business Model Operationalization
BPEL	:	Business Process Execution Language
BPMN	:	Business Process Model and Notation
BPMS	:	Business Process Management System
BS	:	Business Service
C-A	:	Customer-to-Actor
CIM	:	Computer Independent Model
CPM	:	Conceptual Process Model
CSOFT	:	Customer Relationship-Service-Organization of Network-Finance-Technology
CSS	:	Customer Service Scenario
DSR	:	Design Science Research
EC	:	Exclusion Criteria
EPM	:	Executable Process Model
FP	:	Foundational premises
FRA	:	Free Ride Amsterdam
GDL	:	Good Dominant Logic
IC	:	Inclusion Criteria
ITU	:	Intention to Use
JPE	:	Just-in-time Presence of Elderly
MDA	:	Model-Driven Architecture
OL1	:	Operationalization LEVEL-1
OL2	:	Operationalization LEVEL-2
OL3	:	Operationalization LEVEL-3
PEU	:	Perceived Ease to Use
PIM	:	Platform Independent Model
PSM	:	Platform Specific Model
PU	:	Perceived Usefulness
SBMC	:	Service Business Model Canvas
SD	:	Service-Dominant
SDBM	:	Service-Dominant Business Model
SDBM/R	:	Service-Dominant Business Model Radar
SDBMOM	:	Service-Dominant Business Model Operationalization Method

SDL	:	Service-Dominant Logic
SLBMC	:	Service Logic Business Model Canvas
SLR	:	Systematic Literature Review
SOA	:	Service-Oriented Architecture
SOC	:	Service-Oriented Computing
STOF	:	Service-Technology-Organization-Finance
TAM	:	Technology Acceptance Model

1 Introduction

This chapter introduces the research study presented in this dissertation. To provide the context for the research study, we start with the discussion on the concepts of business models and service dominant business. Next, we present the research problem that we have identified and its significance. This is followed by the formulation of the main research question, and a brief overview of the research steps that have been taken to address it. Finally, the structure of this thesis report is presented.

1.1 Business Models and Service-Dominant Business

Service-Dominant Logic (SDL) is a marketing-grounded mindset that has emerged and evolved for capturing and extending a convergence of the perspectives on the evolution of the concepts of *value* and *exchange* [132, 133]. Specifically, SDL shifts the focus of business away from the production and distribution of products in the form of goods or traditional services (referred to as *goods-dominant logic* or GDL) toward the concept of service, the application of knowledge and skills, as the basis of all exchange in which service is exchanged for service [132].

While the emergence of SDL has led to a movement in marketing research, providing a holistic view of value and exchange, SDL has influenced many business domains and other research fields such as services science [104, 118]. It has been used as a logical framework for capturing and understanding the business and the shift in business thinking and innovation which emphasizes integrated customer solutions over products, relations and experiences over transactions, network-centric co-created value that emerges in-context over provider-centric value offerings, and the ever-increasing role of information technologies in value creation [23, 67, 77]. Online shopping, car sharing, online food delivery, on-demand music streaming are among many everyday life examples that represent this shift, which is well-captured by SDL. Despite its recognition for creating diverse opportunities for business, representing a view of the market and business, the practical implications of SDL research have been limited to a set of generic normative guidelines and insights as to how to use the concepts for guiding the business [76, 79, 135].

The concept of *Business Model*, on the other hand, has become increasingly important in business and research circles [85, 111]. Business models serve as templates depicting the way business is conducted [156]. They have received increasing attention from scholars and business strategists interested in explaining firms' value creation, performance, and competitive advantage [154]. Business models can be used in the explication of a firm's current or future value creation logic, in structuring the activities performed by an organization and the interactions with business partners [5]. Moreover, they serve as a unit of analysis to understand and research value creation. Different than a business idea, which articulates an entrepreneurial or innovative intent, a business model represents the integrated elements of business that fit into a working whole [84, 86], thus is a more formal conceptualization that allows the viability of a business idea to be proved [65, 86]. To facilitate

business model analysis and design, several representational design tools have been proposed, such as the Business Model Canvas [97], which has become popular in the business modeling community.

"Business model" is a multi-faceted and complex concept. The diverse range of definitions for the concept of business model are increasingly converging on -firstly- its relation to business strategy and value [65], secondly, on its integrative and bridging function between business strategy and business implementation by employing business processes and information systems (IS) [4, 21, 29, 84, 96, 117, 121], and thirdly, on the relation between the firm and its external stakeholders of business [65]. These points of convergence in business model definitions resonate with the SDL mindset where a network of actors co-create value-in-use via integrated co-production activities using their competencies (i.e., specialized resources) [81].

Recognizing the highly innovative potential of SDL and the enterprises' need for conceptual and methodological support for representing, analyzing and designing service dominant business models, business modelling research has proposed a number of approaches for service dominant business modelling, thereby facilitating the mapping of business decisions to the SDL mindset [23, 36, 68, 74, 83, 91, 94, 130, 152, 154]. By the inclusion of the elements of service dominant or networked business/value settings, such as co-created value, co-production activities or by giving business customers a central role, the scope for business model design has transcended beyond the boundaries of an organization [22, 72, 83, 154]. In particular, a number of business model design tools have been adopted to incorporate SDL elements into focused service-dominant business models [73, 93, 129, 130, 153].

1.2 Problem Statement

A business model can be seen as a macro-level outline description of the essential details of a firm's value proposition for or together with its various stakeholders and the activity system that facilitates value creation [112]. While business model and strategy are distinct conceptual terms, they are closely related as business models serve as operational representations of a firm's strategy [3].

In practice, business model designs are usually represented by a mixture of informal textual, verbal, and ad-hoc graphical representations that build on concepts and their relations (i.e., ontologies) that represent constituent elements of a business model [41, 73, 93, 129, 130, 153]. For business models, such outline descriptions explain the "why" and the "what" of business, but they do not state *how* value-creating activities are carried out [40].

On the other hand, the business models represent dynamic activity systems that operate and need the engagement of human, physical and/or capital resources of any party to the business model to serve a specific purpose towards the fulfillment of the overall objective [155]. Therefore, the design of a viable and feasible solution system should address the 'how' question of a business model, explicating the set of activities and how and when they are to be performed. In essence, a purposeful weaving of interdependent activities performed by the firm itself or by its suppliers, partners and/or customers (i.e. network of actors) is an aim of the business model design [155]. The typical elements of such

operational-level business model design are *business process models*, and other models of IS system designs [4, 7, 30, 71, 117].

In general, the macro-level (why-what) and the operational level (how) perspectives of design are considered as related but separate activities distinguished by their goals, artifacts, and domain knowledge, the latter referred to as *Business Model Operationalization (BMO)*. BMO involves the realization of the business model by deriving business process models and information system components from the outline business model [4], hence, it is the process of *mapping the macro-level elements of a business model to the operational-level artifacts of the parties of a business model*.

Studies in the business model operationalization literature have proposed diverse approaches to guide the business model operationalization process (which are reviewed and presented in detail in Chapter 2). However, in the service dominant business modeling context, there are several shortcomings, in particular in addressing the operational requirements of the key elements of service dominant business models, such as the networked-business actors, customer as a value co-creating and co-producing actor, and a traceable mapping of co-production activities to individual actors' competences and activities.

In summary, the question of how service-dominant business models can systematically be operationalized into operational artifacts, such as specifications of business processes and information systems, has remained largely unanswered. *The purpose of this thesis is to make a major step in answering this question, i.e., in bridging the gap between abstract, functional specifications of business models and concrete, operational specification of business processes implementing these business models.*

1.3 Research Significance

To address the gap discussed in the previous subsection, this thesis proposes a structured method - which we refer to as *SDBMOM* - for the operationalization of service-dominant business models. The core concepts in this method follows the basic principles of the BASE/X business engineering outline framework designed specifically for SDL business settings [47, 74].

We took the BASE/X as our underlying outline framework as there is currently no other business engineering framework that outlines and connects the business elements of strategy and business models (what of business) and service compositions (business processes) and business services (how of business) together, and puts them in the context of SDL. The BASE/X outlines a holistic design approach that covers a wide spectrum of business elements, aiming to integrate concepts from strategy to implementation, which are organized around four core concepts: business strategy, business model, service compositions (conceptual process models) and business services (Figure 1-1).

Business agility is central in BASE/X, aimed at supporting rapid design of business models and the corresponding service compositions. A service composition is an operational representation of a business model by specific arrangements of the business services (which have a slowly evolving

nature [47, 130]). The preceding works on the BASE/X framework address the business strategy [74] and business model layers [130], [45]. In continuation of this service-dominant business engineering line of research, in this thesis, we focus on the operationalization of the service-dominant business models, i.e., on the mapping between the second and third layer of the framework (as depicted in Figure 1-1).

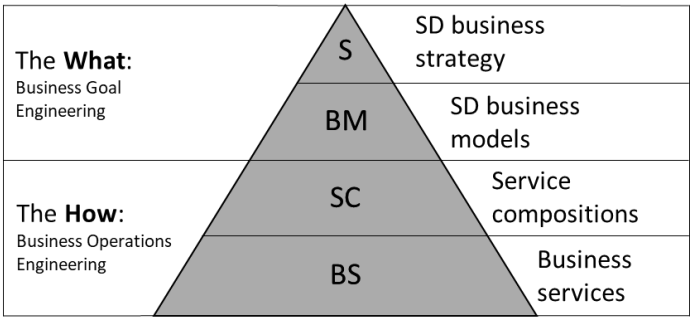

Figure 1-1 BASE/X business engineering framework [47]

A service-dominant business model (SDBM) can be operationalized through the composition of business services [130], or what is referred to as '*business service composition*'. Process modelling is a common and flexible way of representing operational aspects of business models [4, 40, 117] allowing the representation of compositions of services that are provided by human actors as well as software applications and in various levels of operationalization [40, 66, 127]. In this study, we use business processes and their representations as conceptual process models addressed by the BASE/X Service Composition (SC) layer. Further details about the BASE/X framework are presented in Section 2.2.1.

Following our research goal, the contribution of this research is twofold:

1. Conceptual underpinnings of service dominant business model operationalization: the conceptualization of the business service compositions and its characterization in the service dominant business engineering framework by elaborating its relation with the other framework concepts (i.e., business model and business service).
2. SDBMOM - a structured method for the operationalization of a service dominant business model in the form of a conceptual process model that delineates the operational scope for each value co-creating actor serving as a specification for their executable processes.

1.4 Research Questions

Following our focus on service-dominant business model operationalization and the perspectives that we adopt in the BASE/X outline framework, this study has the following main research question:

How can we facilitate the operationalization of service-dominant business models into conceptual business processes in the form of business service compositions given a set of business services?

Accordingly, the main research question can be decomposed into sub-questions. As a first step in designing a method for operationalizing service-dominant business models, there is a need to investigate the existing approaches for business model operationalization and obtain an overall understanding of the existence, characteristics, and use of BMO approaches, as well as identify the gaps to be addressed. Therefore, the first sub-question can be formulated as follows:

RQ.1: Which aspects of business model operationalization have been addressed in the existing academic literature and which gaps remain to be covered?

In order for SDBMOM to stand on solid foundations, the underlying core concepts and their interrelationships should be explicitly and clearly defined. As these concepts originate or are typically referred to in different research domains (such as service science, business process management, and information systems), identification and clear definition of these concepts are important to better communicate the SDBMOM. Therefore, the second research question is formulated as follows:

RQ.2: What are the core concepts that are essential for operationalizing service-dominant business models?

A structured way of operationalizing a service dominant business model implies the need for a step-wise guidance to be followed by practitioners. This is to ensure that the application of the method is effective, systematic and repeatable. The method should also support addressing consistency and traceability concerns regarding different components of the operationalization (business model, business process model, and intermediate artefacts). Identification of related organizational roles with corresponding skills would also help to address these objectives. Accordingly, the third research sub-question is posed as follows:

RQ.3: What are the key steps of a method that can facilitate the operationalization of service-dominant business models into conceptual business processes given a set of business services, and what organizational roles can be linked to these steps?

In the remaining chapters of this dissertation, we describe how we addressed these questions and the results that we have achieved.

1.5 Research Approach

In the information systems discipline, two main research paradigms are predominant: behavioral science and design science [54]. While behavioral science paradigm aims at developing and verifying "theories that explain or predict human or organizational behavior", design science paradigm aims at "extending the human or organizational capabilities with creating new or innovative artefacts" [54]. As the main research question that is posed above (in Section 1.4) implies the necessity to design a new artifact, we followed the design science research paradigm [48, 148]. Following the guidelines

for conducting design science research [100], we performed the following steps to conduct this research:

- *Identifying the problem*: Based on our review of the literature on business model design/representation and service-dominant logic, we have identified our *problem* and defined the *research question* as discussed in above sections (Sections 1.2 and 1.4, respectively).
- *Defining the objectives of the solution*: Based on the research question, we performed a systematic review of related literature to gain an understanding on the aspects of business model operationalization that have already been addressed in the existing literature and to identify gaps (Section 2.3). The SLR also confirmed our problem statement. Taking this and the results of the literature review as basis, we have identified the *objectives* that the SDBMOM should fulfil (Section 3.3).
- *Designing and developing a satisfactory artifact*: Next, we developed the SDBMOM as a design artifact to support the defined objectives (Chapters 4 and 5).
- *Demonstrating/applying the model in a suitable context:* We have applied it in an illustrative business scenario to demonstrate it in an appropriate real-life like business context (Section 6.1).
- *Evaluating the artifact in a real-life business setting*: After the application in a business scenario, we have refined the method and applied it in two real-life business cases to operationalize service-dominant business models and evaluate SDBMOM's validity (Section 6.2). Finally, we conducted interviews with industry experts to gather their view on the utility of the SDBMOM (Section 6.3).

The detailed elaboration of the research design, including the SDBMOM objectives, research methods applied at different steps, is presented in Chapter 3.

1.6 Thesis Structure

Figure 1-2 provides an overview of the structure of this thesis, which is organized in seven chapters.

Following the introduction section, the remainder of the thesis is structured as follows:

Chapter 2 presents the background on the business engineering framework, and the method used for the design of Service-Dominant Business Model blueprints to be operationalized. An overview of the related work regarding business model operationalization as a result of a systemic literature review is also discussed in this chapter.

Chapter 3 presents the design of this research, including the objectives that the proposed method (SDBMOM) was expected to fulfil, and the research methods applied in the design, development, application and evaluation of the proposed method.

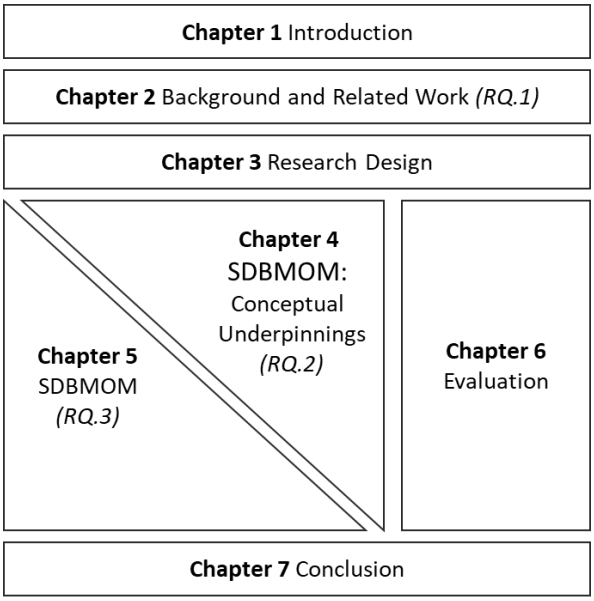

Figure 1-2 Thesis structure

Chapter 4 introduces the conceptual underpinnings of the proposed method, namely: service-dominant business model (SDBMs), customer service scenario, business services, and business service compositions.

Chapter 5 presents the proposed method – SBMMOM- as the design artifact and elaborates on the structured steps to be taken in operationalizing SDBM blueprints into the conceptual process models. The organizational roles that are expected to be involved in different phases of the proposed method are also described in this section.

Chapter 6 presents the results regarding the evaluation of SDBMOM.

Chapter 7 discusses the conclusions, including the implications to research and practice, limitations, and directions for future research.

1.7 Chapter Summary

Service-Dominant Logic (SDL) changes the way how companies conduct their business from focusing on production and distribution of goods towards offering services by co-creating value with their customers. This leads to the creation of diverse business opportunities. However, the practical implications of SDL research have been limited to a set of generic normative guidelines and insights as to how to use the concepts for guiding the business. Business model concepts solidify these set of normative guidance and insights into a practical tool to define business opportunities on the basis of value creation. Thus, it encourages the development of Service-Dominant Business Models (SDBMs).

Yet, the design of a viable and feasible business model should address the 'how' question of a business model explicating the set of activities and how and when they should be performed. This is referred to as *Business Model Operationalization*. While studies in the business model operationalization literature have proposed a number of approaches to guide the business model operationalization, in the service dominant business modeling context, there are still several shortcomings. Therefore, the question of how service dominant business models can systematically be operationalized into operational artifacts remains largely unanswered.

To address the need, this thesis proposes a structured method for the operationalization of service dominant business models, referred to as "SDBMOM". The core concepts of this method are based mainly on the BASE/X business engineering outline framework that is specifically designed for SDL business settings. This research aims contribute to the body of research by proposing the conceptual underpinnings of service dominant business model operationalization, and by the SDBMOM, that is, a structured method that can be used for the operationalization of service dominant business models into conceptual process models that delineates the operational scope for each value co-creating actor serving as a specification for their executable processes. In developing SDBMOM, we have followed the design science research methodology.

2 Background and Related Work

In this chapter, the background for service-dominant business model operationalization (BMO) is described and related literature on business model operationalization is discussed. Section 2.1 gives an overview of Service Dominant Logic. Section 2.2 presents Service-Dominant Business Framework, in which Section 2.2.1 gives an overview of the Service-Dominant Business Engineering Framework, explains its aims and the core concepts, Section 2.2.2 presents Service-Dominant Business Model (SDBM) design tools reported in the literature and outlines the rationale for choosing Service-Dominant Business Model Radar (SDBM/R) as the design template for SDBMs. Section 2.2.3 gives an overview of the SDBM/R and the associated concepts. Finally, Section 2.3 reviews the BMO literature from a service-dominant perspective.

2.1 Service Dominant Logic

Service-Dominant Logic (SDL) is a marketing-grounded mindset that has emerged and evolved for capturing and extending a convergence of the perspectives on the evolution of the concepts of value and exchange [132, 133]. SDL has been developed to provide a simplifying, realistic, and transcending view of markets and marketing and more broadly human exchange systems [134].

SDL views applied, specialized skills and knowledge as the focus of economic exchange, thus gives service exchange a central role in the improvement of individual and collective well-being where humans exchange the service-the application of specialized skills and knowledge that they can provide to others for the service that they need from others [137]. If goods are involved in the exchange, they are seen as mechanisms for service provision.

While SDL represents a departure from the traditional, foundational, goods dominant (G-D) logic of exchange, in which goods were the focus of exchange, it transcends G-D logic by taking it as a nested and integral logic, rather than a distinct logic [134]. In SDL, the distinction between operant resources and operand resources has a key role in building, understanding and applying SDL. Operand resources are static resources, such as natural sources, that require some action to be performed on them before they are engaged in the process of exchange (i.e., “service”,). Operant resources are dynamic resources that act upon other resources such as human knowledge and skills. Two other key concepts in SDL terminology are co-production and co-creation, where the former refers to the creation of the value proposition (e.g., design, production) and the latter refers to the actions of multiple actors, aware or unaware of each other, that contribute to each other’s wellbeing [134]. Table 2-1 contrasts the views of G-D and S-D logics on several key economic concepts.

SDL logic builds on a set of foundational premises which has been developed and refined along its evolutionary path [134, 139]. Five of them are regarded as core foundational premises which capture the essence of S-D logic and arguably leads the derivation of the remaining foundational premises [137]. Thus, these are considered as the axioms of the S-D logic (Table 2-2).

Table 2-1 Contrasting Perspectives (adopted from [80]*)*

Alternative Views	**G-D Logic**	**S-D Logic**
Basis of Exchange	Goods	Service
Rule of Goods	End Products	Appliances (means)
Customer	Operand Resource	Operant Resource
Value	Embedded in Offering (good)	Beneficiary Determined
Firms-Customer Interaction	Transactional	Relational
Economic Growth	Surplus Tangible Resources	Application of Specialized Skills & Knowledge

In the following we summarize the five axioms adopting the definitions mainly from [78, 139]. The complete description of all eleven FPs and further discussion about the axioms, the recommended references are [134, 137, 139].

Table 2-2 Five Axioms of the Service Dominant Logic

Axiom	
Axiom 1/FP1	Service is the fundamental basis of exchange.
Axiom 2/FP6	Value is co-created by multiple actors, always including the beneficiary.
Axiom 3/FP9	All social and economic actors are resource integrators.
Axiom 4/FP10	Value is always uniquely and phenomenologically determined by beneficiary.
Axiom 5/FP11	Value cocreation is coordinated through actor-generated institution and institutional arrangements.

Axiom 1: Service is the fundamental basis of exchange. This axiom is based on the definition of service: the application of operant resources (knowledge and skill) for the benefit of other actors. Actors exchange service as they strive to become better off rather than goods. In other words, service is exchanged for service and, which implies that (1) goods are appliances for service provision, (2) all businesses are service businesses, and (3) all economies are service economies. In this exchange system money, when it is involved in exchanges, represents rights to future service.

Axiom 2: Value is co-created by multiple actors, always including the beneficiary. This axiom contradicts with the G-D logic view that the firm is the creator, of value; rather, it suggests that value is always co-created through the interaction of actors, either directly or through goods. The beneficiary is always a party to its own value creation. Therefore the customer is always a co-creator of value .It follows from this axiom that the service-oriented view is inherently relational because value does not arise from firm's or producer's internal processes but through the use of the service offerings in a particular context, in conjunction with resources provided by other service providers.

Axiom 3: All social and economic actors are resource integrators. The resources to integrate come from a variety of sources, including private sources from self, market sources (through economic exchange), or public sources (i.e., communal and governmental). It is through the integration of these

resources in its many possible explicit and implicit combinations, that value is co-created. This resource integration not only occurs with the resources directly available to actors involved in an exchange, but also indirectly with the resources and actors that provide these resources in a network of other resource-integrating actors' e.g. in a service ecosystem.

Axiom 4: Value is always uniquely and phenomenologically determined by the beneficiary. This axiom highlights two characteristics of S-D logic. Firstly, the term beneficiary reflects the generic nature of actors, a move from a single-minded concern with restricted and pre-designated roles of producers/ consumers, firms/customers, etc. Secondly, axiom reinforces that value is contextual and experiential.

Axiom 5: Value co-creation is coordinated through actor-generated institutions and institutional arrangements. This axiom captures the value co-creation facilitator role of institutions from an ecosystems perspective and draws attention to the rules of effective, efficient and sustainable exchange processes. Accordingly, "institution" refers to relatively isolatable, individual rule (e.g., norm, meaning, symbol, law, practice) whereas "institutional arrangements" refer to interrelated sets of institutions that together constitute a relatively coherent assemblage that facilitates coordination of activity in value-co-creating service ecosystems. In short, institutions provide the glue for value co-creation in ecosystems. A narrative of value cocreation through actors' resource integration and service exchange, coordinated by institutional arrangements that define nested and overlapping service ecosystems is illustrated in Figure 2-1.

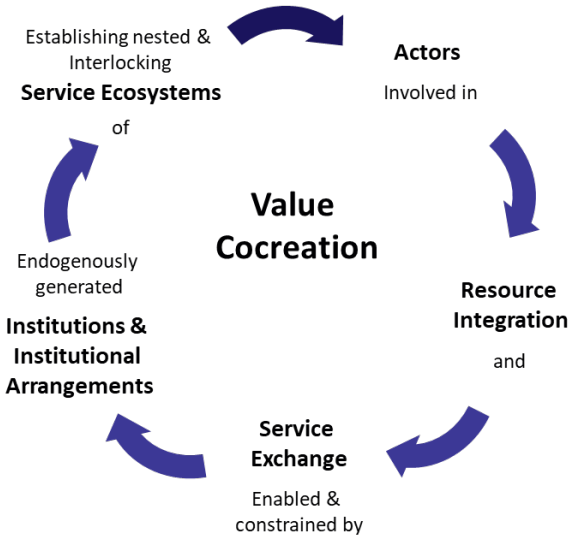

Figure 2-1 The narrative and process of S-D logic (adopted from [134]*)*

In the following section, we introduce the BASE/X outline framework for service dominant business engineering, the SDBM/R as its business modelling tool and we elaborate their relationship with the SDL.

2.2 Service-Dominant Business Framework

In the following sections, we provide detailed descriptions of business model and service-dominant business mentioned in Section 1.1.

Section 2.2.1 gives description on the business engineering framework. Section 2.2.2 presents the evolution of service-dominant business model design tools and SDBM/R that we select as business model representation artifact which is the main input to SDMOM operationalization method. SDBM/R is further explained in Section 2.2.3.

2.2.1 Service-Dominant Business Engineering Framework

A solution-oriented service provider is concerned not only about what services to offer but also about how to deliver them. Managing service complexity and business agility require close integration between the business strategy and business models on the one hand, and the structure of business operation and information technology on the other hand [3]. Truly agile service provisioning business is not achievable if these elements are treated in isolation.

Business Agility through the Cross-Organizational Service Engineering (BASE/X) was introduced as an outline framework to guide research for the development of models, methods and techniques towards the design of Service-Dominant Business [44, 46, 47]. The framework follows a holistic and end-to-end view of a service-dominant business system which is centered around on four core components: business strategy, business models, service compositions (or "conceptual business process") and business services [130]. The components are integrated and represented as a stack of related layers (see Figure 2-2).

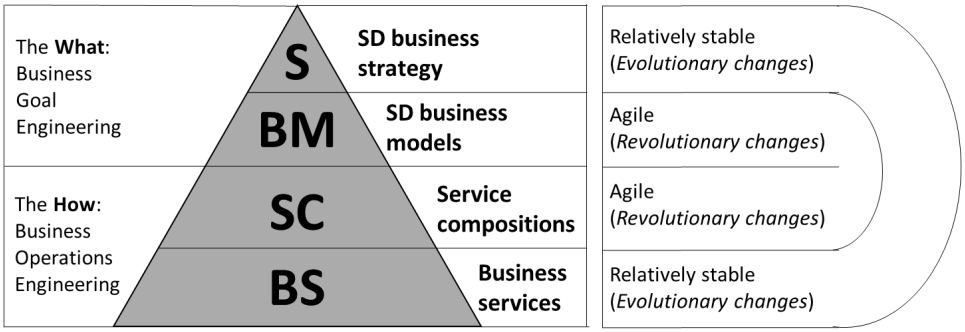

Figure 2-2 Business Pyramid of the BASE/X Framework [130]

The top layer, business strategy, describes the identity of an organization in a service-dominant market [63, 75]. The strategy is relatively stable over time: it evolves. The second layer contains service-dominant business models, describing market offering in the form of integrated solution-oriented complex services. They follow fluid market dynamics and are agile: they revolve – they are conceived, modified, and discarded as required. Business models are distinguished from the strategy as they implement a part of the strategy in a more specific way. They are operationalization of the strategy as they are more concrete. The SDBM/R is a business modeling tools embedded in this framework.

The bottom half of the pyramid covers business operations engineering, which contains business services and service compositions. Each business service represents a core service capability of the organization. As these capabilities are related to the resources, they are relatively stable over time: they evolve. In the service compositions layer, business services are composed to realize the service functionality required by a business model: they implement a concrete value-in-use. A composition, in the form of a business process model, includes business services from the organization's own set, but also business services of partner organizations in the value network [146]. As service compositions follow business models, they are agile: they develop with their associated business models.

Accordingly, the business strategy and the business model together represent the driving idea and the goals (*what?*) of the business whereas the service compositions and the business services represent the operational aspects, thus the activities and the competences (*how?*) for putting the business idea and goals into effect following the SDL mindset.

The framework makes an explicit distinction between the stable essence of a business organization (strategy and business services) and the agile market offerings of that organization (business models and service compositions) [85]. This distinction between the stable and agile aspects is important as digital transformation requires more agility and improved responsiveness [88]. As shown in Figure 2-2, engineering of the stable part of business takes place in the strategic design cycle. In this cycle, the identity and the capabilities of an organization are aligned in an evolutionary fashion. Engineering of the agile part of business takes place in the tactic design cycle. Here, business models and their realization in service compositions are created, modified and discarded in a revolutionary fashion. The tactic design cycle 'spins' at a higher speed than the strategic design cycle. This fast-paced nature of the tactic design cycle supports managing uncertainty (in the business environment), which is essential to success in the digital era. Digitization often needs adaptive approaches to implementing change, which can be contrasted to the traditional, predictive methods of implementing change [88].

The main premise of this framework is that the extent of an organization's agility is determined by its rapid switching capability between the combinations of business model and service compositions which is essential for participation in value co-creation processes in changing value contexts. This allows for continuous service provision in concert with its relatively slow-evolving business strategy and business services. Following this premise, service compositions in the framework function as conceptual business processes that operationalize service-dominant business models by the rapid

composition of business services [130]. However, while BASE/X addresses requirements and addresses service compositions for the operationalization of SDBM/R models [127], there is yet no standardized method provided for the construction of these service compositions.

2.2.2 Service-Dominant Business Model Design Tools

Emerging from the business and management fields, the term *business model* has been used for a diverse range of concepts. The earlier studies on the business model (BM) concept focus on the conceptualization, whereas later studies focus on the integrative and multi-faceted nature of the concept [4, 65]. In their narrative literature review, Klang et.al [65] classify the definitions of business model. Their detailed analysis of the papers in the domain reveals that the relation of the term to the concept of strategy and the relation to the concept of value are two recurring themes [65]. Thus, business models also are related to the strategic arrangement of a company [112, 117, 156].

Business model representations have been in the form of a mixture of informal textual and graphical representations [154]. Following the rise of service-dominant logic (SDL), the design of business models also has evolved to address service-dominant logic premises following the notion of value co-creation: *the locus of value creation is no longer perceived to reside within firm boundaries but value is considered to be co-created among various actors within the networked market* [91].

In the following we summarize and review business modelling tools from the literature (1) to understand to what extend these tools capture service-dominant logic mindset (2) to select the tool that suits the goals of this research. Specifically we review and compare e3-value [41], Business Model Canvas (BMC) [97], Service-Technology-Organization-Finance (STOF) model [14, 33], Customer Relationship-Service-Organization of Network-Finance-Technology (CSOFT) model [53], Service Business Model Canvas (SBMC) [153], Service Logic Business Model Canvas (SLBMC) [94] and Service-Dominant Business Model Radar (SDBM/R) [130].

e3-value: Gordijn and Akkermans propose an ontology (i.e. e3-value) that borrows concepts from the business literature [41, 56]. It uses a network-centric approach to model constellations of enterprises and end-consumers who create, distribute, and consume things of economic value. An e3-value model describes the value exchanges among actors of a business network. It emphasizes the analysis of the economic feasibility of business models through the value exchanges among actors of a business network (rather than the conceptual definition of business models and the *value-in-use*). The relationships between the actors in the network are mapped bilaterally, as opposed to the multilateral nature of the value-network in SD business.

Business Model Canvas: Osterwalder and Pigneur proposed the Business Model Ontology (BMO) that formed the basis for the development of the Business Model Canvas (BMC) [96]. The BMC is a visual chart with elements describing a company's value proposition, customers, infrastructure - including its partnerships, and financial aspects. It has been adopted widely in practice for designing business models (see Figure 2-3 for the template of BMC tool) [97]. It follows an organization-centric

approach that renders the model from the perspective of a single company. It focuses on the processes controlled by the focal company and pays less attention to the customers' active role in value co-creation.

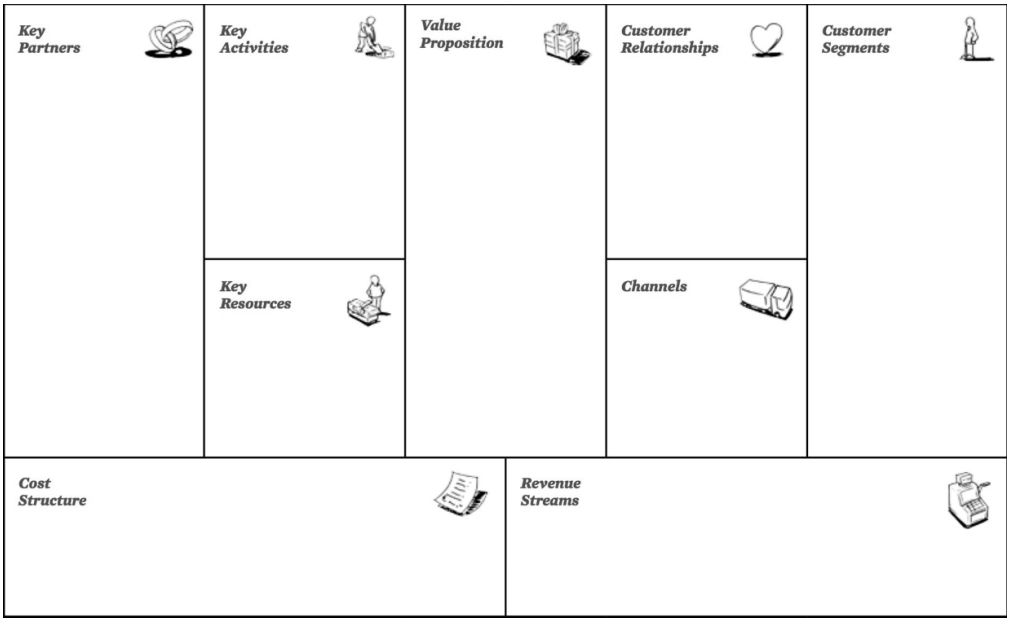

Figure 2-3 Business Model Canvas [97]

STOF-CSOFT: Taking the concept of service offering as a basis, Faber et al. and Bouwman et al. propose the STOF-model [14, 33], which starts from establishing the value to the customer, and consequently focuses on four infrastructural domains, namely service, technology, organization and finance, which comprise the design of the business model. An extension to STOF-model is proposed by Heikkilä et al., which emphasizes the role of customer and supplier relationships (and as such is named CSOFT) [53].

Service Business Model Canvas: Grounded on the premises of service-dominant logic, Zolnowski et al. introduce the Service Business Model Canvas (SBMC) [153]. It is an adaptation of the business model canvas (BMC) that focuses on the representation of the business logic of service offerings. It expands the representation of customer and partners in the business model canvas by separating the business model into three different perspectives (i.e. customer perspective, company perspective, and partner perspective). Therefore, SBMC offers a representation with a stack of multiple BMCs each allotted to a specific network party, including the customer (see Figure 2-4 for the template of SBMC tool) [153].

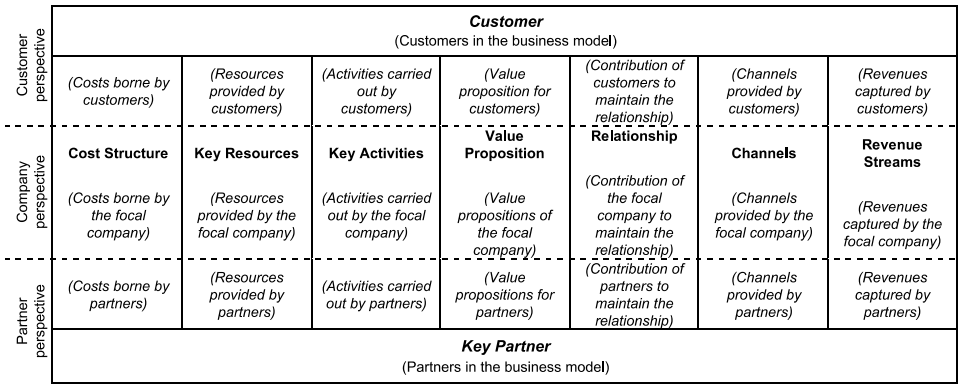

Figure 2-4 Service Business Model Canvas [153]

Service Logic Business Model Canvas: Ojasalo and Ojasalo propose the Service Logic Business Model Canvas (SLBMC) which is a revised version of the business model canvas (BMC) [94]. The modification aims at increasing the service logic orientation of the original BMC tool. SLBMC use BMC original structure and redesign each block to be more service logic oriented. The new canvas also recommends the order in which the elements of the canvas could be developed. The order may be different, depending on each customer profile where the BM will be applied (see Figure 2-5 for the template of SLBMC tool) [94].

Service Dominant Business Model Radar: Following the precedent set by Luftenegger [74], Turetken and Grefen propose the Service-Dominant Business Model Radar (SDBM/R) for designing service-dominant business models [130]. At the center of the radar lies the co-created *value-in-use*, which presents the value that is created together by the service solution providers and the customer. Three rings encapsulate this central *value-in-use*, which highlight how value is created or captured in the model, whereas each ring is divided into 'slices' to represent the set of stakeholders included in the business model design. The actor value proposition ring describes the value that each stakeholder contributes to the central value-in-use. The actor co-production activity ring describes the high-level business activity that a stakeholder performs in order to offer their respective value proposition. The actor costs and benefits ring describes the costs and benefits that each stakeholder accrues from participating in the business model. The detailed explanation of SDBM/R can be seen in Section 2.2.3.

<table>
<tr>
<td>Key Partners

From our point of view:
• Who are our key partners?
• What are the roles of our partners?
• What resources do we need from our partners?
• How do the partners benefit from the cooperation?
From customer point of view:
• How does the customer experience our partners?
• What kind of partnerships does the customer have and how should they be taken into account?

⑦</td>
<td>Key Resources

From our point of view:
• What skills and knowledge do we need?
• What other material and immaterial resources and tools are required?
From customer point of view:
• What skills and knowledge is required from the customer's side?
• What other customer's material and immaterial resources and tools are required?
⑥

Mobilizing Resources and Partners

From our point of view:
• How do we coordinate multi-party value creation?
• How do we utilize and develop partners and resources?
From customer point of view:
• How can the customer utilize and develop partners and resources?

⑧</td>
<td>Value Proposition

From our point of view:
• What value are we selling?
• What are the elements of our offering?
• What is unique in our offering?
From customer point of view:
• What value is the customer buying?
• What are the elements of the customer needing?
• Which of the customer's challenges and problems need to be solved?

②</td>
<td>Value Creation

From our point of view:
• How is our offering embedded in the customer's world?
• How can we facilitate the customer to reach their goals?
From customer point of view:
• How does the value emerge in customer's practices (also from mental and emotional experiences)?
• How are customer's long-term benefits accomplished?
③

Interaction and co-production

From our point of view:
• How can we support customer co-production and interaction between us and the customer?
From customer point of view:
• What are customer's activities during the use and different use contexts?
• What are the customer's mental models of interacting with us?
④</td>
<td>Customer's World and Desire for Ideal Value

From our point of view:
• How do we get a deep insight and holistic understanding of the customer's world (context, activities, practices, experiences), their future strategies, and their own customers' world?
From customer point of view:
• Why does the customer buy?
• What kind of benefits does the customer desire?
• Functional
• Economic
• Emotional
• Social
• Ethical
• Symbolic
• If there were no limits, what would be the customer's desire for the ideal situation and world?

①</td>
</tr>
<tr>
<td colspan="3">Cost Structure ⑨
From our point of view:
• What are the costs inherent in our business model?
• What are our other sacrifices?
From customer point of view:
• What costs and other sacrifices are required from the customer?</td>
<td colspan="3">Revenue Streams and Metrics ⑤
From our point of view:
• What is our earnings logic and how is our financial feedback generated?
• How can we apply customer value-based pricing?
• What else valuable do we get other than money?
• What are the key performance metrics of our business success?
From customer point of view:
• For which benefits is the customer actually willing to pay and how?
• What is the financial value to the customer?
• What are the key performance indicators of the customer's business and how are we following them?</td>
</tr>
</table>

Figure 2-5 Service Logic Business Model Canvas [94]

The main goal of this thesis is to develop a method that facilitates the operationalization of a SD business model (Section 2.2.1). In the following we compare and select SDBM/R from the available business modelling tools, which comes to the fore by capturing SDL, fitting the BASE/X context and including information regarding operationalization. To facilitate the comparisons of business model representations, five essential service dominant business modeling criteria that follow from SDL axioms were defined (see Section 2.1). Table 2-3 gives these five criteria, the primary axioms for each criterion, and compares the business modelling tools included in our review scope. In the table the suitability with criteria is marked as: (+) sufficiently addressed, (+/-) addressed, but somehow lacking (e.g., the notion exists but the definition is not exactly matched, vague definition, etc.), (-) not addressed.

Table 2-3 Business Model Design Tool Comparison

			Business model design tool						
Most Related SDL axiom(s)	**Criteria**	**Explanation**	*e3-value*	*BMC*	*STOF*	*CSOFT*	*SBMC*	*SLBMC*	*SDBM/R*
1,3	**Service-oriented**	Service exchange is integral to the business model. Business model includes elements that show the way its actors exchange service.	-	-	+	+	+	+	+
4,2	**Value-centric**	Value co-created by the beneficiary(-ies) is represented.	+/-	+/-	+/-	+/-	+/-	+	+
2, 3,5	**Network-structure**	Value co-creation involves multiple actors with differentiated but complementary service offerings.	+	+/-	+/-	+/-	+	+/-	+
2, 4	**Customer-focused**	Customer are represented in the business model as main driver of the value creation.	+/-	+/-	-	+/-	+/-	+	+
1, 3	**Capability driven**	Operant resources (e.g., capability, skill, etc.) is represented in the business model.	+/-	+	+/-	+/-	+	+	+/-

Based on the comparison, the rationale to choose SDBM/R over other BM design tools are as follows:

Service-oriented: The BMC or e3-value as a traditional/conventional business modelling tool does not explicitly focus on service provision. The rest of the BMs do. Furthermore, SBMC and SLBMC are designed based on the original BMC, in which they are revised to incorporate SDL mindset. SDBM/R on the other hand include co-production, value-proposition elements per actor that encapsulate information about the details of the "service", that indicates why , how and when each actor take part in value co-creation and the ways they exchange service in the context of the business model.

Value centric: The SBMC addresses the majority of the principles of SD logic. However, the SBMC does not explicitly take the *value-in-use* as a starting point for the business model. It inherits the use of the concept of value proposition but considers it as a value that the focal organization offers to customers and other partners through the business model. This notion does not follow the service-dominant logic principles of value co-creation and inherits the goods-dominant logic rooted in the BMC. Incorporating multiple customer segments in a single representation increases the complexity of the representation and makes it also difficult to reflect and communicate the process-oriented view of the service solution represented by a business model.

Network-structure: The SDBM/R has a network-centric design at its core, allowing the composition of service design in multi-party business networks. It defines how the actors in the business ecosystem participate in value co-creation and what the cost–benefits distribution is. Another network-centric

approach to business model design is the e3-value, which describes the value exchanges among actors of a business network [41]. It focuses on the interactions between the actors of the network in terms of the value exchanges. However, contrasting the SDBM/R, e3-value does not consider the alignment between the business strategy, model, process and the information systems/technology as a harmonized package [4]. The CSOFT ontology and the STOF model consider network-based value creation. This network-centric view is an important contribution to the representation of service business models. However, although these works reason from the basis of services, they do not explicitly incorporate the co-creation of value (particularly including the customer as a co-creator). Moreover, these methods propose sub-models per business model component, which may make it difficult to interpret in practice. On the other hand, BMC does not take into account the broader ecosystem in which a business is embedded [2, 116]

Customer focused: On the other hand, SLBMC provides a focus on customer needs and implements different settings of the business model for different customer profiles. However, there is hardly any change in the business model design from the original BMC that renders the model from the perspective of a single company instead of a network-centric approach. The role of each partner other than the focal organization is not explicitly shown as co-creator of the value, where in SDBM/R each actor/partner is visualized in the same proportion to reflect the network-centric approach of value co-creation, shown as 'slices' in the radar.

Capability driven: The BMC, SBMC, and SLBMC explicitly put 'key resources' in the business model, where operant resources can be addressed there. The SDBM/R doesn't directly mention about operant resources. However, this notion is represented by Business Service (BS) component of the BASE/X framework where SDBM/R is part of this framework and still related to the business model, especially during operationalization.

2.2.3 Service-Dominant Business Model Radar (SDBM/R)

Conventional business modeling tools widely used by companies (e.g. the Business Model Canvas [97]) cannot cover all domain of business, in particularly service-dominant business settings [74]. While most business modeling methods are only using a single organization perspective, service dominant business requires a network of parties to co-create a particular value-in-use and therefore necessitates a network-centric approach to business modeling [74].

The Service-Dominant Business Model Radar (SDBM/R) is a visual template for representing service-dominant business models [130]. It has a network-centric design at its core, allowing the composition of service design in multi-party business networks [74, 130]. It has been developed as an integral component of the BASE/X engineering framework (see section 2.2.1) and has been validated in several domains following the design science research paradigm [129].

The SDBM/R consists of four layers, which are depicted as concentric circles: co-created value-in-use, actor value proposition, actor co-production activity, and actor cost/benefit. The radar is 'sliced'

according to the number of actors involved, where an actor is a specific entity that is involved in the collaboration network (see Figure 2-6).

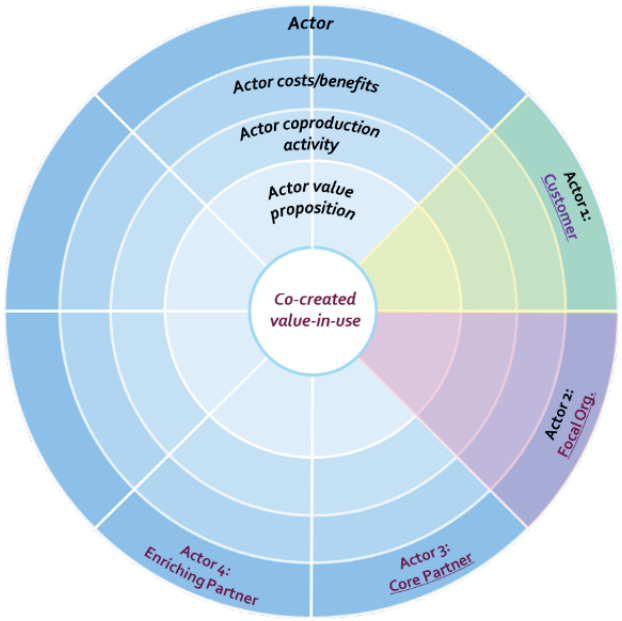

Figure 2-6 Service-Dominant Business Model Radar and its elements [130]

Each actor in the network integrates its competences and resources into complex services according to SDL [78]. The radar distinguishes between different types of actors: The first slice is for the *customer* who also contributes to the production of value-in-use. The second is for the *focal organization*, which is the primary integrator [23, 76] and often the party that initiates the setup of the business model and participates actively in the solution. The rest is for the *core* and *enriching* parties that are involved in the co-creation of value-in-use [130].

The "bull's eye" in the radar represents *co-created value-in-use* and emerges as the actor value propositions are realized. The customer is the actor that experiences the co-created value-in-use generated by the enactment of this business model. In the radar, a *co-production activity(-ies)* is a high-level activity statement that an actor performs in its business context for achieving the co-creation of value, i.e. the actor value proposition. Each actor in the model participates in value co-creation, has one or more actor value propositions and collaborates with others to co-create the value-in-use. Similarly, all actors role have at least one co-production activity with the exception of actor type customer, who may or may not participate in production [81]. *Actor cost/benefits* define the financial and non-financial expenses/gains of the actors that relate to service provision.

2.2.4 Service Composition

In BASE/X, service composition (SC) is a combination of business services to realize the service functionality required by business model, that is operationalized into business process models [47]. Other reference from service-oriented computing (SOC) domain consider service compositions encompasses all processes that create added-value services called composite or aggregated services, from existing/basic services [69, 98]. The similarities found in the description of service composition are: (1) integration of services (2) as a layer that bridges the service capability and service management.

However, service compositions in SOC doesn't seem to focus on services provided by software platforms/applications and does not sufficiently distinguish between (business) service compositions and web/software service compositions[66]. The notion is interchangeably used in SOC, which leads many studies regarding service composition to refer SC as web/software service composition [69], or only exists in the information system viewpoint [20]. However, if business services can be viewed differently between business view and information system viewpoint [20], we consider that it is also necessary to view service composition process in business viewpoint and software/information viewpoint separately.

2.3 Business Model Operationalization

In this section, we provide detailed report of the systematic literature review regarding business model operationalization. This review was conducted as part of the Problem Identification step of the Design Science Research process adopted throughout the research presented in this dissertation (Chapter 3).

In the following sections, we introduce the concept of business model operationalization, explain the protocol for the systematic literature review, and present the results of the review that become basis for the decision making for artifact design.

2.3.1 Introduction of Concept

A business model describes the way in which an organization along with its providers and partners creates value for all its stakeholders [4]. Recently with the emergence of the service-dominant business logic, the business modeling approaches have been proposed to address the need for a multi-stakeholder perspective [19, 74, 91, 130] and agility in its operationalization [18, 55]. Elements that represent concepts such as co-production of value, networked business, and service compositions have been incorporated in business model representations [130]. Together, business strategy and business model describe and answer the "what to do?" question of business. On the other hand, the operational aspects address the "how to do?" question of business.

Business Model Operationalization (BMO) involves the realization of a business model by deriving business process models and information system components from the business model [4]. A process

model is an organization of business roles and activities to achieve a particular goal. From the top-down business model operationalization perspective, the process goals and the arrangements of the related business operations should follow from a BM [4, 17, 117]. Subsequently, the IT components are developed, and the processes models are executed.

2.3.2 Setup of the Systematic Literature Review (SLR)

With the purpose of investigating approaches related to BMO, we performed a systematic review of the literature to obtain an overall understanding of existence, characteristics, and use of BMO approaches. This systematic literature review (SLR) is a means to identify, to evaluate, and to interpret all available research that is relevant to our research [64, 70, 145]. This motivation leads us to search for the answer to a question regarding which aspects of business model operationalization have been addressed in the existing academic literature and which gaps remain to be covered. To minimize the risks of getting results biased by our personal preferences and achieve repeatability, we have designed our review protocol following the guidelines provided by Kitchenham and Charters [64], which has three main phases: planning, conducting and reporting. Figure 2-7 shows the performed steps in these three phases. In this section we represent the outputs of steps 1,2 and 7. Details about other steps are presented in the Appendix A.

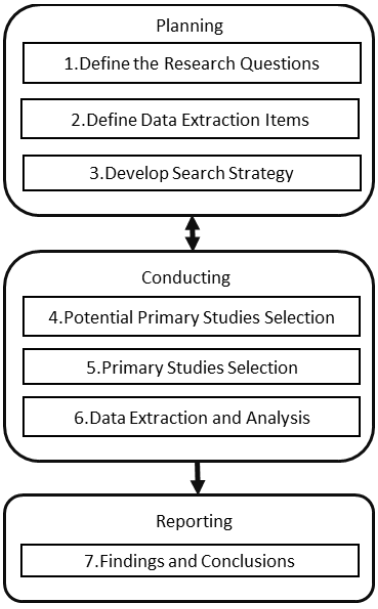

Figure 2-7 SLR Protocol

Research Questions: This systematic review follows from RQ.1 of this dissertation, "*Which aspects of business model operationalization have been addressed in the existing academic literature and which gaps remain to be covered?*'.

In the review, we limit our scope to the methodological aspects of BMO. Hence, we take an engineering perspective to operationalization and aim to gather existing evidence from the literature that relates to the concepts, techniques, tools and approaches taken in the operationalization of business models. Following this aim, we exclude other dimensions from the review scope that relate to the qualities of a business model such as their feasibility, maturity, sustainability or innovative characteristics and their life cycle in the context of organizational dynamics such as ideation or experimentation. To guide our data extraction and analysis process, we breakdown RQ.1 into the following sub-research questions which will subsequently be mapped to data extraction items (Table 2-4).

RQ1.1. Which perspectives are dominant in BMO (operationalization perspective)?

RQ1.2. Which concepts are explicitly addressed in the operationalization process (BMO objects)?

RQ1.3. Which operational levels do BMO studies focus on (operationalization focus)?

RQ1.4. Which methodological approaches to BMO are followed by the studies (methodological approaches followed in operationalization)?

RQ1.5. What are the explicit target business settings for BMO methods (business settings)?

Data Extraction Items: To extract information regarding BMO research, we developed a data extraction scheme for structuring the analysis of the selected studies following the research questions. This scheme was developed gradually through the identification of similarities between articles, such that the item value sets were updated and reorganized by constant comparisons when needed and studies were grouped under the same categories. Data extraction was performed by one researcher, reviewed by another independently. A third researcher was consulted in the case of disagreements between two researchers. Table 2-4 presents the final list of categories and subcategories applied in the classification of the set of publications.

Table 2-4 Data extraction scheme

Data Item	Code	Description	Item Values	Multiplicity
Contribution Type	C	The contribution type of study with respect to the BMO approach/method	New model, theory, method/ framework, guidelines, tools, lessons learned, advice/implications, adapted from [114].	Single
Research Type	T	The research type of paper	Validation research, evaluation research, solution proposal, conceptual paper, experience	Single

Data Item	Code	Description	Item Values	Multiplicity
			paper, opinion paper, adapted from [147].	
Operationalization Perspective (RQ1)		*The operational perspective taken on BMO in the paper*		
Operationalization Perspective Type	P	The type of the operational perspective	Business-oriented (B), IT-oriented (IT), Hybrid (H)	Single
BMO Objects (RQ2)		*The concepts that the study considers in business model operationalization*		
Business model	BM	Representation notation(s) used to describe the business model that will be operationalized	- Adopted (e.g. BMC, e3value, etc.) - N/A (if none is mentioned) - Not specified (if it is mentioned but without further explanation)	Multiple
Service composition	SC	Representation notation(s) used to describe the integration of services.	*same as above*	Multiple
Business service	BS	Representation notation(s) used to describe business service(s), as an interface that enables end-user to receive the delivered value.	*same as above*	Multiple
Process model	PM	Representation notation(s) used to describe the process or sequence of activity.	*same as above*	Multiple
Operationalization focus (RQ3)		*Details on transformation concept used to align business and IT.* (values adopted from [4, 87, 117])		
From BM level to CPM (Conceptual Process Model)	BM-CPM	Transformation concept/type/tool/notation which are used in the method	Yes (1), No (0)	Single
From CPM level to EPM (Executable Process Model)	CPM-EPM	Transformation concept/type/tool/notation which are used in the method	Yes (1), No (0)	Single
Methodological approach followed in operationalization (RQ4)		*Methodological approach utilized in every part of the operationalization.*		
Approach(es) followed	OA	The approach to determine the steps/ phases/procedure in the development process of the system	Adopted (e.g. MDA, SOA, etc.)	Multiple
Business Settings (RQ5)		*Identification of the settings in which the method applied.*		
Multiple stakeholders	M	Does the approach/method accommodate the perspective of multiple stakeholders?	Single (S), Multiple (M)	Single
Agile	A	Does the approach/method explicitly consider the agility aspect?	Yes (1) [if the author explicitly mentions agility or applies an approach known for targeting agility (e.g. SOA, MDA)], No (0)	Single

2.3.3 Results of the Systematic Review

The results of this systemic review are presented based on the extracted evidence and structured by the data extraction schema.

Type of Research and Contribution: We adopted the research types and research contribution classification from Wieringa et al. [147] and Shaw [114] to understand the general distribution of the type of contribution in BMO research. The result of our examination shows that out of 27 contributions on the topic of BMO, 22 studies present methods to operationalize or implement a business model. Three studies present either lessons learned from conceptual approaches or experience papers that studied BMO. The remaining two studies promote a framework or architecture related to BMO. As for the type of research, 12 studies are classified as solution proposals without a validation or an evaluation (Figure 2-8). Eight studies validated their proposals in 'in vitro' settings, where three of the studies evaluated their BMO methods in real life industry cases. This shows that while the academic literature has proposed solutions for BMO, most of the work is focused on presenting the concept and the work is not always evaluated thoroughly from an application point of view.

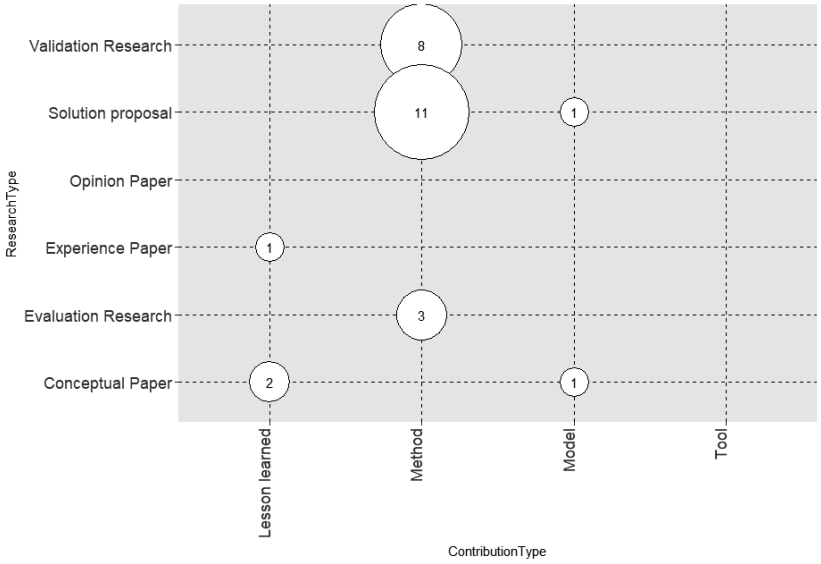

Figure 2-8 Research Type and Contribution Type

Methods in BMO: Our investigation regarding the type of contribution to BMO literature showed that the majority of the solutions proposed (artifact) are methods. However, the characteristics of the methods that are proposed in the studies we reviewed vary significantly. Below we briefly mention the notable ones. Fayoumi and Laucopoulos [S1] present conceptual modeling steps, which transform a high-level business goal model into a process-aware information system design in nine steps. This

method suggests tools for a systematic analysis that leads to identifying the necessary IS services as part of it. Di Valentin et al. [S10] introduce a method for transforming business models into process models through the use of a component-based business model which is subsequently transformed using a four-view process template. Ulmer et al. [S14] introduce a metamodel-centric methodology for business process management by integrating concepts from Model Driven Architecture (MDA). This methodology allows business analysts to develop graphical conceptual models, in accordance with a formalized meta-model. De Castro et al. [S13, S18] developed the Service-Oriented Development Method (SOD-M), which is a service-oriented information system development method that includes the transformation of a value model by following the MDA approach. The authors represent the Computer Independent Model (CIM) level by using Business Process Modelling Notation (BPMN) for modeling business process, and by using a value model for identifying services in the business perspective. Rhazali et al. [S2, S3, S4, and S6] propose a CIM to the Platform Independent Model (PIM) transformation method with clear transformation rules using graphical presentation. This approach provides a solution to the problem of transforming value models represented at CIM level to analysis and design models, modeled at PIM level. Full list of the BMO papers with a method proposals are given in Table 2-5.

Based on our review, only a small number of methods exist that aim to use high-level business models and fully transform them into executable process models [S13, S17]. The following points summarize our findings:

1. The first set of methods [S1, S5, S10- S12, S20, S21, and S24] includes those that use a high-level business model as the starting point of the transformation and continue to operationalize it into one or more conceptual process models. These methods, however, do not proceed to the implementation of the solution. In addition, some of them do not address network-centric business settings, which put additional challenges on the operationalization process.
2. The second set of methods [S8, S9, S14, S19, S25] focuses on the technical aspects, i.e., on the transformation of the models, and even considers a loose coupling arrangement, which leads to business agility in model transformation. However, they do not explicitly refer to business models as the starting point.
3. The final set [S2-S4, S6, S7, S15-S18, S22, S23, S26, and S27] proposes detailed transformation procedures, but address business model aspects in a limited way; consequently, high-level BMO cannot benefit directly from these methods.
4. Among the approaches applied in the transformation process, model-driven architecture (MDA) and service-oriented architecture (SOA) are two frameworks that stand out in terms of the number of methods that take them as a basis. The existing literature on BMO uses a diverse set of approaches for business modeling design. These range from well-known a business model design technique (i.e. Business Model Canvas - BMC) to the process model-friendly BM design approach of the e3value framework.

Table 2-5 List of BMO Method from the SLR

No	Title	Author	Year	Contribution #
1	Conceptual modeling for the design of intelligent and emergent information systems	Fayoumi and Loucopoulos	2016	S1
2	CIM to PIM Transformation in MDA: From Service-Oriented Business Models to Web-Based Design Models	Rhazali, et al.	2016	S2
3	A Model Transformation in MDA from CIM to PIM Represented by web models through SoaML and IFML	Rhazali, et al.	2016	S3
4	Model Transformation with ATL into MDA from CIM to PIM Structured through MVC	Rhazali, et al.	2016	S4
5	A Methodology for Transforming CIM to PIM through UML: From Business View to Information System View	Rhazali, et al.	2015	S6
6	A complete approach for CIM modelling and model formalizing	Li et al.	2015	S7
7	Alignment of Business Models and Software: Using an Architecture Centric Method to the Case of a Healthcare Information System	López-sanz and De Castro	2015	S9
8	Towards a framework for transforming business models into business processes	Di Valentin, et al.	2012	S10
9	Transforming Software Business Models into Business Processes	Schief, et al.	2012	S12
10	Applying CIM-to-PIM model transformations for the service-oriented development of information systems	De Castro, et al.	2011	S13
11	Towards a pivotal-based approach for business process alignment	Ulmer, et al.	2011	S14
12	A Meta-model for Developing Business-model Driven Management Information Systems	Wu and Zhong	2010	S15
13	The research and implementation for model transformation of Service Oriented	Li, et al.	2010	S16
14	Towards A Service-Oriented MDA-Based Approach to the Alignment of Business Processes with IT Systems: From the Business Model to a Web Service Composition Model	De Castro, et al.	2009	S18
15	A model-driven approach for collaborative service-oriented architecture design	Touzi,et al.	2009	S19
16	Putting Business into Business Process Models	Decreus and Poels	2008	S20
17	On the Alignment of Business Models and Process Models	Edirisuriya and Johannesson	2008	S21
18	Service Architecture Design for E-Businesses: A Pattern Based Approach	Gacitua-Decar and Pahl	2008	S22
19	Integrating Value-based Requirement Engineering Models to WebML using VIP Business Modeling Framework	Azam, et al.	2007	S23
20	From Business Models to Service-Oriented Design: A Reference Catalog Approach	Lo and Yu	2007	S24
21	SOA-Driven Business-Software Alignment	Shishkov, et al.	2006	S25
22	Business Process Semi Automation Based on Business Model Management	Terai, et al.	2003	S27

Perspectives in BMO: Regarding the perspectives on business model operationalization, our analysis reveals that 30% of the studies focus only on the business-related aspects of BMO, 37% focus solely on the IT-related aspects, while the rest takes a hybrid view. These results show a balanced distribution of interest in business and IT related perspectives of BMO (Figure 2-9).

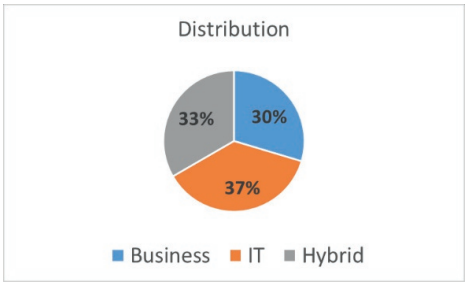

Figure 2-9 Distribution of Operationalization Perspectives

BMO Objects: The results of our information extraction regarding BMO objects (Figure 2-10) add to our understanding regarding the aspects discussed below.

1. The use of business models, indicating the type of business model concept that is applied. Only 33% of the studies do not specifically mention the business model concept that they apply [S3, S4, S6, S11, S12, S15, S16, S19 and S25]. Other studies use various concepts of business models, either widely known business model concepts or self-developed ones. The most commonly used business model notation in BMO is e3value [S9, S17, S21, S23].

2. The use of service compositions. Only a few studies do not include composition of services in their method [S12, S15, and S24]. From all 89% studies that include the composition of services for the BMO, a few studies [S13, S18] directly use the term service composition to refer to the integration of services while the others do not explicitly use the term, however, imply it. For modelling compositions, 33% of the studies that specify the tool/approach [S1, S2, S3, S6, S9, and S11] use the Unified Model Language (UML) or its extensions to provide a graphical representation of service composition.

3. The use of business services. About half of the studies (48%) explicitly discuss the concept of (business) services as an integral part of BMO [S1, S2, S8, S9, S13, S14, S17, S18, S20, S22, S26, and S27]. A few studies [S9, S17] refers to web services to describe business services. Overall, the results indicate that a significant number of methods include business service as a key component of their method with a specific focus on using available web services for service composition.

4. The use of process models. Our findings show that 96% of the studies (except for [S16]) include process models in their BMO context. Among the studies that specify their tool/approach, 58% refer to BPMN as the selected notation for representing business processes [S1, S4, S7-S9, S11, S17, S19-S21, and S22].

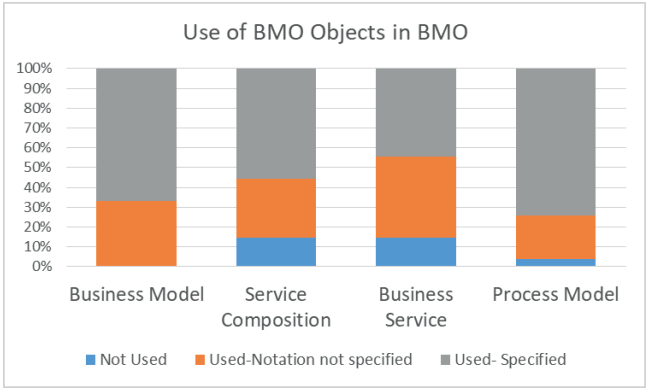

Figure 2-10 Use of BMO Objects

Approaches in BMO: Regarding methodological approaches in BMO, as shown in Figure 2-11, Model Driven Architecture (MDA) is the most commonly referred approach in guiding the transformation of business models into process models [S2-S4, S6, S7, S9, S13, S15, S16, S18, S19, S23, and S25]. This is followed by approaches based on Service-Oriented Architecture (SOA) with the aim to support agility in the transformation process [S1, S8, S16, S19, S22, S24, and S25]. Several approaches (i.e., value modeling [S9, S11, S13, S17, S18, S21, S23], goal modeling [S20, S24, S26], meta-modeling [S14]) for business modeling are also mentioned in the effort of offering the most suitable business modeling approach that supports the operationalization methods.

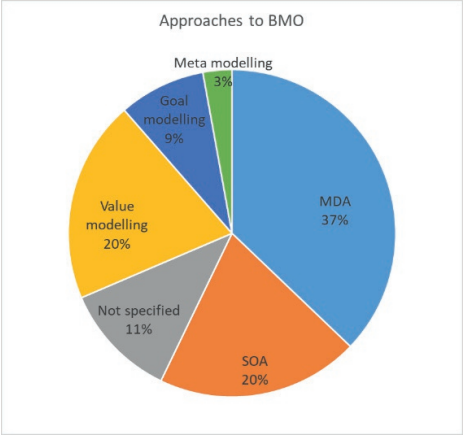

Figure 2-11 Approaches to BMO

BMO Transformation Concept: Regarding the target objects of BMO, we found only 29% [S1, S7, S8, S13, S17, S18, S27] address the need to transform conceptual process models (CPM) to executable process models (EPM), while 89% of the papers only address the need to transform business models

into conceptual process models (CPM) [S1-S4, S6, S7, S10-S27]. This shows that the existing literature focus their attention more on the first transformation activity (BM to CPM). While UML is often used in the first transformation activity [S1-S3, S6, S9, S11], the studies also refer to commonly used existing techniques or notations (e.g. BPMN, BPEL, Petri-nets) that can support the second transformation activity (CPM to EPM).

Target Business Settings: Regarding target business settings, only seven of the BMO methods [S7, S11, S13, S18, S19, S21, and S23] reflect on the need to consider the multi-stakeholder nature of the contemporary business model design. The majority of the papers [S1, S9, S10, S12-S16, S20-S22, S24, S25, S27] addresses the necessity for focusing on business agility as a motivation for BM operationalization, either explicitly incorporated or indirectly influenced by the applied approach (e.g., SOA). Only three [S13, S20, S21] address both business agility and address multi-actor BMs into account.

2.3.4 Research Gaps in BMO

Following from the analysis results, additional important findings were found to relate to the BMO research gaps:

A significant gap in the covered aspects lies in the conceptualization of the business models taken as basis for operationalization. None of the BMO method contributions we reviewed explicitly build on or associate their business modelling concepts to the paradigms of business-oriented and managerial domains (e.g. business management, marketing, strategic management) such as Resource-based view [143] or Service-dominant logic [133]. Furthermore, only few of the BMO method proposals use representational artifacts (e.g. models) of business models as the basis, such as e3value value modelling [S9, S13, S18, S21], Balanced Score Card [S1], or i* goal modelling [S24]. These representations focus on the formalization (such as ontologies) rather than a "conceptualization" of business models.

Another finding relates to the facilitation of business process design by BMO method proposals. Almost all studies that propose a BMO method take business processes models into account as BMO objects, they mainly focus on the conceptual associations, the alignment and the mappings between the business models and the business processes in an IS design context. Thus, the business processes are taken as givens and the methods do not explicitly aim the facilitation of business process design Furthermore, a few of the works that propose a BMO method take network structure of business into account [S7, S11, S13, S18, S19, S21, and S23]. Among all BMO method proposals, only two conference papers [S20, and S21] explicitly address business process design and take multi-actor networked business models into account in their proposal.

As a conclusion, our findings identify BMO as a field in its initial levels of maturity with key research gaps to be investigated so that the result of BMO research can address the necessary aspect required for the utilization of BMO in a service-based business network. Gathering and analyzing evidence

from BMO literature, we identify the following important gaps which indicate directions for BMO research:

Foundational Conceptualizations for BMO: Many qualities of a BMO method inherently rely on the conceptualization of BM and the definitions for its elements. While the operational artifacts of a business mainly the artifacts of business processes management and information systems domains, the complex concept of Business Model has been evolving on an interdisciplinary path [65, 154]. Therefore, associations between the theories, views and tools of business research domains to those of the process management and IS domains should be established [4]. While the results of our review support that BMO research recognizes the need to develop an aligned business-process-IT perspective on BMO [4], the BMO methods do not effectively address this gap.

Support for Networked business: Despite its recognition by Business Modeling research and BM tools [19, 74, 91, 130], multi-stakeholder perspective in the current business models and the environment is taken into account by very few BMO methods and in a limited way. In today's business settings, value creation is facilitated by a network of stakeholders which also includes the customer [77].

Support for Process Design: While in general the role of business processes along business model transformation process is recognized in BMO research, existing BMO methods considers operationalization in the context of software system design and development. Process are engineered artifacts which goes through a (re)design cycle as business models are operationalized [4, 117]. While few BMO studies address this need, there is a large gap in the BMO research for the development of methods (1) that facilitate end-to-end BM operationalization, (2) addressing the design concerns for both processes and information systems and (3) provide relationships between the elements of business models, business processes and information systems for their traceability.

2.4 Chapter Summary

Service-dominant logic (SDL) is a new paradigm in marketing where the needs of customer shifts from the ownership of goods to experiencing services. The principle of service-dominant logic is described in five axioms, namely:

1. Service is the fundamental basis of exchange,
2. Value is co-created by multiple actors, always including the beneficiary.
3. All social and economic actors are resource integrators.
4. Value is always uniquely and phenomenologically determined by beneficiary.
5. Value cocreation is coordinated through actor-generated institution and institutional arrangements.

BASE/X framework is a business engineering outline framework specifically designed to align with SDL principles. This framework has four main components, namely: Business Strategy (S), Business Model (BM), Service Composition (SC), and Business Services (BS). The first two components (S and BM) are the 'what' of a business, while the last two (SC and BS) are the 'how' of a business. BASE/X also distinguish between the stable essence of a business organization (S and BS) and the agile market offerings of that organization (BM and SC).

SDL has an evident influence on business model design tools which resulted in modifications or introduction of business modelling elements that intend to address implication of SDL premises. Among those business modelling tools that we compared using the criteria derived from SDL axioms, the Service Dominant Business Model Radar (SDBM/R) is considered as the one that address SDL the most. SDBM/R is a service-dominant business model design tools that is part of BASE/X engineering framework. Integral with the BASE/X framework, SDBM/R incorporates all necessary criteria for a business modelling tools that address SDL principle, which are: service-oriented, value-centric, network-structure, customer-focused, and capability driven.

None of the business model design tools that we examined provides a method to operationalize the business model after it is successfully designed. The operationalization of a business model involves the realization of a business model by deriving business process models and information system components from the business model. Therefore, we conducted a systematic literature review on business model operationalization (BMO) to understand which aspects of business model operationalization have been addressed in the existing academic literature and which gaps remain to be covered. The SLR results in 27 studies that provides findings regarding: the type of research and contribution, the perspectives in BMO, the objects in BMO, the approaches in BMO, the transformation concept in BMO, and the target business settings. These findings identify BMO as a field in its initial levels of maturity with key research gaps to be investigated so that the result of BMO research can address the necessary aspect required for the utilization of BMO in a service-based business network. The findings can be summarized as follows:

1. While BMO research recognizes the need to develop an aligned business-process-IT perspective on BMO, the BMO methods do not effectively address the gap in the

foundational conceptualization, which is the establishments of the associations between the theories, views and tools of business research domains to those of the process management and IS domains.

2. Despite its recognition by Business Modeling research and BM tools, multi-stakeholder perspective in the current business models and the environment is considered only by few BMO methods and in a limited way.
3. While in general the role of business processes along business model transformation process is recognized in BMO research, the existing BMO methods address operationalization under the software design and development context and do not consider the essential element of business processes as a core element of information systems that enable business models.

3 Research Design

In this chapter, we elaborate the research design for the work reported in this thesis. In the first section, we explain how the overall research design is built on the principles of design science research. In the following sections, we focus on the various elements of the overall research design. In Section 3.6, we discuss the knowledge contribution of the research from a design science research perspective. We end the chapter with a summary.

3.1 Overview of Research Design

In this research, we have followed a design science research methodology [54], as our primary goal is to develop a new information systems design artifact, which we refer to as service-dominant business model operationalization method (SDBMOM). Specifically, we have followed the design science research (DSR) methodology process model proposed by Peffers et al. [100], which proposes the following iterative activities for a problem-centered research study [9, 102]:

- identifying the problem,
- defining the objectives of the solution,
- designing and developing a satisfactory model (artifact),
- demonstrating/applying the model in a suitable context,
- evaluating the artifact in a real-life business setting, and
- communicating the artifact.

Accordingly, we have designed the process depicted in Figure 3-1 for this research study (please note that the last methodological item - 'communicating the artifact' corresponds to this thesis manuscript).

After identifying the problem through our interactions with practitioners and the review of relevant literature through a systematic literature review (SLR), we defined our objectives for SDBMOM. Based on these objectives and insights from the review of existing literature, we developed the initial version of the SDBMOM. Next, we applied the method in an illustrative business scenario. This was followed by taking the output (i.e., a conceptual process model) generated through the application of the method, and performing subsequent operationalization steps to develop a software application that supports the business scenario.

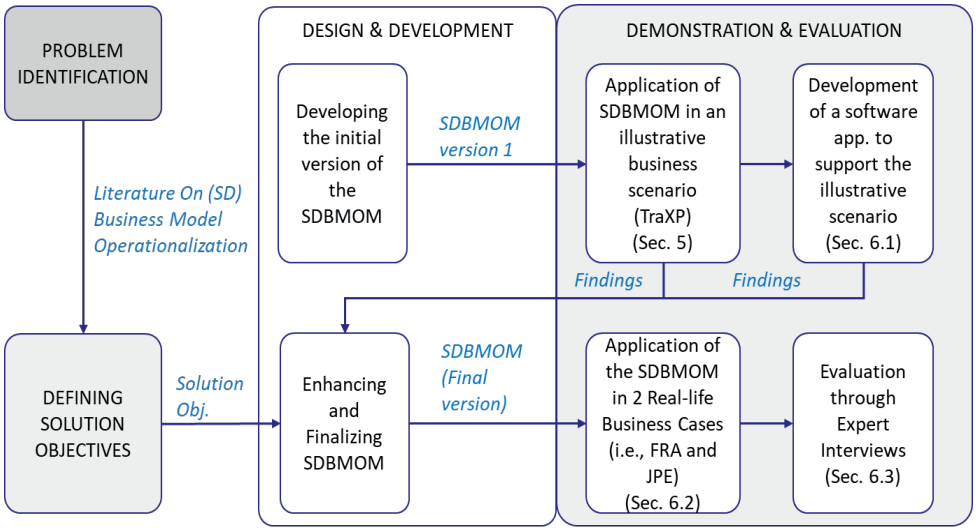

Figure 3-1 Research Process

Based on the feedback gathered, we refined and finalized the SDBMOM to increase its relevance and applicability. Following the refinement, we used the method in operationalizing two real-life business models (that were designed to address specific business problems) to evaluate the method's *validity* (i.e., the extent to which it is applicable and can be used for its intended purpose of use [48]). Finally, we conducted interviews with industry experts to evaluate SDBMOM's *utility*, i.e., how useful and easy to use they consider the SDBMOM is for the operationalization of service-dominant business models.

3.2 Problem Identification

Prior work relevant to the study (including existing service dominant business modeling tools and business model operationalization methods that have already been developed) is reviewed to get a better understanding of the state-of-the-art contributions in this relatively new domain of service-dominant business. For the Business Model Operationalization (BMO) study, we specifically follow an SLR guide [64]. The review also helps in gaining a clear understanding of the gaps that exist in the BMO domain and appropriate research questions for our research in our effort to close those gaps. In the introduction section of this thesis report, we discuss our research problem and the gap that this study aims to address.

3.3 Solution Objectives

The research problem and gaps that were identified (and elaborated in Section 2.3.4) formed the basis for the objectives that the solution (design artefact) is expected to achieve. Following the service-dominant business engineering outline framework (Section 2.2), we expect the method to be developed to fulfil the following objectives:

Objective 1 - Value creation, in today's business landscape, is facilitated by a network of stakeholders exchanging *services*. This network also includes the customer as a party in value co-creation [77]. Therefore, the method should support taking a *service-dominant* business model as input for operationalization. This entails a multi-stakeholder model where the customer is also involved in the proposed value co-creation [76, 77].

Objective 2 - As delineated in Section 2.3.4, the BM concept has been evolving on an interdisciplinary path [65, 154], and associations between the theories, views and tools of business research domains to those of the process management and IS domains should be established [4]. Therefore, there is a need to develop the conceptual underpinnings that align the service-dominant business model, process and IT perspective on BMO, and to build the method upon the conceptual foundations of BMO [4].

Objective 3 - As argued in Section 2.3.4, delivering complex and integrated solutions requires a *network of business service providers* [38, 76]. Therefore, the operationalization method should enable the composition of services of multiple parties involved in the business model. In addition, the output of operationalization should be a technology-agnostic in order to allow for subsequent operationalization levels to apply the most suitable technology that is relevant and applicable for the specific context.

Objective 4 - Our review of the relevant literature showed that the BMO research recognizes the need to develop an aligned business-process-IT perspective on BMO [4]. However, current approaches to do not effectively address this gap. Therefore, we pose that the method should offer a step-by-step iterative guide for the operationalization of the business model and should enable explicit traceability between inputs, outputs and all intermediate models.

Objective 5 - To facilitate its application in real-life business settings the method should include an organizational structure that describes the (organizational) roles that are expected to be involved in the application of the method, including their responsibilities and necessary skills.

In addition to the requirements listed above, we require our artefact to be considered useful and easy-to-use by its users, as it is designed for being used by industry professionals, practitioners in various domains, possibly with limited experience in business model operationalization.

3.4 Design and Development of the Method

This task was the critical component of the research work, where the proposed method - as a design artifact- was developed based on the above-mentioned objectives, findings from the literature review, and critical analysis of existing methods, tools, and solutions.

To develop the ideal design capable to address the main research question and relevant objectives of the design artefact as a method, we followed an iterative design and development process taking the method engineering as a basis [16]. Accordingly, a method is an approach based on a specific way of thinking, consisting of directions and rules, and structured in a systematic way with corresponding development products [16]. It offers a systematic structure to perform work steps to achieve defined goals [15]. Accordingly, the critical elements of a method constitute the following:

- Activity: Task that creates a distinct (intermediate) output
- Technique: Detailed instruction that supports the execution of an activity
- Tool: Templates, software, etc. that support the execution of an activity
- Roles: Actors that execute or are involved in the execution of an activity
- Defined output: Defined outcome per activity

In addition to the elements, a method should strive for achieving specific goals/objectives and include a systematic procedure model to ensure repeatability [27]. Therefore, we have defined our objectives (as given in Section 3.3 above) and designed the method aligned with these requirements.

The design and development process involved (i) individual analysis of existing methods for their appropriateness for the problem at hand (mainly by the author of this thesis manuscript) and a number of meetings with 3 field experts (on business models and business process management) to present the findings, and receive feedback on the design decisions. These meetings were organized and conducted as informal gatherings without recordings or written minutes. The designed artifact (proposed method) presented in the meetings were considered complete and ready to proceed to the next step when all experts had a consensus on their completeness.

As shown in Figure 3-1, after the development of the initial version of the method it has been applied in an illustrative business case, and refined/enhanced taking relevant findings into consideration. The initial version of the method has been published in [122, 123]. The final version of the method is described in Chapters 4 and 5.

3.5 Demonstration and Evaluation

For demonstration purposes, we performed a series of activities. First, we used an illustrative real-life -like business case of a virtual travel agency company – TraXP [46], and applied the initial version of the method to operationalize one of its service-dominant business models (i.e., the TraXP eXecutive model). This case is chosen mainly because it is well-documented and used in the literature [44, 46, 47], rich in features, and strongly reflects the SDL principles. We use this business case to

help in explaining both the SDBMOM concepts in Chapter 4 and the method steps in Chapter 5 of this thesis report.

Next, we used the output of the application of this operationalization activity (i.e., the conceptual process model for how the relevant business model would operate) as input for the development of relevant executable process models and the running software system. We performed this activity to demonstrate that the output generated through the application of the method can be used as a *valid* input to progress further with the operationalization and can result in a running software system. We explain the details of this activity in Section 6.1.

After finalizing the method, we applied it in two business cases to assess its applicability in real-life settings, and therefore, to elicit evidence for its validity in producing the output it is expected to yield. Both business cases originate from the mobility domain and feature new service-dominant business models that require operationalization in the form of conceptual process models and eventually software systems to support their operation. While the application of the method is not limited to a specific business domain, the characteristics of the cases made them suitable for the application of the method. Following the final version, the method was successfully applied for the operationalization of service-dominant business models that were created in both business cases. Relevant application steps with intermediate outputs and resulting models are presented in Section 6.2

As a final evaluation activity, we focused our attention on gathering evidence for the utility of the method. Accordingly, we conducted structured-interviews with industry experts, where we demonstrated the method and how it can be applied to gather their opinion on how useful and easy to use they consider the method is. The details of the conducted interviews and findings are presented in Section 6.3.

3.6 DSR Knowledge Contribution of the Research

This section explicates the proposed knowledge contribution of the designed artefact (i.e., SDBMOM) to position it with respect to the design science research knowledge contribution spectrum. The developed method in this research aims to align and ease the connection between business concepts and their implementation. This research contributes mainly to the service-dominant business domain that can be considered to have a low application domain maturity. We adopted and integrated existing solutions (e.g., BPMN 2.0) in the design of our method. Following the design science research classification, the knowledge contribution of this research study is of the *exaptation* type [48] (as depicted in Figure 3-2). In this research, the application domain maturity (the service-dominant business) is low, while the components of the solution can be considered to have high maturity.

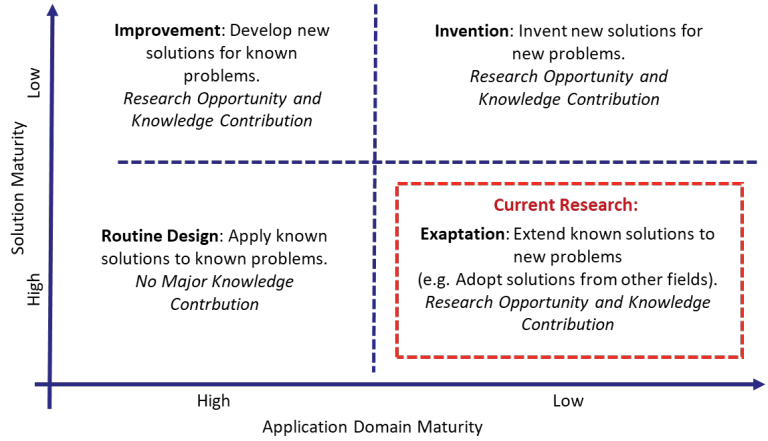

Figure 3-2 DSR Knowledge Contribution (adapted from [48]*) and Current Research*

3.7 Chapter Summary

In this chapter, we have described the overall research process underlying this thesis and the activities in this process as shown in Figure 3-1. Table 3-1 provides a brief description of each activity of the research process.

Table 3-1 DSR activities in SDBMOM development

DSR Activity	Activity Description for the Research Design
Identify Problem & Motivate	We recognized the problem in the service-dominant business as the lack of a method that enterprises can use to realize and leverage the SDL mindset through operationalizing their business models in a systematic way. Accordingly, we defined our research goal as 'to develop a method that will support the operationalization of service-dominant business models'. In order to gain an extensive understanding of the existing research, we performed a systematic literature review on the methods that can be applied for use for the operationalization of (service-dominant) business models.
Define Solution Objectives	We defined the following objectives for tour design artifact (aka solution): Obj1- The method should support taking a service-dominant business model as input for operationalization. This entails a multi-stakeholder model where the customer is also involved in the proposed value co-creation. Obj2- The method should be built upon the conceptual underpinnings that align the business model, process and IT perspectives on BMO. Obj3- The method should enable the composition of services of multiple parties involved in the business model. In addition, this composition model should be technology-agnostic. Obj4- The method should offer a step-by-step iterative guide for the operationalization of the business model and should enable explicit traceability between inputs, outputs, and all intermediate models. Obj5- To support its application in real-life business settings the method should include an organizational structure that describes the (organizational) roles that are expected to be involved in the application of the method, including their responsibilities and necessary skills.
Design & Development	We designed and developed the method iteratively in two rounds taking as input the solution objectives and insight on the existing research, as well as the findings of the initial rounds of application and demonstration.
Demonstration & Evaluation	- First, we instantiated/applied and demonstrated the initial version of the method in an illustrative business case (TraXP). - Taking the output of this first step as input, we performed further operationalization steps to develop a running software system to show that the method can be used to produce valid outputs. - Next, we applied the method to operationalize two service-dominant business models in two real-life business cases. - We interviewed industry experts to gather their opinion on the utility of the artifact.
Communication	This thesis report.

4 Service-Dominant Business Model Operationalization Method (SDBMOM): Conceptual Underpinnings

This chapter introduces the core concepts relevant to the Service-Dominant Business Model Operationalization Method that we propose in this study. The objective is to provide the conceptual underpinnings upon which the proposed method is built. After providing a brief overview of the SDBMOM, Section 4.1 follows with the specification of service-dominant business models using Service Dominant Business Model Radars. We explain the SDBM/R business modelling template and the concepts (actors, co-production activities) that are extracted from an SDBM/R and used in SDBMOM application. Section 4.2 describes the concept of Customer Service Scenario and explain its elements that are extracted in an SDBMOM application. Section 4.3 describes the concept of Business Service and Service Catalogue from an operationalization viewpoint. Section 4.4 explicates the Business Service Composition concept as a conceptual process model that results from the application of SDBMOM. In Section 4.5, we combine these concepts together into a conceptual model that highlights their relationships. Together with the definitions of the concepts, this model corresponds to the 'conceptual underpinnings' of the SDBMOM. Section 4.6 concludes this chapter with a summary.

In a service dominant business setting, a business model represents the logic of running a specific business, hence answers questions such as 'why a network of actors come together?', "what do the actors propose for value creation?" and "how does the business work as a whole?" [47, 74, 130]. In other words, a *service dominant business model* represents the way in which a network of organizations –including the providers and customer, co-creates value for the customer through solution-oriented services, and generates revenue and benefits for all network partners [129].

The operationalization of a service-dominant business model aims to provide artifacts that describe the practical and day-to-day operational aspects of a business model from a behavioral and functional perspective and show how actors fulfill the requirements from these perspectives in concert and as implied by the business model using their 'business services'.

Following these premises, a Service-Dominant Business Model Operationalization Method (SDBMOM) incorporates a structured set of steps that results in a conceptual process model (business service composition), which is a specific arrangement of activities and interactions of the actors that participate in a business model. The resulting process model meets the requirements of the business model and its associated customer service scenario. The activities and interactions included in the process model emerge from the actors' business services, hence, from a service perspective, the method produces conceptual process model as a business service composition that connects and organizes the business services of a network of actors as required by a service dominant business

model represented in SDBM/R (Figure 4-1). A Customer Service Scenario, together with actor co-production activities in a SDMB/R model, is the main source of information regarding the interactions between all actors including the customer (*addressing the Solution Objective-1 as discussed in Section 3.3*).

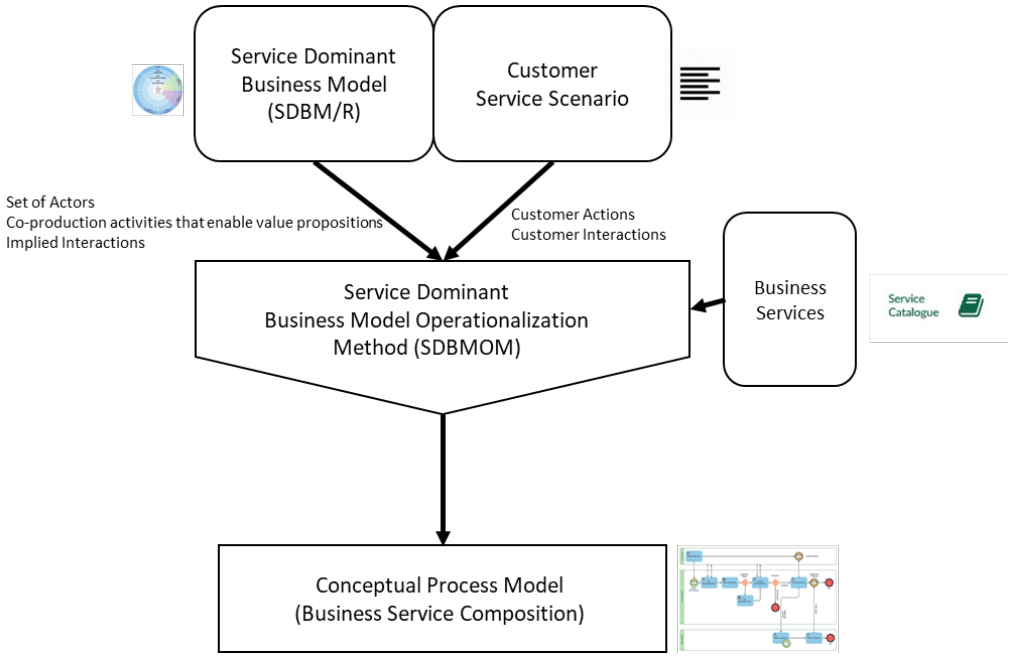

Figure 4-1 SDBMOM Input-Output Overview

In the following sections, we further elaborate on these concepts that constitute the inputs and outputs for the SDBMOM. We demonstrate the SDBMOM steps using the case of the virtual travel agency company – TraXP that we introduced in Section 4.1 as a running example.

4.1 Service-Dominant Business Model in SDBM/R

SDBMOM is a method for the operationalization of Service-Dominant Business Models, i.e., business models that are developed by following the service-dominant mindset. Specifically, the method supports business models that are designed using the Service-Dominant Business Model Radar (SDBM/R) (see Section 2.3).

From an operational perspective, not all types of information represented in the structure of the radar are directly relevant: SDBMOM does not aim to explain why a business (solution) model exists or

survive, rather it aims to provide a "mechanistic" operational solution for the model. Following this purpose, SDBMOM takes the actor and co-production activity specifications from the model as method inputs. In Figure 4-2, A1 represents customer/user, A2 represents a focal organization, and A3-A4 represent other parties. An actor might have more than one co-production activities. All actor and co-production activity descriptions are provided in plain text format.

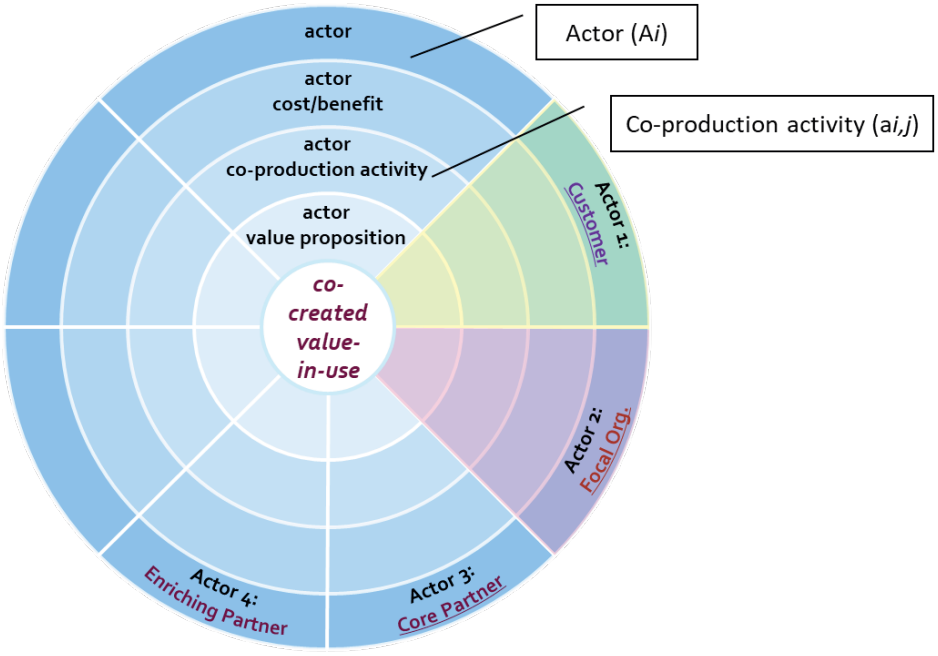

Figure 4-2 Actor and co-production activity in SDBM/R

Actors interact with each other. The interaction between actors has two types: *customer-actor* interactions involve the customer and one or more actor(s), *actor-actor* interactions involve the actors other than the customer, all taking place during the performance of co-production activities (Figure 4-3). This interactions are in the form of message exchanges. The groups of coherent interactions between actors are *co-production activities*, which occurs as business service activities and customer activities are performed.

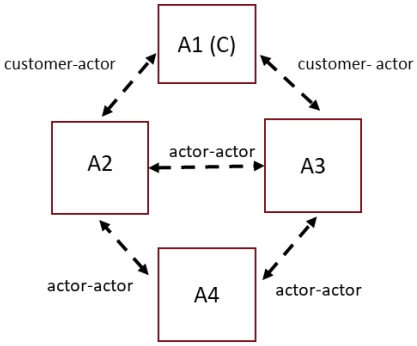

Figure 4-3 Actor Interaction Types

One of the SDBMs of TraXP is depicted in Figure 4-4. The *eXecutive* SDBM aims at providing company executives a "seamless travel experience". It means that when customers (i.e., Executive Travelers) want to travel, TraXP will arrange everything for them from the start to the end of the journey. TraXP will make sure that all necessities during travel are handled correctly. Thus, customers will be able to have a seamless travel experience. For this purpose, it brings six network parties together including TraXP as the *focal* organization and the executive traveler as the *customer*.

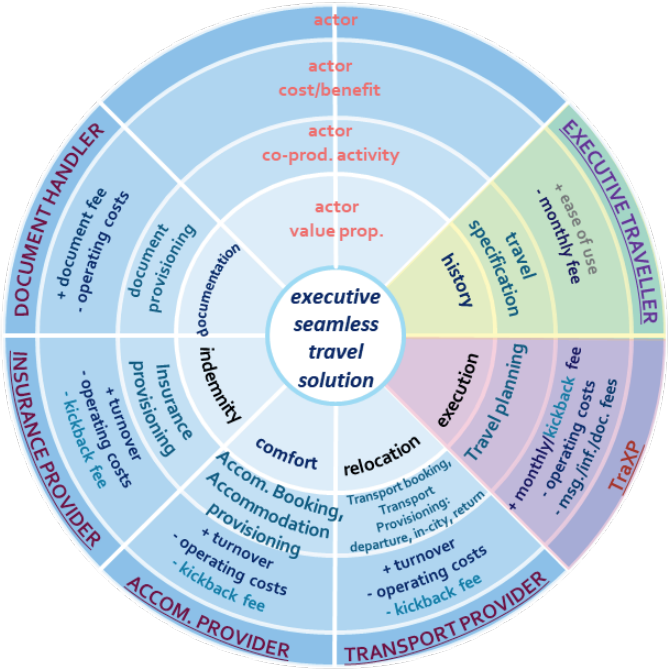

Figure 4-4 TraXP eXecutive SDBM/R

4.2 Customer Service Scenario

A Customer Service-Scenario (CSS) is a process-oriented narrative of the activities of the customer actor and its interactions with other SDBM/R actors. A CSS aims to describe the co-created customer value-in-use anticipated by the SDBM/R, hence it is an essential complement to SDBM/R. SDBM/R and CSS are therefore co-designed together.

The Customer Service Scenario as a concept shares a coherent sub-collection of several elements filtered from the multi-aspect concept of 'customer experience' (also known as service experience) that aligns with the SDL [60, 124, 140]. CSS emphasizes the process characteristics of the experience where an understanding of the formation of the customer's experience within the service system is a requirement for the successful development of service offerings, environments, and systems service [60]. Thus, CSS includes information and evidence on customer activities and the customer's interactions with the other actors of the model in a logical sequence. A second dimension relates to the time horizon of a customer's experience: Customer Service-Scenario (CSS) involves service-time, a shorter episode of a full customer's experience that extends a time horizon from customer expectations before the actual service experience and to the assessments the customer makes after the experience [10]. Third and the last, CSS describes a service scenario from a customer's viewpoint and does not include descriptions from individual service provisioning actors' perspective. This is essential in service-dominant settings since (1) co-created value-in-use emerges from the value propositions from multiple networked actors (aka. value constellations) [124] and (2) only the fronting activities of the service provisioning actors that interact with the customer are relevant for the specification of the service process that needs to be operationalized. The selection of activities as explained in the second criterion here is very similar to the criterion used in Service Blueprinting technique for service process modeling in the marketing research [12]. Service blueprints include a virtual "line of interaction" whereby customer only actions and his/her interactions with the service provider are identified, however from a single service provider's perspective.

To be able to describe the value-in-use, CSS is presented as textual description. The CSS should be easy to understand and describes the journey that customer experiences by interacting with services involved in the process. This way, CSS contains information regarding: value-in-use, customer actions, and the interactions (i.e., message exchanges) between customer and other actors through services owned by them. The business model TraXP *eXecutive* comes with a customer service scenario that explains how a customer can experience the value-in-use that is offered. Here is an example scenario statement for TraXP eXecutive [46]:

John Smith is the CFO of a multi-national industry organization. He travels frequently for his job – for which he is an executive customer of TraXP. In a Monday morning meeting in Amsterdam about a new stock emission, John decides that he needs to be on Wall Street in New York City at 10 am on Thursday the same week. With his mobile phone, John sends a text message to a dedicated TraXP number saying," Wall Street NYC USA 10 am - 2 pm this Thu". Ten minutes later he receives a text message from TraXP saying," For NYC: pick-up at home 10:30 this Wed, back at the office at 9:30

this Fri". He receives all the necessary documents and itinerary for his travel via email. On Wednesday, John leaves the house at 10:30 and steps into a taxi that has just arrived. The taxi brings him to the airport - John doesn't care about which airport. Having arrived at the airport, John receives a text message saying," Check-in at desk 56". He checks in - John doesn't really care which airline. The plane flies him to an airport near NYC. After disembarking at this airport, he gets a text message indicating "Taxi pick-up at Exit 4". He is greeted by a driver holding a sign with his name at Exit 4. The taxi brings him to a hotel. John checks in at the hotel and enjoys his rest in a comfortable room. The last text message that day says "Taxi pick-up 09:30 tomorrow morning". The next morning, a taxi already waits for him in front of the hotel to bring him to Wall Street. There is always a taxi available for him during his stay in NYC. After he finished his business, a taxi picks him up again. The way back home proceeds in a similar way with how he departs to the destination. The taxi brings him to the airport, John flies back home, a taxi picks him up again at the airport and then deliver him home.

Figure 4-5 illustrates an abstract representation of operationalization-related information that can be extracted from the customer service scenario. Accordingly, the customer (A1) performs activities (act.1-act.7) to experience the value-in-use, some of which involve customer-actor interactions with business services (BS) provided by the other actors (A2 & A3) of an SDBM/R (Section 5.4.1 explains this customer activity process of as an integral step of SDBMOM with illustrations)

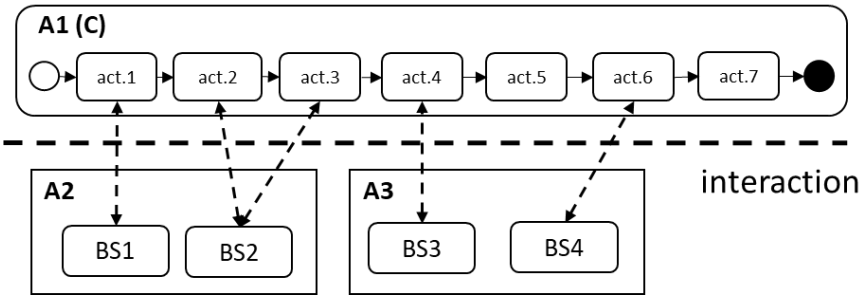

Figure 4-5 An illustration of an itemized Customer Service Scenario

4.3 Business Service (Catalog)

Although the term *service* appears in several domains, there is not a widely and consistently used definition for the term 'business service' (BS).

In the service-oriented computing (SOC) field, the term business service is used to distinguish the encapsulated business logic from the application logic encapsulated by 'software services' [98, 99]. In a simple sense, everything that is needed to make a particular business function happen is a business service. Business services can be implemented by software services, offering an increased Business–IT alignment [66]. Therefore, a business service describes the functions and how service interacts.

And from the implementation point of view, a software service describes the process to deliver the service [59].

The service marketing field makes no distinction between a 'business service' and a 'service' as it adopts the concept of service in the business context [74]. In the SDL, a service is defined as the application of specialized skill(s) and knowledge for another party [136]. One fundamental notion in SDL is that all socio-economic actors apply specialized skills and knowledge (i.e. *operand resources*) reciprocally, in exchange for what they cannot do (i.e. skills and knowledge that they are not specialized in). Following this view, a firm becomes a service provider with a set of micro-specializations that are made available to other actors of the value network where the firm's operant resources constitute the fundamental sources of its strategic benefit [76].

The common denominator of most SDL compatible service definitions is "activities" or "processes" [138]. Service provision is conceptualized as "the ongoing combination of resources, through integration, and their application, driven by operant resources — the activities of actors" [135]. Another widely used service definition by [50] which is also in line with process characterization is as follows: "*Processes consisting of a series of activities where a number of different types of resources are used in direct interaction with a customer so that a solution is found to a customer's problem*".

Following these two perspectives for the concept of business service from SOC and SDL literature, we adopt a multi-aspect definition of the term in the service dominant business modeling context as follows:

A Business Service is micro-specialized competence of an enterprise in the form of a coherent activity and (operant) resource bundles and is tightly connected to the business strategy. Business service is reusable across the business models such that for each business model a specific configuration of the activities it encapsulates are provided and performed.

At the design-time of a business model, a business service is an offering that enables one or more co-production activities of an actor in a business model. At service-time, it is a process that enables 'service' exchange with other actors as required by the business model. In SDBMOM, in order to structure and emphasize reusability and increase the consistency with services computing literature, each specialized activity type of an actor in a BS is called a *"business service operation"*. The business service operations are performed for service provision as described by the CSS and the SDBM/R of the business model. A business service typically includes other operations (activity types) that are required for service operations to function, usually referred to as 'support', 'internal', or 'background' activities. However, such operations are outside the scope of service dominant business model and their operationalization since they do not involve in any interaction with other actors (see Figure 4-6).

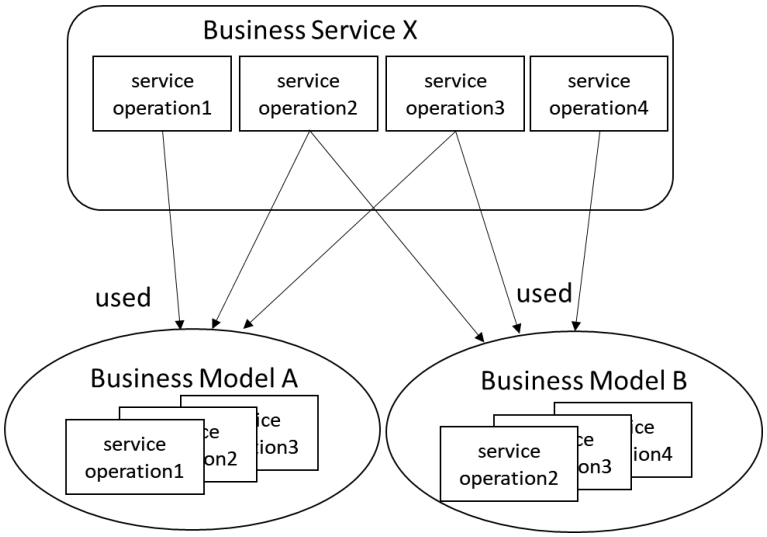

Figure 4-6 Business Service Operation

The list of business services offered by a networking party (actor) is described in the actor's Business Service Catalog [74]. Each actor provides a business service catalog. Using the set of business catalogues from each actor at the design-time, the network parties choose and configure the business services (and their operations) which will enable their co-production activities in a specific business model. In the context of a business model, an actor always interacts with an external entity (customer or another business partner) through the service operations included in its configured business service. Therefore, each *business service* is instantiated for a specific business model by selecting and deploying all or a subset of its service operations (see Figure 4-7). The selected business services and business service operations for a business model will be used in the SDBMOM to operationalize that business model.

In SDBMOM, business services are assumed to exist in semi-structured textual specifications, which at a minimum, provide the service name and the list of service operations that can be performed. Figure 4-7 shows a minimal example of business service and its operations that applies to TraXP. From the list of operations in each business service, not all will be applied in TraXP operationalization (only the one in *italic*)

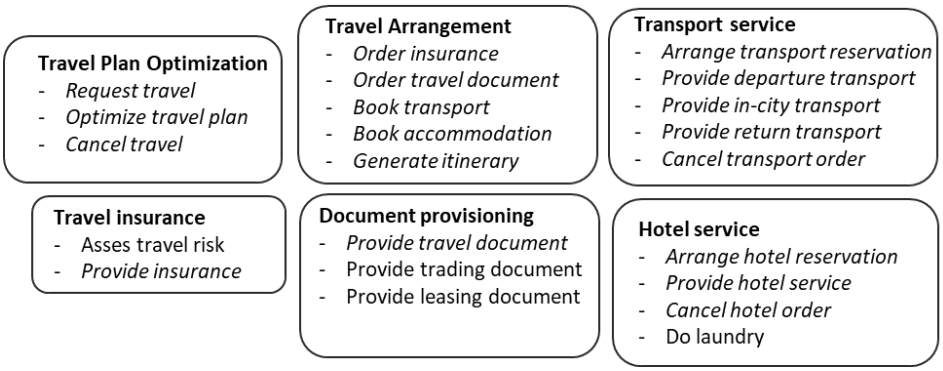

Figure 4-7 Business Services in TraXP Traveling Service

From the selected business services, there are business services which the actor will interact and exchange service with the customer (*customer-actor*) and with other actors (*actor-actor*). To experience the value-in-use, the customer interacts with one or more business services provided by at least one of the actors of the business model.

4.4 Conceptual Process Model (Business Service Composition)

SDBMOM results in a *conceptual process model* that shows how the actors fulfill the required behavior in concert and as implied by the business model using their 'business services'. Drawing on the process aspect of business services (see Section 4.3) and the SDL mindset, where the business services are specialized/competent activities of actors at service-time and the interactions thereof, this process model can alternatively be viewed as a *composition* of the *business services* of the actor-network. Hence, *a business services composition* is an artifact that shows how the business services of the actors connect and interact over "service operations" and how the exchange of service between the networks of actors is operationalized (see Figure 4-8).

The term *service composition* is often considered as a means to the technical implementation of a solution. For instance, the field of Service-Oriented Computing adapts a technical perspective and defines the term as a solution that results from the process of composing new *software* services from existing services through reuse. Accordingly, a service composition (also referred to as a composite service) provides the functionality required to automate a specific business task or process [6, 32, 57, 98, 150]. Service aggregators/integrators who perform this composition become service providers by publishing the service descriptions of their composite services. The composite services can be used as basic services in further service compositions or offered as complete applications and solutions to service clients [98]. As a model, several terms such as service flow, orchestration, and choreography [25] were used along with the term service composition to describe the composition of services in a process flow [105].

By combining the aspects from SOC and SDL perspectives, we define *Business Service Composition (BSC) as a special type of conceptual process model, a solution to the operational requirements of a business model, where business services of the networked-actors connect and interact over "service operations"* (see Figure 4-8).

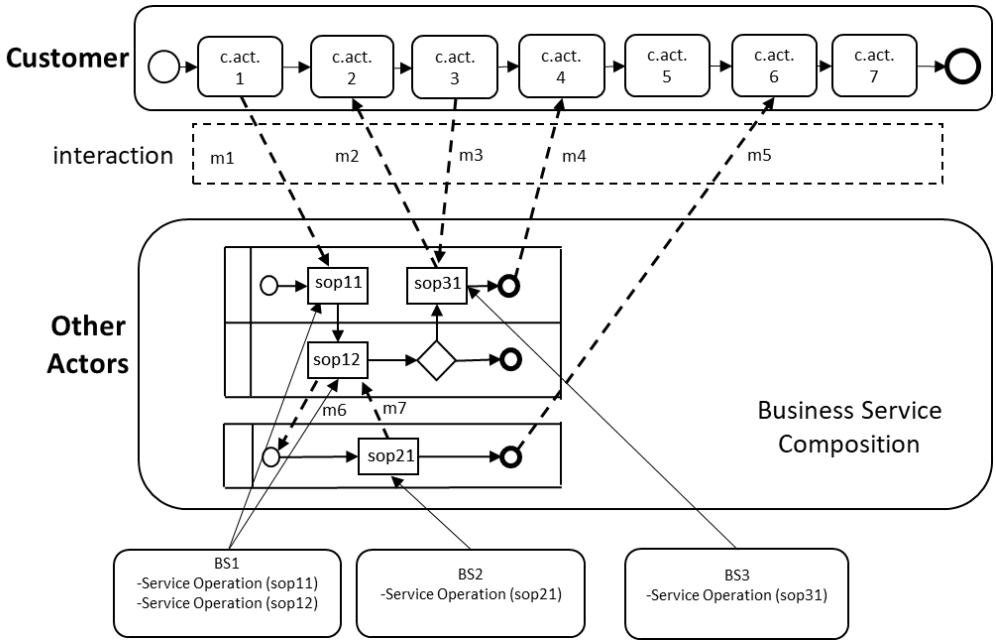

Figure 4-8 Business Service Composition

In SDBMOM, business service composition has two presentations following the two phases of business model operationalization steps (Figure 4-8). In the "specification" phase, 'interaction' is the viewpoint to specify a business service composition such that the interactions between all actors realize the *value-in-use*. In this phase, information regarding actors, their co-production activities and their interactions including those with the customers are extracted from the SDBM/R business model and CSS and combined into a (choreography) process model.

Following this phase comes the 'design phase' where the 'activity' becomes the viewpoint of a business service composition and the specified process behavior in the previous step is implemented. In this representation, service activities from business service configurations are used as design elements and are arranged into a (collaboration) process model. As processes, both business service composition presentations are represented using BPMN 2.0 notation – the de-facto process modeling notation in practice [51].

4.5 Associations between concepts

The conceptual model of the concepts used in SDBMOM is presented in Figure 4-9.

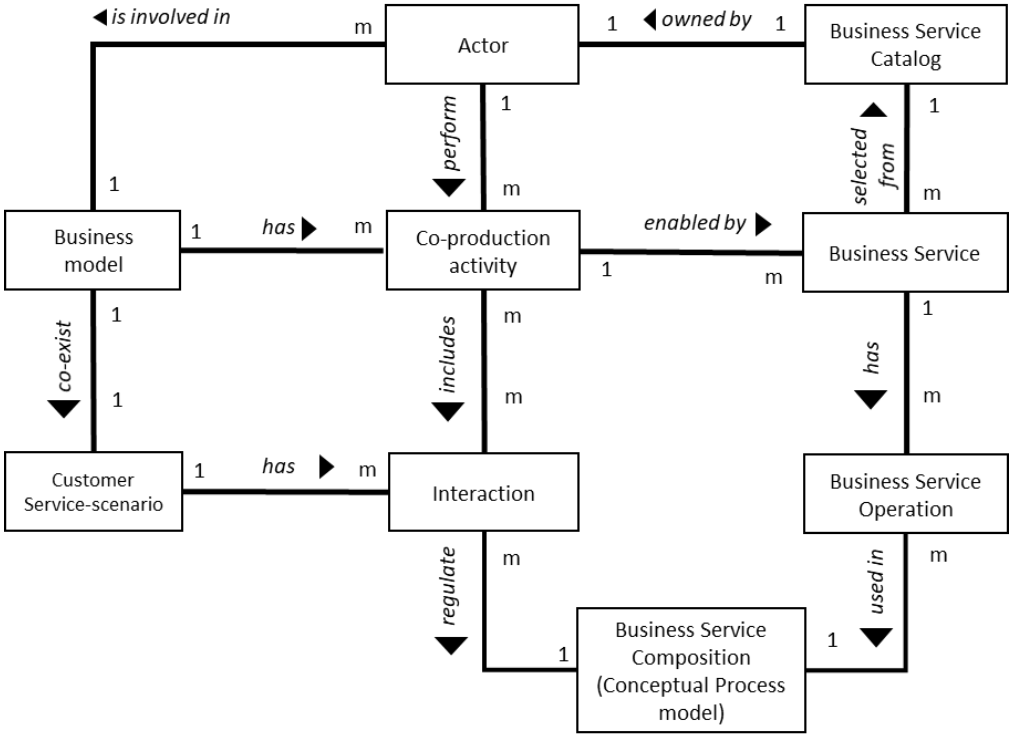

Figure 4-9 Associations between concepts in SDBMOM for the operationalization of a 'single' business model

In SDBMOM, the *service dominant business model* to be operationalized is represented using the SDBM/R. Multiple *actors* are involved in an SDBM, each engaging into the value co-creation by its value proposition(s) enabled by one or more *co-production activities*. Each actor maintains the list of *business services* in a *business service catalog*, to be deployed in an SDBM operationalization. A customer is a special actor who is actively involved in the value co-creation and will experience the value-in-use but may not own a business service per se. An SDBM co-exists with a *customer service scenario*, as the *value-in-use* in the SDBM is realized through it. Customer service scenario guides the mapping of *customer-actor interaction* and its flow. Then, the rest of the co-production activities from the business model are mapped as *actor-actor interaction*. These interactions regulate the design process of a *business service composition (conceptual process model)*. Lastly, *business service operation* is applied to generate a collaboration diagram from the choreography diagram by using service operations listed in each business service specification.

4.6 Chapter Summary

This chapter provides the foundational conceptualizations upon which the proposed method is built (*addressing the Solution Objective-2 as discussed in Section 3.3*). It introduces the core concepts relevant to the Service-Dominant Business Model Operationalization Method that we propose in this study.

Table 4-1 shows a description of the key terms used in Service-Dominant Business Model Operationalization Method (SDBMOM).

Table 4-1 SDBMOM key terms

SDBMOM	Description
Service-Dominant Business Model (SDBM)	The way in which a network of organizations –including the providers and customer, co-creates value for the customer through solution-oriented services, and generates revenue and benefits for all network partners [129].
Service-Dominant Business Model Radar (SDBM/R)	A visual template to guide the design and representation of service-dominant business models [129]
Business Service	A micro-specialized competence of an enterprise in the form of a coherent activity and (operant) resource bundles and is tightly connected to the business strategy. Business service is reusable across the business models such that for each business model the business service is used in, a specific configuration of the activities it encapsulates are provided and performed.
Business Service Operation	A specialized work/activity (-type) performed by actors to exchange service.
Business Service-Catalogue	A catalog of all business services and their specifications offered by an actor.
Actor	A networking party that is involved in the collaboration. A customer is a special actor that will experience the value offering.
Customer Service-Scenario	A process-oriented narrative of the activities of the customer actor and its interactions with other SDBM/R actors.
Co-production Activity	An activity, in the form of one or more interaction between actors. Co-production activity is enabled by one or more business services via business service operations.
Interaction	Communication between actors in the form of message exchanges.
Business Service Composition	A special type of conceptual process model, a solution to the operational requirements of a business model, where business services of the networked-actors connect and interact over “service operations”.

SDBMOM required three inputs, namely: service-dominant business model (i.e., SDBM/R), customer service scenario, and business service. The most important information to be extracted from SDBM/R are the actor and the co-production activity. Additionally, a customer service scenario is the realization of the value-in-use that is present in SDBM/R, where the interaction between actors (especially with customer) can be derived from it. A business service is part of a business service catalog, while a business service operation is part of a business service. As for the output, SDBMOM produces business service composition, in the form of conceptual process model using BPMN notation.

5 Service-Dominant Business Model Operationalization Method (SDBMOM)

In this chapter, we present the Service-Dominant Business Model Operationalization Method (SDBMOM) as a step-wise method to operationalize a service-dominant business model represented in an SDBM/R into a (set of) conceptual process models. First, we describe the levels of business model operationalization and delineate the scope for SDBMO in Section 5.1. Then, we show how BPMN 2.0 is used in SDBMOM in Section 5.2. Section 5.3 gives an overview of the SDBMOM. Next, we present the detailed steps of the method and demonstrate them using a running example in Section 5.4. Finally, we describe how specific business engineering *roles* are mapped to the SDBMOM steps in Section 5.5 .

5.1 The Scope for SDBMOM

The operationalization of a business model is a multifaceted task addressing the requirements at different business layers and aspects, resulting in varying details in its operational artifacts. In Chapter 4, we define the conceptual underpinnings of SDBMOM. SDBMOM takes these concepts and their relations as a constituent component of the method representing SDBMOM's abstract view of its operational context.

As the SDBMOM aims at operationalizing service-dominant business models into conceptual business *process models*, the primary focus is on the *control-flow* and *functional* aspects of business model operationalization. (Accordingly, we leave out concerns regarding -for instance- resources, such as people, material, etc. or feasibility evaluations of BM operationalization from the scope of SDBMOM and address them as future research.)

In line with the findings from the literature [4, 117], and the business engineering outline framework, we identify three levels of operationalization (see Figure 5-1) for an SDBM that can be supported by an information system. These operationalization levels also correspond with the detailed modelling phases in the Model-Driven-Architecture (MDA) [87]. MDA is a modelling approach that is largely followed in the model transformation stages during BMO (please see the result of the SLR regarding 'Approaches in BMO' in Section 2.3.3). The key concepts of MDA and the matching concepts of SDBMOM is given Table 5-1.

Table 5-1 Comparison between MDA and SDBMOM

MDA	**SDBMOM**
Viewpoint	Level
Computer Independent Viewpoint	Operationalization LEVEL-1
Platform Independent Viewpoint	Operationalization LEVEL-2
Platform Specific Viewpoint	Operationalization LEVEL-3

MDA	SDBMOM
Model	Model
Computer Independent Model	Conceptual Process Model
Platform Independent Model	Executable Process Model
Platform Specific Model	Platform Specific Model

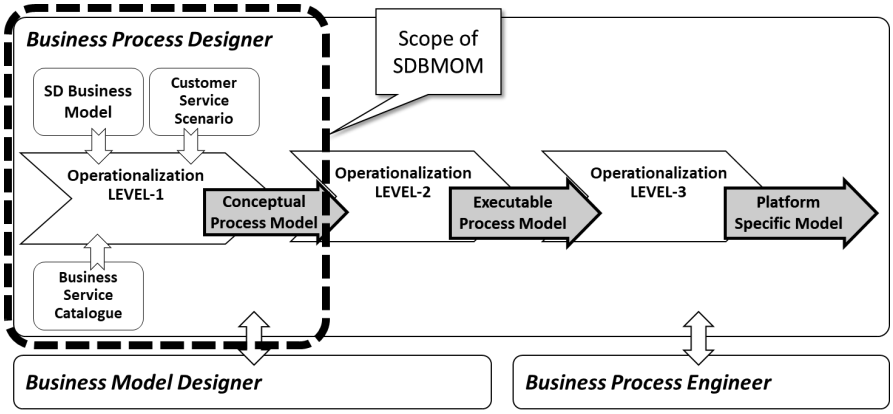

Figure 5-1 Levels of Service-Dominant Business Model Operationalization

These levels of operationalization are:

1. **Level-1**: The first level of operationalization is *conceptual*. The objective is to operationalize a service-dominant business model, taking SDBM/R presentation, accompanying customer service-scenario and business service catalog of network parties as inputs. The operationalization should ensure that the business network parties (actors) perform their co-production activities using their business services and in accordance with the scenario. The output is a conceptual process model (or business service composition) which serves as an operational contract between the parties, delineates each actor's operational scope and shows flows of information between them.
2. **Level-2**: The second level of operationalization takes a conceptual process model as input and generates one or more *executable* process models that can be enacted in (process-aware) information systems (e.g., Business Process Management System - BPMS). The output is execution-ready process models that implement the conceptual process model aligned with various solution-related design choices (e.g., implementation scope, architectural considerations, type of execution platform used, possible translation of syntactical constructs, etc.).
3. **Level-3**: In the third, *platform-specific* level, the executable processes are transformed into executables by the containers of a BPMS platform. The running process instances are created by deploying the executable process model on specific instances of the execution platform;

deployment implies adding execution parameters such as identification of the specific business process management server instance.

This research focuses on the operationalization of an SDBM into conceptual process models, and therefore takes Level-1 Operationalization in Figure 5-1 in its *scope*.

As we can see in Figure 5-1, there are different roles that are involved in the SDBM operationalization. These roles have its own expertise that influences the design process. For example, in the process of transforming the conceptual process model into an executable process model (i.e., Level 2), the process model might also change/simplified. What is important in the conceptual process model is that it should show how different organizations, as many as the number of actors in the SDBM/R, collaborate by interacting through message exchanges. Thus, the conceptual process model can truly be traced back to the SDBM/R. This way, each actor can have the freedom to design their process fulfilling the specified interactions through messaging. Figure 5-2 abstracts and illustrates the components within each level of operationalization and in the figure, it can be seen that conceptual process model represents this notion specifying actors' processes and the messaging between them. However, during implementation, the process model may change (i.e., merging the pools of the organization into one pool separated by swim lanes) for the purpose of presenting one process to the customer, hiding away the interactions between other actors which are invisible to the customer.

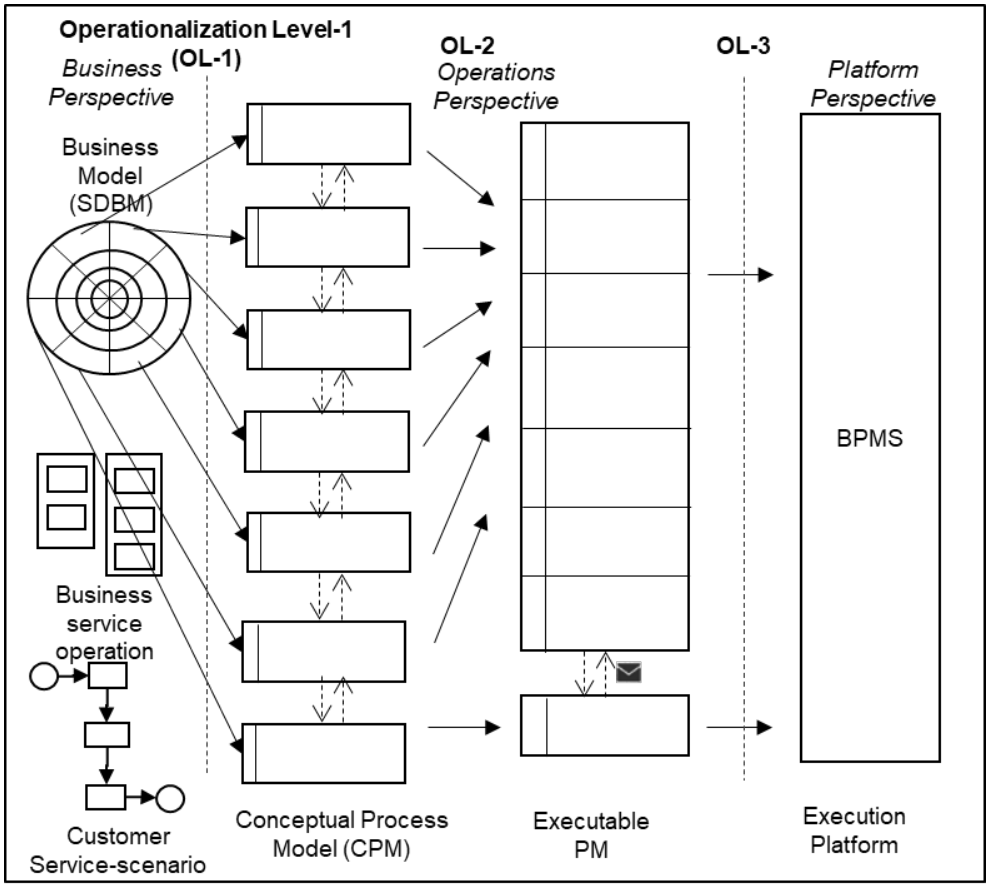

Figure 5-2 Components of Service-Dominant BMO Levels (exemplified)

5.2 Mapping of the SDBMOM Key Terms to BPMN 2.0

In SDBMOM, we use BPMN 2.0 notation [92] to represent various concepts and artifacts in the operationalization of a business model. In this section, we give a mapping between SDBMOM and BPMN elements.

All actors that are present in an SDBM/R participate in its operationalization. In conceptual process models that are represented using BPMN 2.0, these actors are represented by *pools* (or *swim-lanes* within pools). Actors collaborate with each other actor via *message exchanges*.

There are two important viewpoints to describe service composition: interaction-view, and activity-view (see section 4.4). In the interaction-view, a service composition describes the actors and their interaction with other parties in the form of message exchange in a 'big picture' or 'sunny day'

scenario that we want to describe in the model. The focus is to create a process model that is consistent with the business model. All elements in this phase of service composition should be traceable to the elements of a business model to operationalize. On the other hand, what matters in the activity-view service composition definition is how the service composition can become the guidance for the day-to-day business process. Therefore, it should show the 'detailed' arrangement of activities in a full (or completed) scenario, including the rainy-day scenario (i.e., including exception management). Therefore, to model the service composition, we use BPMN 2.0 notation since it specifies process diagrams and related elements for interaction- and activity-based modeling.

BPMN 2.0 provides the techniques of *choreography diagram* and *collaboration diagram* to model both forms of service compositions. A collaboration diagram depicts the interactions between two or more business entities. A collaboration usually contains two or more pools, representing the participants in the collaboration. The collaboration can be shown as two or more processes communicating with each other via message exchanges. A process (or orchestration) describes a sequence or flow of activities in an organization with the objective of carrying out work. The collaboration can be extended to choreography. Choreography is a definition of the expected behavior, basically a procedural contract, between interacting participants [92].

In BPMN 2.0, there is a differentiation for the meaning of 'activity' in the choreography diagram and collaboration diagram [92]: *"To leverage the familiarity of flowcharting types of Process models, BPMN Choreographies also have "activities" that are ordered by Sequence Flows. These "activities" consist of one or more interactions between Participants. These interactions are often described as being message exchange patterns (MEPs). MEP is the atomic unit ("Activity") of a Choreography" (p.315).* In the choreography, activity is seen as 'interaction' while in the collaboration or orchestration is seen as 'work'. The activity described in business models seen as an interaction between actors while in process models described as a work/task conducted by actors. Therefore, we utilize choreography diagram to represent the interaction-oriented service composition and collaboration diagram to represent the activity-oriented service composition.

Thus, in service composition, activities conducted by actors (including the customer) are represented by activities, roles, and pools of a BPMN 2.0 process model. All interactions between actors are represented as message flows. Together with the customer service scenario, the service composition is a choreography diagram. Together with the service activities, the service composition can then be transformed into a collaboration diagram. In summary, Table 5-2 shows the mapping of terms used in SDBMOM concepts to BPMN 2.0 concepts.

Table 5-2 Mapping of SDBMOM key terms to BPMN 2.0

SDBMOM	**BPMN**	**Description (from OMG guide version 2.0)** [92]
actor	*participant*	A Participant (see page 113) can be a specific PartnerEntity (e.g., a company) or can be a more general PartnerRole (e.g., a buyer, seller, or manufacturer) (p.111).
	pool	In the Collaboration view, the Participants of the Choreography Task Participant Band's will be represented by Pools (p.324).
interaction: customer-actor & actor-actor	*choreography*	A Choreography is a definition of expected behavior, basically a procedural business contract, between interacting Participants. A Choreography formalizes the way business Participants coordinate their interactions. The focus is not on orchestrations of the work performed within these Participants, but rather on the exchange of information (Messages) between these Participants (p.315).
co-production activity	*(choreography) activity/task*	A BPMN Choreographies also have "activities" that are ordered by Sequence Flows. These "activities" consist of one or more interactions between Participants. These interactions are often described as being message exchange patterns (MEPs). MEP is the atomic unit ("Activity") of a Choreography (p.315).
business service composition: choreography	*choreography diagram*	A Choreography is a type of process but differs in purpose and behavior from a standard BPMN Process (p.315).
business service composition: a conceptual process model	*collaboration diagram*	A collaboration diagram depicts the interactions between two or more business entities (p.107).
Business service operation	*(orchestration) process*	A Process describes a sequence or flow of Activities in an organization with the objective of carrying out work (p.143).
	(collaboration) activity/task	Activity is work that is performed within a Business Process (p.149).

5.3 Method Overview

In this section, we present the overview of SDBMOM. Figure 5-3 shows the activities that take place in SDBMOM in the form of a process model. These activities take place in OL1 (Level 1-Operationalization) (see Figure 5-1 for the complete levels of operationalization).

Table 5-3 shows the details of the SDBMOM steps, relevant inputs, outputs, as well as the roles that are involved in their execution.

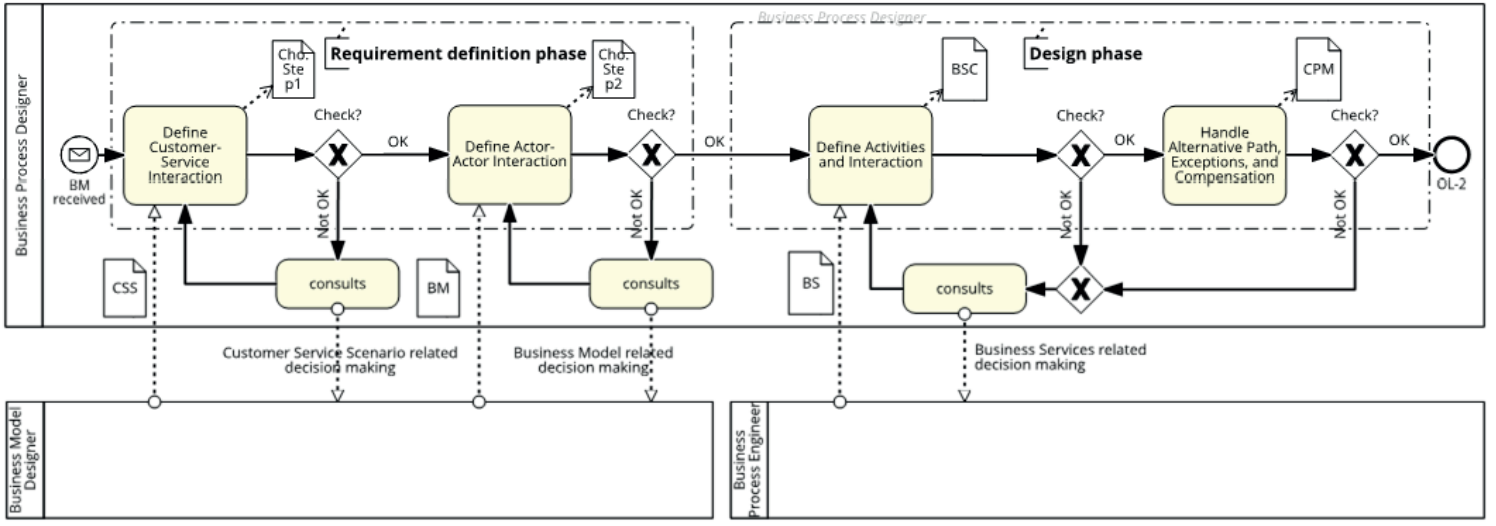

Figure 5-3 SDBMOM Steps and Roles in a Process Model

Table 5-3 SDBMOM Steps

Step	Input	Output	Roles
Step 1. Define Customer-Service Interaction Develop a (choreography) process model that captures the customer-actor activities/interactions.	- Customer-service Scenario - SDBM/R	Choreography diagram-1 (Customer-Actor interactions)	- Business Process Designer - Business Model Designer (Support)
Step 1.1. Generate an itemized representation of the customer service-scenario of the SDBM including the customer actions and customer-actor interactions.			
Step 1.2. Match the co-production activities of the actors with the itemized customer-actor interaction elements.			
Step 1.3. Extract the information about the actor and their co-production activities from the SDBM/R.			
Step 2. Define Actor-Actor Interaction Develop a model that captures the sequence of activities in which all actors involved in the business model are present.	- SDBM/R - Choreography diagram-1	Choreography diagram-2 (Actor-Actor interactions)	- Business Process Designer - Business Model Designer (Support)
Step 2.1. Extend the Step 1 output choreography-1 with actor-actor interactions and matching co-production activities.			
Step 3. Define Activities and Interactions in a Service Composition Develop a business service composition where process model activities can be mapped to the operations of business services offered by the network parties.	- Choreography diagram-2 - Business Services Catalog	Business Service Composition	- Business Process Designer - Business Process Engineer (Support)
Step 3.1. Create pools in a collaboration diagram for the actors (network parties) represented in choreography model-2, and add message exchanges between actors.			
Step 3.2. Fill in the pools by adding service operations, control flow, and messaging			
Step 4. Complete the Model with Alternative Paths and Exceptions Address the requirements of the alternative scenarios and (business-domain related) exceptions that are not represented in the choreography or business service composition models.	- Business Service Composition - Business Services Catalog	Conceptual Process Model	- Business Process Designer - Business Process Engineer (Support)

The SDBMOM activities can be mapped to two phases of a typical system development lifecycle [58]: *requirements definition* and the *design* phases. The requirements definition phase aims at describing the requirements for the operationalization and specifying them as a high-level business service composition not explicitly linked to business service operations. The design phase aims for a business service composition that explicitly incorporates BS operations for the realization (design) of the specification. Steps 1 and 2 take place in the requirements definition phase, while step 3 is performed in the design phase. Here, the output OL1 is performed by the *business process designer* in close collaboration with the *business model designer* and *business process engineer*. Details regarding the roles involved in each step (activity) are described in Section 5.5.

Each step outputs process models that include specific elements that represent the information extracted from the inputs, namely, customer service scenario (CSS), the business model represented in SDBM/R, and the business services catalog (BS). Step 1 uses CSS as input and produces an intermediate *choreography* diagram (Cho.Step1) that represents the customer-actor interactions. Step 2 produces a more detailed *choreography* diagram (Cho.Step2), which includes actor-actor interactions added to the choreography diagram and all co-production activities in the SDBM are matched. Cho.Step2 is a specification of the requirements in a process diagram, which are to be met by the business service composition. In Step 3, the interactions are transformed into collaboration diagrams taking the choreography produced in Step 2 as the basis. The collaboration diagram generated in Step 3 represents the resulting business service composition (BSC) which is designed as a solution to the specified requirements from Step 2. In Step 4, the conceptual process model (CPM) is enhanced with alternative and exceptional paths (e.g., cancellation, compensation, exception, etc.) that the designer requires in a complete scenario. CSS only contains the 'sunny day' scenario. Therefore, Step 4 complements the scenario by adding the 'rainy day' scenarios as well.

To ensure traceability and consistency between the inputs and outputs of each step, it is necessary to ensure that all models produced in these steps are consistent with the elements of the business model, customer service scenario, and business services. Therefore, SDBMOM features consistency control checklists after each step, where the outcome of each step is verified with respect to the inputs. These checks are performed together with the business model designer to ensure that the corresponding output models address the requirements set by the business domain in the input models. The verification activities are supported by matrices that show how each element of an output model can be traced to the elements of prior models to address the need for consistency in model transformations.

The method operates on the assumption that the information represented in input models (i.e., in SDBM, CSS, and BS Catalogue) is correct and complete (i.e., possess all the information necessary) to develop corresponding conceptual process models. However, in the case that this assumption is not fully met (i.e., the input is not complete or correct), the business model designer and potentially other domain experts can be consulted to provide the required information or refinements to the inputs to proceed with the operationalization. In Section 5.4, we describe the steps and conditions to be met to move to the next step.

5.4 Method Steps

In this section, we provide detailed descriptions of the individual SDBMOM steps shown in Figure 5-3. In the following paragraphs, we explain the purpose of each step, give the pre-requisites, the tasks that are involved, the output that is produced, and the conditions (checklist) for the verification to ensure that it is appropriate to proceed to the next step.

Table 5-4 Method Step Specification Structure

Element	Description
Purpose	The purpose of performing the step.
Pre-requisites	The set of actions and/or inputs that needs to be completed/available before starting the execution of step
Tasks (sub-steps)	The specific tasks that needs to be performed to complete the step.
Output	The resulting outputs of the task after performing all the tasks.
Consistency control	The conditions that needs to be checked and satisfied before moving to the next step.

5.4.1 Step 1: Define Customer-Service Interaction

Purpose: To develop a (choreography) process model that captures the customer-actor activities/interactions.

The choreography model captures the sequence of activities through customer interaction with the service system (to be collectively offered by the other network parties/actors). This step uses the CSS to guide the mapping of the co-production activities – represented by choreography activities - into a sequence of activities that realize the value-in-use.

In an SDBM, all network parties - including the customer – participate in and contribute to value creation. However, for the purpose of business model operationalization, in Step 1 we *single-out* the customer as a first step to guide the specification of the interaction between actors in later steps. Thus, this step shows the customer-(other) actor (C-A) interactions. Although, the customer is a networking party in an SDBM/R, its special characteristics as an actor to experience the *value-in-use* to be offered by the SDBM makes it an appropriate starting point for the operationalization. Thus, the customer is supposed to lead the value co-creation [49, 115]. As the operationalization proceeds to later steps and yields a conceptual process model, this distinction no longer matters as the customer eventually becomes an 'ordinary' party in the network.

Pre-requisites: SDBM/R (actors, co-production activities), Customer Service Scenario

The CSS is required to provide information on the sequence of activities that the customer follows to experience the value-in-use in the form of a set of interactions with the business services provider. What is needed from SDBM/R is information regarding the actors and the co-production activities.

Tasks:

Step 1.1: The first task in Step 1 involves the generation of an itemized representation of the customer service-scenario of the SDBM including the customer actions and customer-actor interactions.

Table 5-5 shows this representation for the running application scenario. It shows the statements of the customer service-scenario of TraXP's *eXecutive* SDBM, together with examples of the customer actions and the customer-actor interaction that can be extracted. As it is possible that the CSS is not complete and lacks some necessary information, during the extraction the process designer may involve the business model designer (and possibly other domain experts) to avoid missing important activities and interactions.

As depicted in Table 5-5 the information extracted from the CSS of the running example leads to six main customer-actor interactions.

Table 5-5 Customer service scenario in TraXP eXecutive

No	Customer service scenario statement	Customer actions	Customer-Actor (C-A) interaction
1	John Smith is the CFO of a multi-national industry organization. He travels frequently for his job – for which he is an executive customer of TraXP. In a Monday morning meeting in Amsterdam about a new stock emission, John decides that he needs to be on Wall Street in New York City at 10 am on Thursday the same week. With his mobile phone, John sends a text message to a dedicated TraXP number indicating "Wall Street NYC USA 10 am - 2 pm this Thu".	Executive Traveler request travel via mobile phone.	Executive Traveler request travel and give the travel specification to TraXP.
2	Ten minutes later he receives a text message from TraXP saying," For NYC: pick-up at home 10:30 this Wed, back at the office at 9:30 this Fri". He receives all the necessary document and itinerary for his travel via email.	Executive Traveler is prepared for the travel.	Executive Traveler receive notification of departure from TraXP (including all necessary documents and itinerary).
3	On Wednesday, leaves the house at 10:30 and steps into a taxi that has just arrived. The taxi brings him to the airport - John doesn't care about which airport. Having arrived at the airport, John receives a text message saying, "Check-in at desk 56". He checks in - John doesn't really care which airline. The plane flies him to some airport near NYC. After disembarking at this airport, he gets a text message saying, "Taxi pick-up at Exit 4". He is greeted by a driver holding a sign with his name at Exit 4. The taxi brings him to a hotel.	Executive Traveler goes to the destination and stays at the hotel.	Executive Traveler departs: Executive Traveler receives notification/appointment. At depart date, Executive Traveler is picked up by taxi (Transport Provider) at home and then go to the airport. Executive Traveler checks in at an airline desk and then fly to the destination airport. Executive Traveler is picked up by taxi at the airport and then go to the hotel.
4	John checks in at the hotel and enjoys his rest at the comfortable hotel.	Executive Traveler rests at the hotel	Executive Traveler checks in and completes all the paperwork to get his/her room key.

No	Customer service scenario statement	Customer actions	Customer-Actor (C-A) interaction
5	The last text message that day says," Taxi pick-up 09:30 tomorrow morning". The next morning, a taxi already waits for him in front of the hotel to bring him to Wall Street. There is always a taxi available for him during his stay in NYC.	Executive Traveler do his/her business	Executive Traveler receives notification/appointment. At due date, a taxi is always ready to deliver. ET is picked up by taxi at the hotel and then delivered to the travel destination.
6	After he finished his business, a taxi picks him up again. The way back home proceeds in a similar way with how he departs to the destination. The taxi brings him to the airport, John flies back home, a taxi picks him up again at the airport and then deliver him home.	Executive Traveler returns home.	Executive Traveler returns: Executive Traveler receives notification/appointment. At return date, Executive Traveler is picked up by taxi and then go to the airport. Executive Traveler checks in at an airline desk and then fly back home. Executive Traveler is picked up by taxi at the airport and then return home.

Step 1.2: The second task is to match the co-production activities of the actors with the itemized customer-actor interaction elements. The customer-actor interaction explains how the system can realize the anticipated value-in-use that the customer would like to experience. As these customer-actor interactions are part of the co-production activities, we can then match the corresponding co-production activity according to the sequence of the customer actions (see Table 5-6). The corresponding message exchanges can also be presented there.

Table 5-6 Mapping of customer-actor interaction

C-A message exchange	travel specification	itinerary, visa, insurance, tickets, reservation proof	departure notification	hotel room paperwork	in-city travel notification	returning notification
Customer Actions	**book travel**	**prepare travel**	**go to destination**	**use accommodation**	**doing business**	**return home**
Customer-actor interaction	travel specification	travel planning	departure transport provisioning	accommodation provisioning	in-city transport provisioning	returning transport provisioning

Step 1.3: The last task in Step 1 is to extract the information about the actor and their co-production activities from the SDBM/R (see Table 5-7).

Table 5-7 Ownership information for co-production activity

Co-production activity	Actor
provide travel specification	Executive traveler
	TraXP

Co-production activity	Actor
travel planning	
insurance provisioning	Insurance provider
document provisioning	Document handler
transport booking	Transport provider
departure transport provisioning	
in-city transport provisioning	
returning transport provisioning	
accommodation booking	Accommodation provider
accommodation provisioning	

Figure 5-4 illustrates how the customer-actor interaction in Table 5-5 is itemized into co-production activities. These co-production activities are enabled by business service owned by other actors. Then, by combining the information regarding co-production activities, message exchanges, and actors involved, a choreography diagram can be generated.

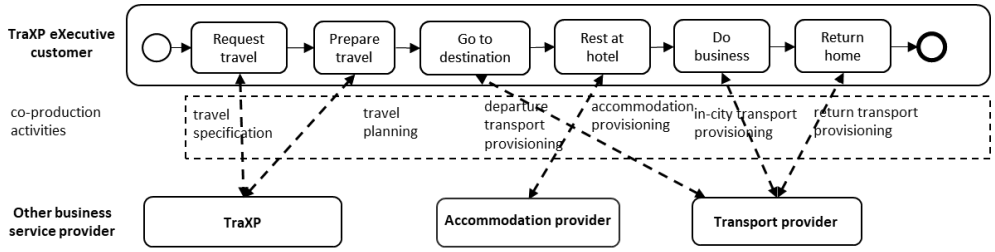

Figure 5-4 Itemization of Customer-actor interaction for TraXP eXecutive

Output: A choreography diagram is used to model the customer-actor interactions.

Thus, step 1 produces a Step-1 Choreography model (see Figure 5-5 for the running application case). Each co-production activity is a choreography activity/task.

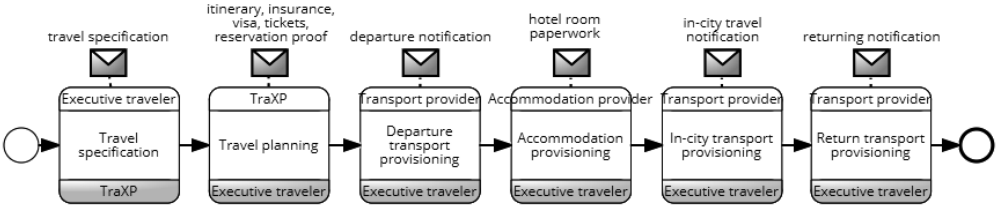

Figure 5-5 Step-1 Choreography

Consistency control: The choreography diagram represents customer-actor interactions. Therefore, the control checklist rules are:

1. All actors in the choreography are in the SDBM/R.
2. All choreography activities (blocks) are in the SDBM/R as co-production activities.
3. All choreography activities (blocks) have the customer as one of the participants.

Table 5-10 is an example of the consistency control matrix used in Step 1.

5.4.2 Step 2: Define Actor –Actor (A-A) Interaction

Purpose: To develop a model that captures the sequence of activities in which all actors involved in the business model are present.

Actor-actor interactions which are not represented in the outcome of the first step (but implied by the co-production activities of the SDBM/R) are incorporated into this model.

Pre-requisite: The co-production activities to provide the set of activities that represent actor interactions with the customer or with other actors.

Task: Extend the Step 1 output Choreography with actor-actor interactions and matching co-production activities.

In Step 2, we mapped the co-production activities - the enabler of customer-actor interactions - to the choreography diagram. In the next step, the business process designer, in collaboration with the business model designer, maps the rest of co-production activities that are part of the actor-actor interactions.

Table 5-8 shows the distribution of co-production activities mapping for the TraXP eXecutive application case. Several co-production activities have been recognized as part of C-A interaction from Step 1. Thus, those that remain are part of A-A interaction.

Table 5-8 Distribution of interaction in co-production activities

Co-production activity	Type of interaction
travel specification	C-A
travel planning	C-A
insurance provisioning	A-A
document provisioning	A-A
transport booking	A-A
departure transport provisioning	C-A
in-city transport provisioning	C-A
returning transport provisioning	C-A

Co-production activity	Type of interaction
accommodation booking	A-A
accommodation provisioning	C-A

The prior step ensures that all necessary interactions that together deliver value-in-use are identified and represented. Table 5-9 gives an example of the running scenario, where the additional mapping of A-A interaction is basically the extension of the Choreography Step1, which then leads to the development of the Choreography Step 2 model.

Table 5-9 Mapping of all co-production activities

A-A message exchange		insurance order, travel document order, transport booking order, hotel booking order, insurance, visa, tickets, reservation proof				
C-A message exchange	travel specification	itinerary, visa, insurance, tickets, reservation proof	departure notification	hotel room paperwork	in-city travel notification	returning notification
Customer Actions	book travel	prepare travel	go to destination	use accommodation	doing business	return home
Customer-Actor interaction	travel specification	travel planning	departure transport provisioning	accommodation provisioning	in-city transport provisioning	returning transport provisioning
Actor-Actor interaction		document provisioning, insurance provisioning, transport booking, accommodation booking				

Output:

A choreography diagram is developed to model the complete set of interactions (i.e., that includes actor-actor interactions). Thus, this step produces the Step-2 Choreography model (see Figure 5-6 for the running example). The step-2 choreography model constitutes the specification for the

operationalization, which describes what needs to be operationalized as extracted and implied from CSS and SDBM.

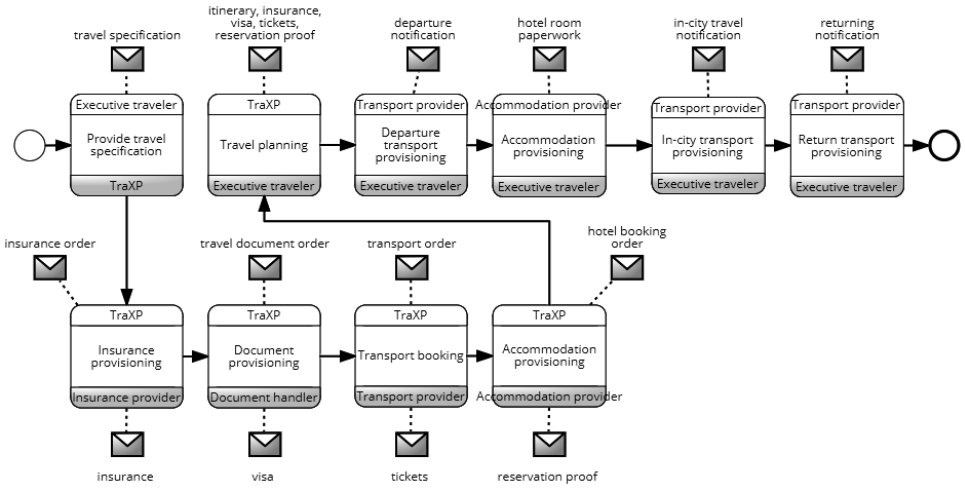

Figure 5-6 Step-2 Choreography

Consistency control checklist:

The conditions to be satisfied at this step are the following:

1. All network parties (actors) in the SDBM is present in the Step-2 choreography model.
2. The step-2 choreography model shows all co-production activities that are depicted in the SDBM (and potentially not in step-1 choreography model).

Table 5-10 gives an example matrix (of the running case) that can be used for consistency control between models. Both Step 1 and 2 use the same consistency control because Choreography Step 2 model is an extension of the Choreography Step 1 model that has the same components.

Table 5-10 Consistency Control Checklist Matrix of Step 1 & 2 for TraXP/X

Step	Business model TraXP eXecutive						
	Co-production activity	Actors					
		executive traveler	TraXP	insurance provider	document provider	transport provider	accommodation provider
1	travel specification	x*1*	x*2*				
1	travel planning	x*1*	x*2*				
1	insurance provisioning		x*2*	x*5*			
2	document provisioning		x*2*		x*6*		

Step	Business model TraXP eXecutive						
	Co-production activity	Actors					
		executive traveler	TraXP	insurance provider	document provider	transport provider	accommodation provider
2	transport booking		x*2*			x*7*	
1	departure transport provisioning	x*1*				x*3*	
1	in-city transport provisioning	x*1*				x*3*	
1	returning transport provisioning	x*1*				x*3*	
2	accommodation booking		x*2*				x*7*
1	accommodation provisioning	x*1*					x*4*

5.4.3 Step 3: Define Activities and Interaction in a Service Composition

Purpose: To develop a conceptual process model - in the form of a business service composition-, where process model activities can be mapped to the operations of business services offered by the network parties.

Pre-requisite: In order to map the activities of the conceptual process model to business service operations, the process designer requires the business services catalog of network parties that specify the list of business services and corresponding operations.

Tasks:

After the two requirements definition (*specification)* steps in SDBMOM, the final step in Level-1 operationalization takes place. Step 3 is a *design* activity and involves a change of perspective for activities. In prior models, where the activity is considered as a set of interactions, in this step, it becomes an actor task that enables the interactions. Therefore, this step involves transforming the step-2 choreography model 2 into a conceptual process model in the form of a *collaboration* diagram. In this transformation, service operations are incorporated into the activity block in a choreography diagram. After the diagram transformation, the service operation become a task in a collaboration diagram.

In this step, the business process designer collaborates with the business process engineer (as depicted in Figure 5-3) to select the business service operations from the business service catalog and map to the activities in the conceptual process model. Thus, it is necessary to firstly configure the business service operations before we start generating the collaboration diagram.

Configuring Business Service Operation: Aligned with the assumptions of the SDBMOM regarding the inputs, the method assumes that each network party/actor possesses the necessary capabilities to perform the required activities and has represented these capabilities in a catalog of business services

(and corresponding operations). This is with the exception of the customer which does not necessarily own business services but can still participate in a co-production activity by providing information for other actors' business services. In practice, however, situations where actors discover the necessity to create new business services or re-design them to cope with the new business opportunities, may occur, in which case the SDBMOM steps proceed after this activity is performed.

Table 5-11 shows the selected business services that are taken as input to the business service composition for our running TraXP application case.

Table 5-11 Selected business service from each actor's service catalogue

Actor	**Business services**
Executive traveler	travel plan optimization
TraXP	travel plan optimization
	travel arrangement
Insurance provider	travel insurance
Document handler	document provisioning
Transport provider	transport service
Accommodation provider	hotel service

Table 5-12 gives an example set of business services and corresponding operations for the actors that take part in the running case. Note that not all business service operations are needed for a specific conceptual process model (business service composition), as a service operation may be used in multiple SDBMs. Re-usability of service operations is a cornerstone for the realization of business agility [35].

Table 5-12 Business Service Operations for TraXP/X

Business services	**Code**[1]	**Business service activity**
travel plan optimization	B	request travel, optimize travel plan, cancel travel
travel arrangement	O	order insurance, order travel document, book transport, book hotel, generate itinerary, cancel transport order, cancel hotel order
travel insurance	I	provide insurance
document provisioning	D	provide travel document
transport service	TS	arrange transport reservation, provide departure transport, provide in-city transport, provide returning transport, cancel transport order

[1] The code functions only to help in tracking each service operation in the conceptual process model.

Business services	Code[1]	Business service activity
hotel service	A	arrange hotel reservation, provide hotel service, cancel hotel order

Generating the Collaboration Diagram: A collaboration (or orchestration) diagram is a BPMN diagram that captures the control-flow aspect of the business model in addition to the message exchanges that is inherited from the choreography model. The generation of the collaboration diagram involves mapping of the service operations to the activities in the pools of actors depicted in the step-2 choreography model. The detailed steps that the process designer follows are as follows:

Step 3.1: Creating *pools* in the collaboration diagram for the actors in line with the number of network parties represented in the step-2 choreography model. Add also messages exchanged between actors (pools) shown in the choreography model.

This pool configuration is a direct translation of a choreography diagram into a collaboration diagram. By configuring the pools without the orchestration first, it will reduce the complexity of message exchange arrows visualization during the design process of the collaboration diagram. Although, the pool configuration in the collaboration might be changed depending on how the end results of the conceptual process model. Even when creating the executable process model in the Level 2 Operationalization, this pool's configuration might change again depending on the design of the business/software services or the decision of the business process designer to create more effective or efficient process models. The easiest way to do it is by creating the pools for the customer and focal organization first, then add the actor pools that also interact with the customer between these two pools, and lastly, add the actor pools that have no interaction with the customer below the focal organization pool. For example, see Figure 5-7 that shows the design for the running application case.

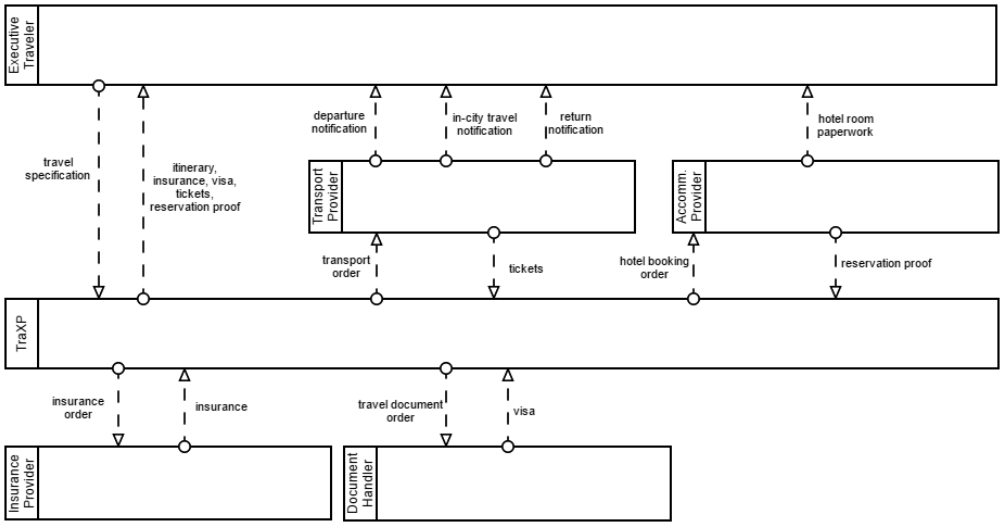

Figure 5-7 Pools configuration

Step 3.2: Fill in the pools by adding service operations, control flow, and messaging to the collaboration diagram in such a way that each activity block in choreography diagram is correctly and completely operationalized in the collaboration diagram.

For example, the activity of 'insurance provisioning' in the step-2 choreography diagram (see the left side of Figure 5-8) gives the information that the co-production activity 'insurance provisioning' depicts the interactions between two actors: TraXP and insurance provider. Two interactions can be recognized from two messages (insurance order and insurance). TraXP initiates the process by sending insurance order and receives insurance in return. To carry it into the collaboration diagram (see right side of Figure 5-8), service operations that can enable the two interaction are added.

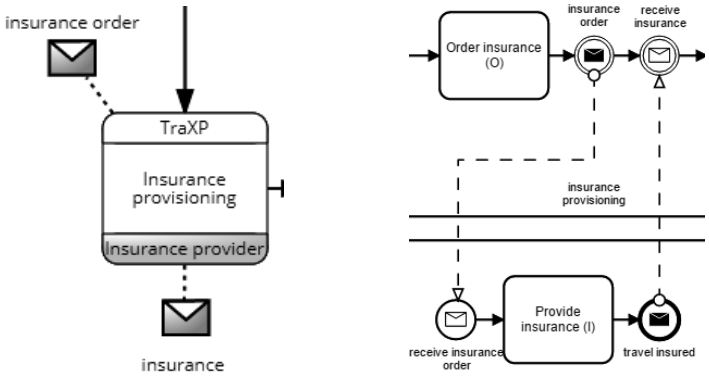

Figure 5-8 Transformation of a choreography activity block to collaboration

As depicted in Figure 5-8, 'order insurance' is a task in a conceptual process model that maps to an operation of the 'travel arrangement' business service of TraXP (check Table 5-12). Similarly, 'provide insurance' maps to the operation belonging to the insurance provider as a part of their 'travel insurance' business service.

Output: A conceptual process model in the form of a business service composition.

The choreography activity in the diagram from Step 2 represents a bundle of interactions, with information on actors that interact and messages exchanged between them. In the collaboration, all of the choreography activity block is extended into set of message exchanges and tasks between actors. Therefore, all information in the choreography diagram are present in collaboration diagram. Figure 5-10 shows the conceptual process model for our TraXP/X SDBM in BPMN collaboration diagram[2].

The output model is in the form of a business service composition and address the solution objective-3 (as defined in Section 3.3).

Consistency control checklist: The conditions that must be satisfied in this step are the following:

1. Each co-production activity (block) specified in the step-2 choreography are in the collaboration diagram.
2. Each service operation used to define the co-production activity is specified in BS configuration.
3. Service operations of different business services interact with each other and/or with the customer actions to realize a choreography block (co-production activity).

Table 5-13 presents the example matrix for the running TraXP case[3].

5.4.4 Step 4: Complete the Model with Alternative Paths and Exceptions

Purpose: To address the requirements of the alternative scenarios and (business-domain related) exceptions that are not represented in the choreography or business service composition models.

Pre-requisite: In order to handle alternative scenarios, the process designer requires the business services catalog of network parties to also include the exceptions as service operations in their business services. The choreography diagram in prior steps shows the 'sunny day' scenario of the

[2] The output for step 3 and 4 is combined. The difference is only the additional alternative path, exceptions, and compensation that make the 'sunny day scenario' conceptual process model become a complete CPM by including 'rainy day scenario'.

[3] Step 3 & 4 use the same consistency control matrix.

business model. However, the operationalization should also consider alternative scenarios and (business-domain related) exceptions that are likely to occur in process executions (for example, 'order cancellation by the customer' as depicted in Figure 5-9).

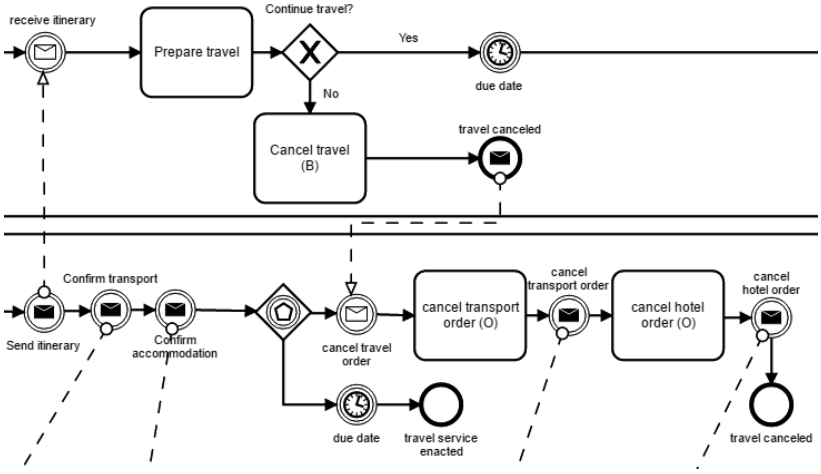

Figure 5-9 Adding new task in collaboration

Output: The output for this step is a complete conceptual process model in the form of a business service composition. Unlike the intermediate models of choreography, this model can also include alternative scenarios or exceptions related to the business model that is being operationalized. Figure 5-10 shows the conceptual process model for our TraXP/X SDBM in a BPMN collaboration diagram.

Consistency control checklist: The conditions that must be satisfied in this step are the following:

1. Each co-production activity (block) specified in the step-2 choreography are in the collaboration diagram.
2. Each service operation specified in BS configuration is present in the collaboration diagram.
3. Service operations of different business services interact with each other and/or with the customer actions to realize a choreography block (co-production activity).

Table 5-13 presents the example matrix for the TraXP case.

Table 5-13 A consistency control matrix for choreography-collaboration diagram transformation

				Choreography diagram									
	business service	**business service operation**	***Step***	*travel specification*	*travel planning*	*insurance provisioning*	*document provisioning*	*departure transport provisioning*	*accommodation provisioning*	*in-city transport provisioning*	*returning transport provisioning*	*cancellation*	
business service configuration TraXP eXecutive	(customer actions)	request travel (shared)	3	x*1*									**Collaboration diagram**
		prepare travel	3		x*2*								
		go to destination	3					x*5*					
		stay at hotel	3						x*6*				
		do business	3							x*7*			
		return home	3								x*8*		
		cancel travel (shared)	4									x*9*	
	travel plan optimization	request travel	3	x*1*									
		optimize travel plan	3	x*1*									
		cancel travel	4									x*9*	
	travel arrangement	order insurance	3			x*3*							
		order travel document	3				x*4*						
		book transport	3					x*5*		x*7*	x*8*		
		book hotel	3						x*6*				
		generate itinerary	3		x*2*								
		cancel transport order	4									x*9*	
		cancel hotel order	4									x*9*	

				Choreography diagram									
	business service	**business service operation**	***Step***	*travel specification*	*travel planning*	*insurance provisioning*	*document provisioning*	*departure transport provisioning*	*accommodation provisioning*	*in-city transport provisioning*	*returning transport provisioning*	*cancellation*	
	travel insurance	provide insurance	3			x*3*							
	document provisioning	provide travel document	3				x*4*						
	transport service	arrange transport reservation	3					x*5*		x*7*	x*8*		
		provide departure transport	3					x*5*					
		provide in-city transport	3							x*7*			
		provide returning transport	3								x*8*		
		cancel transport order	4									X9	
	hotel accommodation	arrange hotel reservation	3						x*6*				
		provide hotel service	3						x*6*				
		cancel hotel order	4									*x9*	

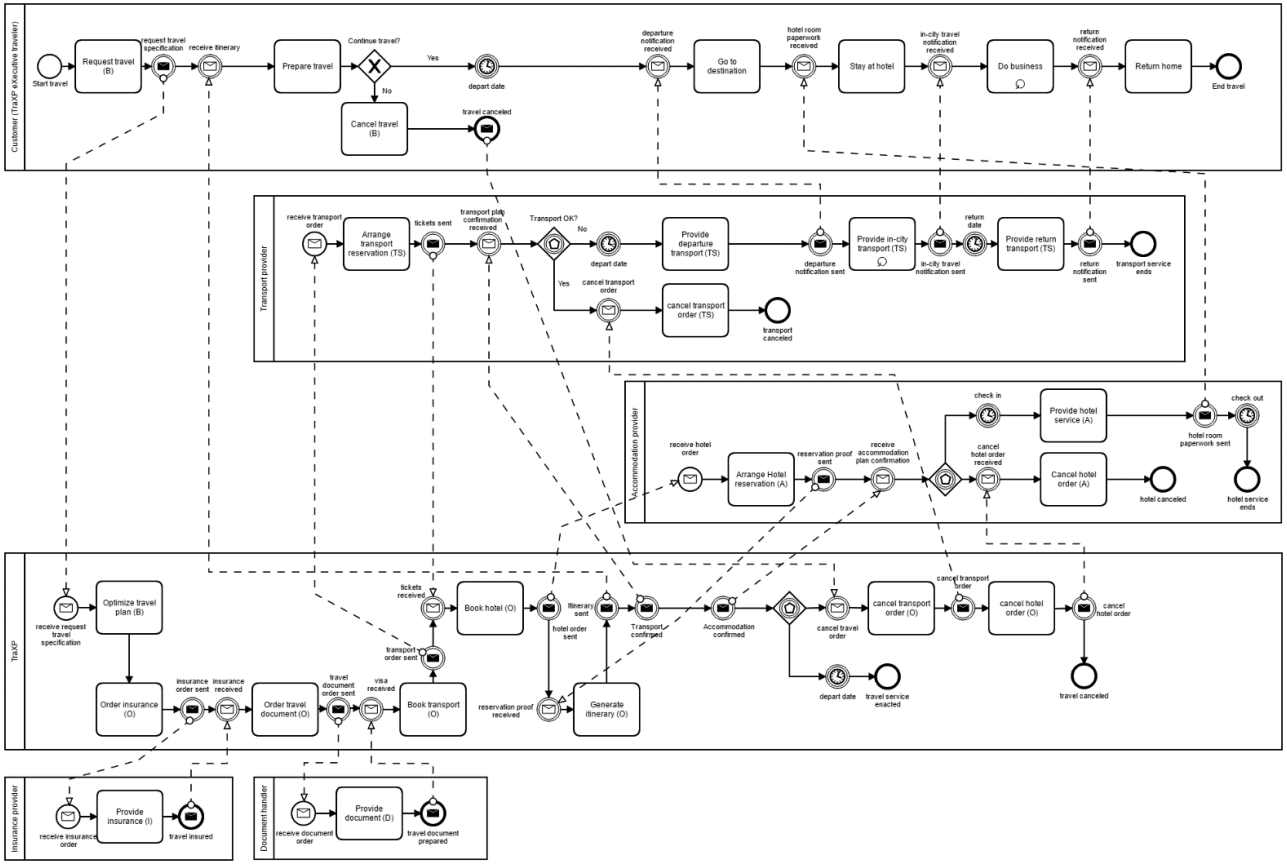

Figure 5-10 Conceptual process model for the TraXP eXecutive case in the form of a collaboration diagram

5.5 Method Roles

As mentioned in Section 5.1, different design roles are involved in the design of SDBM and its operationalization by applying SDBMOM. Figure 5-11 shows an overview of the five main roles in the main stages – each stage has two roles communicating as indicated by the horizontal arrows in the figure. In the first stage, a business owner communicates with a business model designer for developing a new business model complemented with a customer service scenario. In the next stage, a business process designer communicates with a business model designer to derive a conceptual process model (business service composition). In the third stage, the business process designer and a business process engineer convert the conceptual process model into an executable process model for a specific business process management platform. In the last stage, this executable process model is deployed on the platform with the help of a platform administrator. Note that we distinguish five different roles in the modeling process, but that multiple roles may be played by the same person – certainly in a small organization. In complex design environments, the entire operationalization process can be managed by a business architect, who oversees the entire operationalization sequence, safeguarding consistency across the various stages.

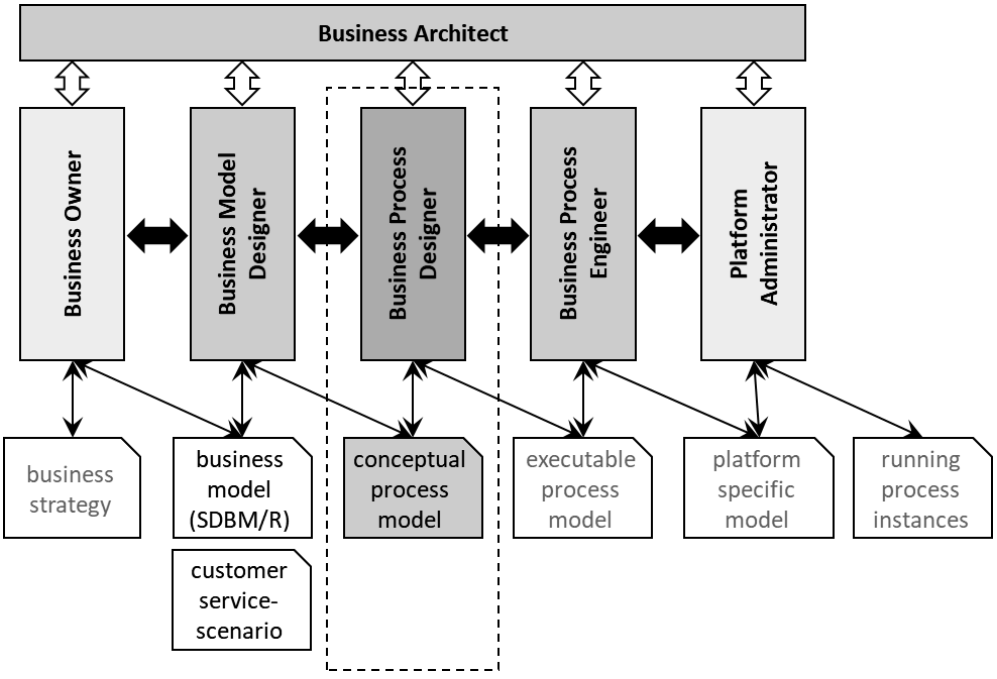

Figure 5-11 Roles and Artifacts in SDBMOM

This study focuses on deriving a conceptual process model from an SDBM, i.e., the part of Figure 5-11 that is framed in the dotted rectangle. To support the application of SDBMOM in real-life business settings, we explicate relevant qualifications of the roles that are expected to be involved in the application of SDBMOM in Table 5-14 (*and thereby address the Solution Objective-5 as discussed in Section 3.3*).

Table 5-14 Role qualifications in SDBMOM

Roles	Description	Qualification
Business Architect	A business architect is responsible for the design phase, as well as key decisions in the processes of business analysis, business modeling, and development and reviewing project documentation as requested to ensure it meets the standard, is horizontally integrated and fulfills the process strategy of the organization [11, 37, 52, 82, 113, 120].	Understanding of project management
Business Owner	A business owner determines which business models will be put in the market, based on the business strategy.	Capable of strategic decision making
Business Model Designer	A business model designer configures the elements within the business model according to the role of each entity involved in the business model and decides which set of business model design patterns he would like to integrate into his business model so that the business model is viable [95, 119, 125]	Understanding of business modeling
Business Process Designer	A business process designer is responsible for determining the requirements and design of the solution by orchestrating service components based on the business process [34, 107].	Expertise in business process modeling
Business Process Engineer	A business process engineer is responsible for assessing and describing operational aspects of businesses including business processes, organizational culture and structure, facilities, and other resources. A business process engineer should be able to identify core business processes, model and justify them with the goal of increasing return for the business [61].	Capable to design executable process models
Platform Administrator	The platform administrator is responsible for the correct operation of the platform, including setup and monitoring [103].	Have the necessary capability to manage the platform

5.6 Chapter Summary

SDBMOM is a DSR artifact in the form of a method. We conceptualize the BMO as a three-level process starting with the design of a business model and ending with it successfully implemented into a process-aware information system. However, the scope of SDBMOM is only in the first level of BMO (operationalization level-1), where the main objective is to develop a conceptual process model that serves as a specification to the further development of an executable process model (operationalization level-2). This decision is also supported by the findings of our literature review that signifies this as the most significant research gap. The last level (level-3) of the BMO involves the instantiation of the model in a specific platform. Different organizational roles are involved at each BMO level. For instance, the business process designer is central in SDBMOM, who is also supported by business model designer and process engineer.

SDBMOM consists of four steps: (1) define customer-service interaction, (2) define actor-actor interaction, (3) define interaction and activities in a service composition, and (4) complete the model with alternative paths and exceptions. Figure 5-3 provided a graphical representation of the method, while Table 5-3 presents additional details regarding the steps, inputs/outputs and relevant roles.

Figure 5-12 presents an overview of the SDBMOM steps together with its position in the BMO. As explicated above in this section, SDBMOM offers a step-by-step iterative guide for the operationalization of the business model where explicit traceability between inputs, outputs, and all intermediate models can be established (*addressing the Solution Obj-4 as discussed in Section 3.3*).

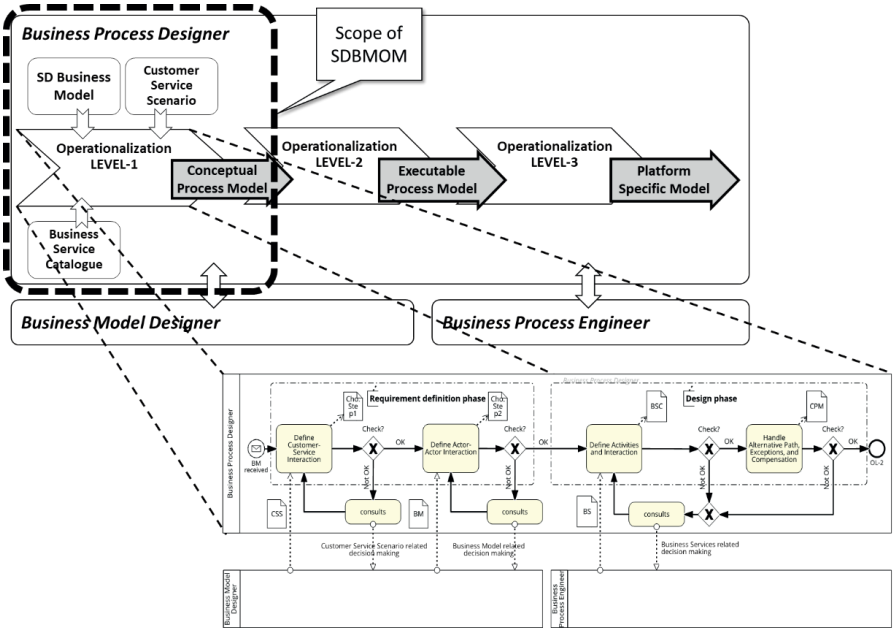

Figure 5-12 The first level of BMO as the scope of SDBMOM

6 Evaluation

In the design science research, it is necessary to apply and evaluate the artifact that has been developed in real-life business settings [54]. In this chapter, we focus on the application and evaluation of SDBMOM.

For the evaluation, we have focused on SDBMOM's *validity* and *utility*. The *validity* criterion concerns the extent to which the artifact is applicable and can be used for its intended purpose of use. The *utility* criterion is used to assess whether the achievement of goals has value outside the development environment [48]. Several methods are available for use for the evaluation of an artifact with respect to these criteria [101]. Demonstration using an instantiation or illustrative scenario, and application on real-life cases are considered as effective techniques [106].

To provide evidence for SDBMOM's *validity*, we performed two sets of activities. First, we aimed at showing that the conceptual process model (business service composition) can be used as a *valid input* for the subsequent operationalization levels 2 and 3 (see Section 5.1 and Figure 5-3). That is, we targeted for an evidence that SDBMOM can generate valid conceptual models that can go through level-2 and -3 operationalizations. Hence, taking the conceptual process model that was generated in the running illustrative business scenario (the TraXP eXecutive case), we performed the level-2 operationalization step by extending the model into an executable process model, and level-3 step by implementing it in a business process management system (BPMS) platform. Section 6.1 describes these activities and the results.

Second, we applied the SDBMOM in two business cases to assess its applicability in real-life business settings. This set of activities involved the use of SDBMOM, hence, level-1 operationalization. We explain these activities and the outcome in Section 6.2.

To evaluate the *utility* of SDBMOM, we aimed at exploring how its potential users consider it as useful and easy-to-use. Accordingly, we conducted interviews with 10 industry experts to elicit their view on the usefulness and its ease of use of the SDBMOM as a tool to generate conceptual process models based on SDBM/R blueprints. Section 6.3 describes the results of this evaluation.

6.1 Evaluating validity through application in operationalization levels 2 and 3

In this evaluation activity, we took the conceptual process model of the illustrative business scenario (TraXP eXecutive case) as a basis (see Figure 5-10), and continue with the subsequent level 2 and 3 operationalization steps (see Section 5.3 for more details regarding this overall depiction of the operationalization levels).

Conceptual process models are typically abstract in nature and intentionally do not provide technical implementation details [31]. In order to provide a running software system to support the process, the conceptual process models must be transformed into executable process models to be interpreted and

automatically executed by a platform, such as a BPMS. Hence, for Level-2 operationalization, the conceptual process model of our running illustrative business scenario, as depicted in Figure 5-10, was transformed into an executable process model following the steps proposed in [31]. These include the identification of the automation boundaries, the review of the manual tasks, the completion of the process model using advanced execution-specific process model elements, and the reviewing of the model to make sure that the activities are at an adequate level of granularity.

The resulting executable process model of Level-2 is platform independent. The Level-3 operationalization takes this model as input and transforms it into a concrete platform dependent version with execution properties specific to the chosen BPMS platform. Table 6-1 depicts the inputs that were used for each level, the methods or tools utilized, and the outputs generated at each operationalization level.

Table 6-1 The Operationalization Process for the TraXP Executive SDBM

Oper. Level	Input	Method/Tool	Output
Level 1	- SDBM/R Blueprint - Customer Service Scenario - Business Service Catalogue	SDBMOM	Conceptual Business Process Model (Business Service Composition)
Level 2	Conceptual Business Process Model	Camunda Modeler (v.1.8.2)	Executable Process Model (.bpmn)
Level 3	Executable Process Model (.bpmn)	Camunda BPMS Platform (Camunda Modeler v.1.8.2, Camunda Process Engine v.7.8.0., and IDE - Intellij IDEA coding assistant)	Platform Specific process Model + Application (in Java)

The Level-1 operationalization involved the application of the SDBMOM as demonstrated in Section 5.4. In Level-2, the model resulting from Level-1 has been mapped to an executable process model (using the Camunda Modeler). The resulting executable process model is presented in Figure 6-1.

In Level-3, the executable model is transformed into a platform-dependent specification which runs on the Camunda BPMS platform. Business Process Management Systems (BPMS) are prevailing platforms for business process execution [62]. They support the definition, administration, customization, and evaluation of tasks evolving from business processes, as well as from organizational structures. We refer the reader to the online demonstration video (*https://youtu.be/riSSLnTj4_A*) that shows how process instances for the TraXP eXecutive scenario are running and how the platform supports the business case.

Performing Level-2 and Level-3 operationalizations based on the Level-1 output has demonstrated that the output resulting from the application of the SDBMOM (i.e., the conceptual process model) can be used as a valid input for the subsequent operationalization levels for the implementation of a software system that supports the process and thereby enables the operation of the corresponding business model.

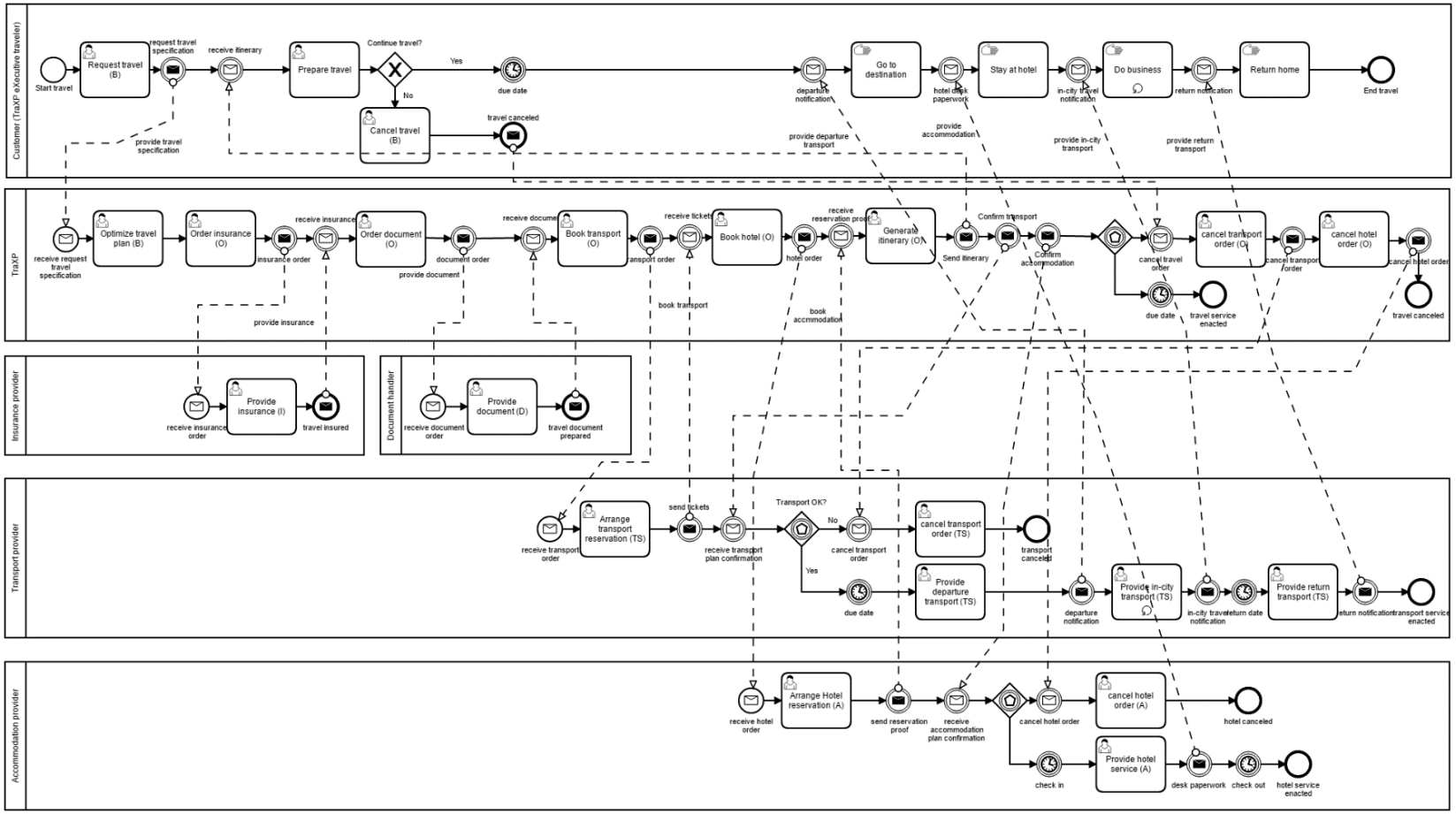

Figure 6-1 TraXP eXecutive - Executable Process Model

6.2 Evaluating validity through application in real-life business cases

For the second activity regarding the evaluation of SDBMOM's validity, we applied it in two real-life business cases and assessed its applicability in these settings. Both business cases emerge from projects that have been conducted in the mobility domain. The first case - Free Ride Amsterdam (FRA) [45] - aims at providing a solution that supports addressing the heavy traffic problem in the South-Eastern part of Amsterdam that intensifies particularly during the time of large public events (concerts, sports events, etc.). The second case - Just-in-time Presence of Elderly (JPE) [43] - offers a mobility solution that mainly benefits the hospitals in a certain region and the elderly people who are expected to be in these hospitals at the right time in line with their appointments. The fact that both business model blueprints were designed to address the real problems of customers, and the service solution involves multiple stakeholders to cooperate, and that they require a software solution to be implemented to support the (co)operation of these stakeholders, makes these cases suitable for the application of the SDBMOM to evaluate its validity.

In the sub-sections below, we briefly explain each business case and show how SDBMOM can be applied to operationalize the corresponding SDBM blueprints.

6.2.1 SDBMOM Application in Business Case 1: Free Ride Amsterdam (FRA)

Like most large cities, Amsterdam is characterized by heavy traffic which becomes worse during daily rush hour but reaches its climax when large events are held in the southeast part of the city. Events, such as football matches and concerts (and sometimes the combination), attract large volumes of traffic in a narrow time window. Locations to accommodate such large events are clustered in South-East Amsterdam, which consequently meets these traffic problems at regular intervals. To try and counter these problems collaboratively, an SDBM blueprint was developed [129] within the scope of a project [126] with the participation of a large variety of stakeholders, both of the public, the private and the individual kind. The public participants included the city of Amsterdam, the province of North-Holland and the Dutch road authority. The private participants included representatives of several event location owners in the southeast section of the city, organizers of events at these locations, local retailers, parking providers, and transport providers. The third group was formed by individual road users, both car drivers and other users affected by car traffic.

Figure 6-2 depicts the completed SDBM/R blueprint for the business model.

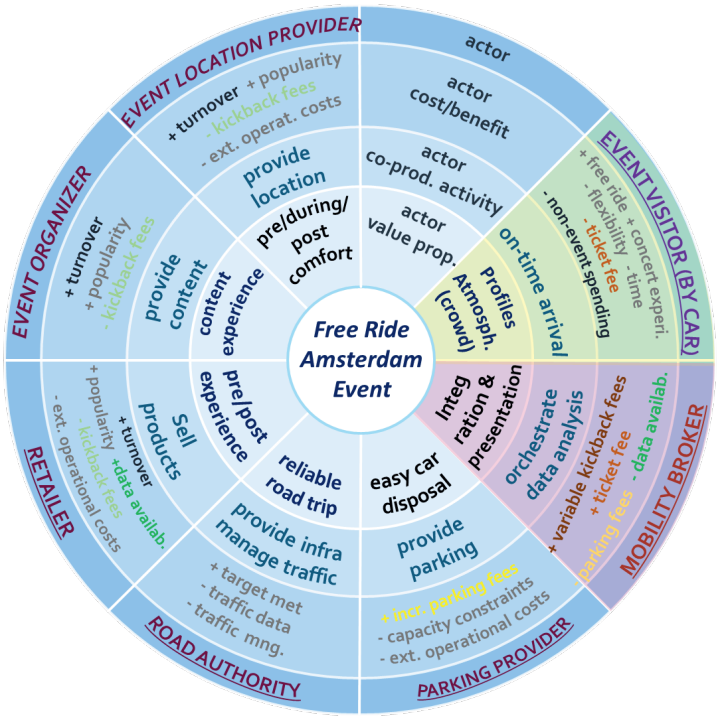

Figure 6-2 Service-Dominant Business Model Blueprint: "Free Ride Amsterdam event"

The Free-Ride Amsterdam Event value-in-use contributes to the positive experience of event visitors who plan their arrival by car. The idea behind the model is to attract visitors at a much earlier time than the beginning of the event, which helps reduce the traffic just before the event. This is facilitated by offering free parking, funded by parties benefiting from the early presence of the visitors (such as retailers). A number of stakeholders in the network contribute to this solution. The Mobility Broker acts as the focal organization orchestrating the parties. The Parking Provider provides parking services for easy car disposal, while the Road Authority provides the road infrastructure and traffic management before and after the event for a reliable and safe trip. Retailers are also involved by contributing to customer's experience with pre- and post-event convenience (shopping, eating, etc.).

Below, we present how the SDBMOM has applied for the level 1 operationalization of the FRA blueprint.

SDBMOM application in Business Case-1 – Free Ride Amsterdam (FRA)

Step 1: Define customer-actor (C-A) interaction

The first step is to extract information from the 'Free Ride Amsterdam event' value-in-use proposed in the Customer Service-Scenario (CSS) of the FRA. The identified actor-to-customer interaction is presented in Table 6-2.

Table 6-2 Free Ride Amsterdam CSS

No	Customer service scenario statement	Customer Actions	Customer-actor interaction
1	Lara wants to attend a concert which is held in Amsterdam Arena. She plans to travel by car. She visits the event organizer's website to book the tickets.	Event Visitor books concert tickets online	Event Visitor sends concert ticket order to Event Organizer.
2	After she successfully buys the tickets, the website offers her a free car-parking service (which is offered to event visitors that intend to come to the event by car). Interested by the offer, Lara clicks on the link to make use of the offer and reserves a free parking ticket for her car. The website asks about some related information (e.g., the license plate of the car that she will travel with) and arranges the specific time and location when she should arrive at the parking lot. Lara needs to arrive at the specific exact time and location for the offer to be valid.	Event Visitor gets free parking ticket online	Event Visitor sends free parking ticket request (car info: number of passengers, age, food preferences) via the website (of the Mobility Broker). Event Visitor receives a free parking ticket in return.
3	After receiving her free parking ticket, Lara waits for the concert day.	Event Visitor waits for the day of the concert.	
4	On the day of the concert, Lara departs. She receives optimized traffic information from road authority (through preferred means, e.g., SMS) so that she can drive to the parking location and arrives at the parking lot on time. This saves Lara lots of trouble finding the less crowded route to the concert venue.	Event Visitor goes to the parking lot on time on the day of the concert.	Event Visitor departs at the concert date. Road Authority provides optimized traffic information for Event Visitor to use as guidance to travel to the parking lot near the concert location to park her car.
5	She directly goes to the arranged parking location after scanning her ticket.	Event Visitor parks the car	Event Visitor shows/scans her free parking ticket to get entry to the designated parking lot.
6	Lara then walks into the venue. While waiting for the concert to start, Lara enjoys herself with diverse options regarding food and beverages that the retailers offer around the venue.	Event Visitor waits around the venue while enjoying the retailers' offers.	Event Visitor reaches to the venue. While he/she waits for the concert to start, the Retailer offers services.
7	Before the concert starts, Lara walks to the Arena and enters by showing her concert ticket.	Event Visitor enters into the event location	Event Visitor shows/scans his/her ticket to the Event Location Provider so that he/she can get entry into the venue.

We can then map the Customer-actor interaction to the list of co-production activity. As we can see that although there are seven steps of the service customer actions, only six Customer-actor interaction are present. We are now mapping these C-A interactions to co-production activities from the FRA

BM blueprint, including the messages exchanged in the interaction. The mapping can be seen in Table 6-3.

Table 6-3 Mapping of C-A interaction in FRA

C-A message exchanges	concert ticket order, concert ticket	free parking ticket request, free parking ticket		optimized traffic information	free parking ticket	flyer	concert ticket
Customer Actions	**book concert ticket**	**book free parking**	**wait for the concert date**	**go to the parking lot**	**park the car**	**go to the location and wait for the concert**	**enter the venue**
C-A interaction	content (concert) provisioning	free parking ticket orchestration		on-time arrival	parking provisioning	products provisioning	location provisioning

Based on the C-A interaction mapping presented in Table 6-3, we can generate the first Choreography diagram (Figure 6-3) as the output of Step-1.

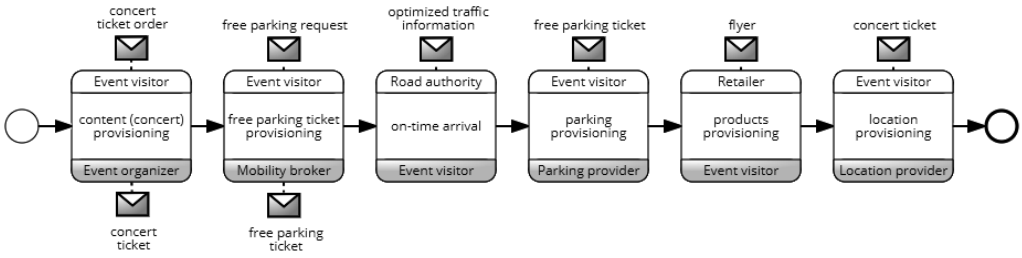

Figure 6-3 Choreography Step-1 for FRA

Step 2.Define actor to actor (A-A) interaction

The remaining co-production activities can be mapped to actor-to-actor interaction to complete the scenario. The complete interaction requires all co-production activities from FRA BM to be mapped. The mapping can be seen in Table 6-4.

Table 6-4 Mapping of A-A interaction in FRA

A-A message exchanges		event visitor data analysis					
C-A message exchanges	concert ticket order, concert ticket	free parking ticket request, free parking ticket		optimized traffic information	free parking ticket	flyer	concert ticket

Customer Actions	book concert ticket	book free parking	wait for the concert date	go to the parking lot	park the car	go to the location and wait for the concert	enter the venue
C-A interaction	content (concert) provisioning	free parking ticket orchestration		on-time arrival	parking provisioning	products provisioning	location provisioning
A-A interaction		customer analysis provisioning		traffic arrangement			

Based on the information given in Table 6-4, the second Choreography diagram of Step-2 can be generated as depicted in Figure 6-4.

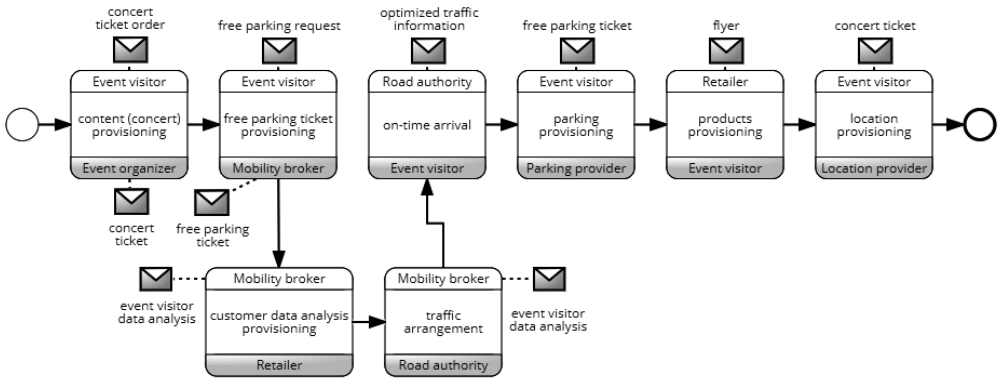

Figure 6-4 Step-2 Choreography of FRA

Step 3: Define Activities and Interaction

Given the business services that are listed in Table 6-5, we can subsequently generate the collaboration diagram based on the second choreography. The Mobility Broker manages the free parking arrangement and data analysis business services, while the Parking Provider employs the parking management service. The Event Visitor doesn't own a business service, but her 'on-time arrival' co-production activity is supported by the Road Authority traffic management service.

Table 6-5 Selected business services for FRA

Co-production activity	Actor	Business services
content (concert) provisioning	Event Organizer	Event organizing
free parking ticket provisioning	Mobility Broker	Free parking arrangement
visitor data analysis provisioning		Data analysis
on-time arrival	Event Visitor	Traffic management
traffic arrangement	Road Authority	
parking provisioning	Parking Provider	Parking management

Co-production activity	Actor	Business services
location provisioning	Event Location Provider	Event location management
products provisioning	Retailer	Product sales

The business service catalog contains also the service operations necessary to generate the collaboration diagram. These are listed in Table 6-6.

Table 6-6 Business service operations for FRA

Business services	Code	Business service operation
Event organizing	EO	sells concert ticket, cancel concert ticket
Free parking arrangement	FP	provide a free parking ticket, cancel free parking ticket
Data analysis	DA	analyze customer profile, provide customer data analysis
Traffic management	TM	arrange traffic
Parking management	PM	provide parking
Event location management	EL	check tickets
Product sales	SF	sells food, etc.

As a first step in generating the collaboration diagram, we can create the pools for the participating parties (as presented in Figure 6-5 for the FRA case).

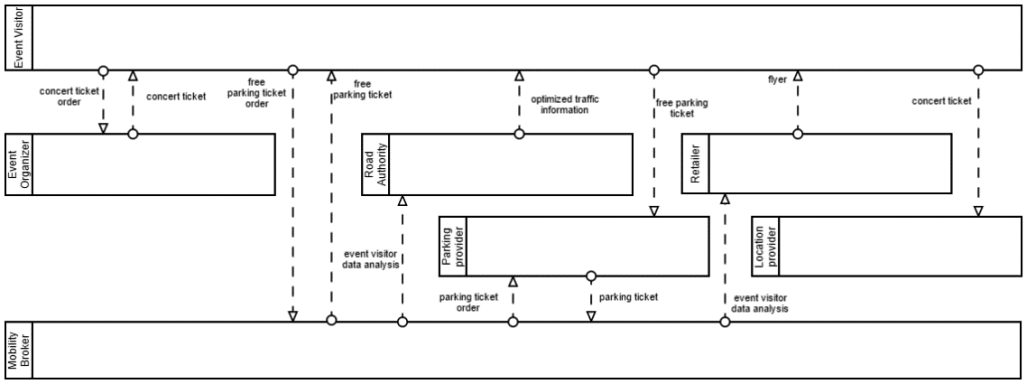

Figure 6-5 The Pool configuration for FRA collaboration diagram

To generate collaboration diagrams, we use business service operations to fill in the pools. We also add necessary messaging and events from BPMN notation to describe the overall process performed by each actor and how they interact.

Step 4: Handle the alternative path, exceptions, and compensations.

The 'event organizing' business service include the option of cancel concert ticket in its service operations (see Table 6-6) in case the customer (i.e., event visitor by car) decides canceling the trip. In this case, necessary actions should be taken by a number of parties (e.g., the mobility broker, parking provider). Therefore, such process elements should also be included in the process model. The resulting conceptual process model for the business model blueprint is depicted in Figure 6-6.

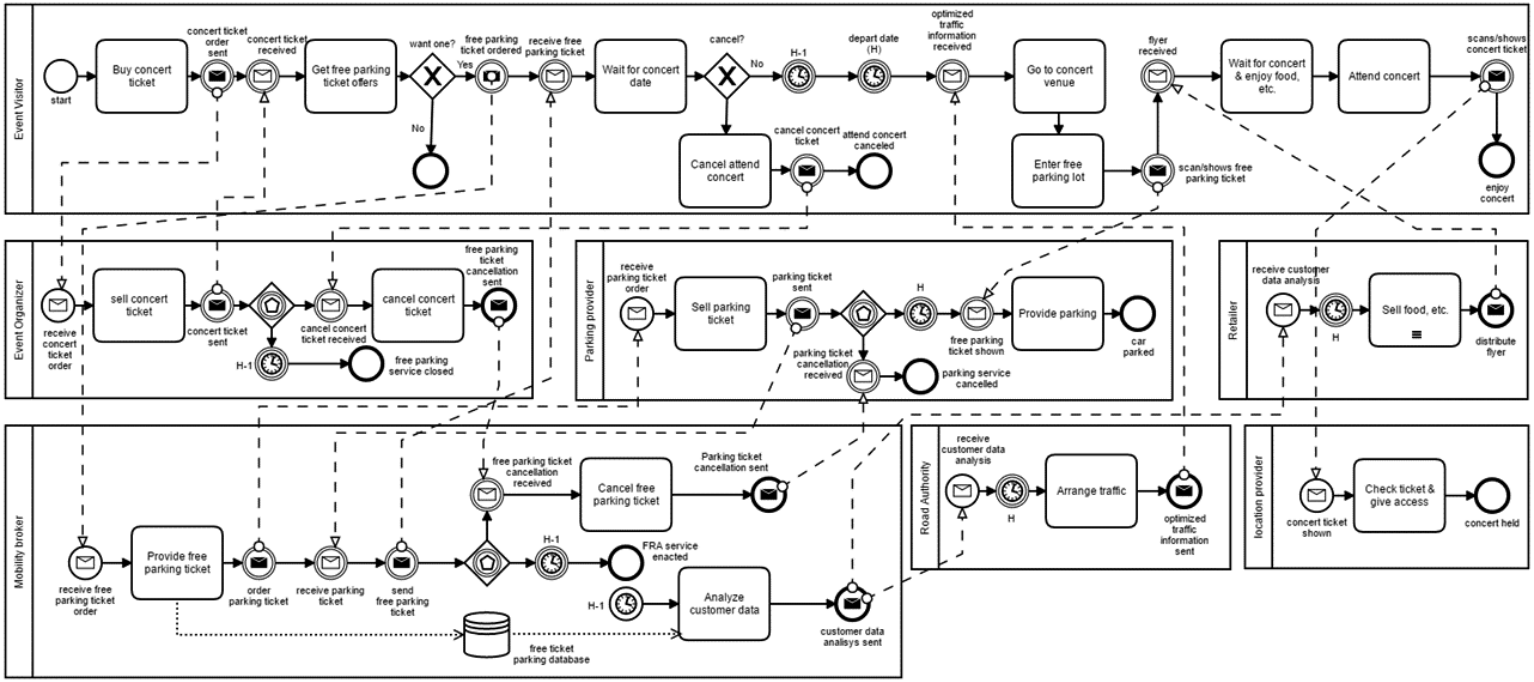

Figure 6-6 Conceptual process model for FRA

6.2.2 SDBMOM Application in Business Case 2: Just-in-time Presence of Elderly (JPE)

Providing urban access and mobility is one of the main goals of modern cities. Good public transportation systems are essential parts of a safe, clean and affordable mobility solution, particularly in urban areas. From a social perspective, public transportation should be usable by all citizens including the elderly. While safe, green, and affordable transportation for the elderly has obvious benefits for older generation and municipalities, enterprises and institutes (particularly healthcare institutions) can benefit from just-in-time delivery of elderly, as well. Consider one of the common destinations for elderly, namely, hospitals. Hospitals generally have quite high operational costs. Hence, delays in the arrival of patients, which is quite common for elderly, leads to major losses. One could argue that the main beneficiary of the just-in-time transportation of elderly is institutes such as hospitals.

The business model *Just in Time Presence of Elderly (JPE)* has been designed as a part of a program, which has been established by a municipality to not only support safe, green, and affordable transportation for elderly, but also ensures their just-in-time delivery to the destination (healthcare) institutes [43].

One of the key aspects of the model is to provide door-to-door free transportation for the elderly using electric cars. While the program overall has evident social and environmental benefits, its feasibility is a key concern. Considering the aging population of the citizens the related transportation costs are quite considerable. For this reason, the municipality seeks for a business model that its considerable benefits for destination institutes would justify fully covering the elderly transportation costs by those institutes.

The designed business model blueprint aims at providing a network of parties such that they benefit from elderly transportation and hence can support it. In this model, the Destination (Healthcare) Institute is the customer – i.e., the party that mainly benefits from the proposed value-in-use (just-in-time arrival of elderly patients). The idea is that the destination institutes fully cover transportation costs. In addition, they provide the necessary information (e.g., schedule, delays) and thus supports the required facilities for smooth receiving of elderly people. In this scenario, the Municipality is the focal organization orchestrating the package of activities performed by different actors. The Municipality has an overview and is the central point of contact for the Elderly and other parties. This core partner plans the mobility, both drivers (unemployed citizens) and Elderly and integrates all other parties. Furthermore, there is a need for a Transportation Provider party that offers easy access for the elderly. The SDBM blueprint is depicted in Figure 6-7.

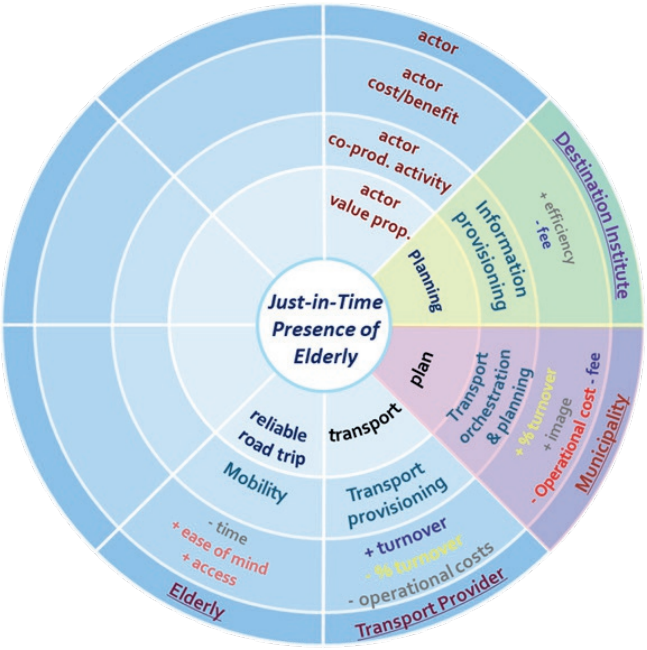

Figure 6-7 SDBM Blueprint: "Just-in-time Presence of Elderly"

Step 1: Identify C-A interaction using CSS

As a first step, necessary information from the value-in-use proposed in the Customer Service-Scenario (CSS) of the JPE can be extracted. The identified customer-to-actor interaction is presented in Table 6-7.

Table 6-7 JPE's CSS

No	Customer service scenario statement	Customer actions	Customer-actor interaction
1	The Destination Institute has many elderly people as patients. They are often late or forget their appointment with Destination Institute. Therefore, every time a Destination Institute makes an appointment for the elderly people, it offers the JPE service solution managed by the Municipality. If the elderly agrees, Destination Institute requests the JPE service via JPE website by filling in the necessary information (e.g. name of the patient, pickup point, date & time, number of passengers, special transport requirement (e.g. wheelchair, etc.). The elderly are also asked whether he/she wants the option to also include the return service.	Destination Institute requests JPE service for an elderly patient appointment.	Destination Institute request service by sending a service request (information: name of the patient, pickup point, date & time, number of passengers, include return service? special transport requirement (wheelchair, etc.) to the Municipality.

No	Customer service scenario statement	Customer actions	Customer-actor interaction
2	When the service is booked, the Destination Institute receives a notification (service confirmation), confirming that the delivery and the (optional) return service for that patient has been arranged.	Destination Institute receives JPE service confirmation.	Destination Institute receives message/notification (i.e. service confirmation) for the successful JPE service reservation from the Municipality.
3	Destination Institute just needs to wait until the appointment date arrives. Destination Institute is assured that the service also makes sure that the elderly receives successful service confirmation.	Destination Institute waits for the appointment time.	
4	On the day of the appointment, Destination Institute receives the elderly patient delivered by the transport provider on time for the appointment.	Destination Institute receives the Elderly patient on time.	Destination Institute receives Elderly patient delivered by Transport Provider.
5	After Destination Institute finishes their appointment meeting with the elderly patient, if the elderly patient did not have the return service, then the process ends. If he/she opted for the option, Destination Institute notifies JPE to pick up the elderly patient and safely returns him/her home.	If the return option selected, Destination Institute requests the return pick up for the elderly patient.	If the return option is selected, Destination Institute sends return pickup requests to JPE after their appointment ends. Destination Institute receives the return pickup confirmation (information: pickup time) from the transport provider.

Based on the information depicted in Table 6-7, the customer-actor interaction from the list of co-production activity can be mapped as depicted in Table 6-8.

Table 6-8 Mapping of C-A interaction for JPE

Message exchanged	service request, service confirmation				pickup request, pickup confirmation
Customer actions	**request for service**	**receive confirmation**	**wait for the appointment time**	**receive elderly patient**	**request for return pickup**
C-A interaction	information provisioning				transport orchestration

As a next step, the first choreography can be generated as shown in Figure 6-8.

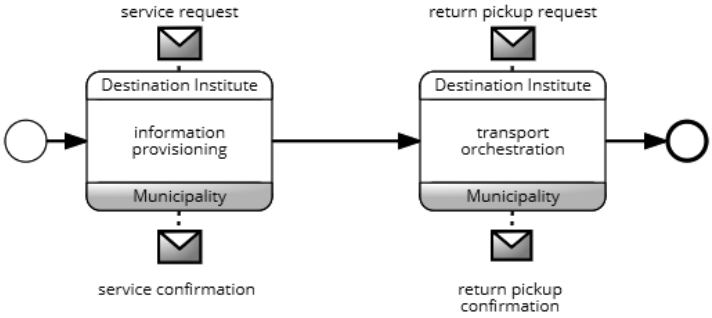

Figure 6-8 Choreography Step-1 for JPE

Step 2. Define A-A interaction

Taking the blueprint and the first choreography as input the remaining co-production activities can be mapped to actor-to-actor interaction as given in Table 6-9.

Table 6-9 Mapping of A-A interaction for JPE

A-A message exchange	transport order, transport reservation		service confirmation		depart pickup notification, return pickup notification
C-A message exchange	service request, service confirmation				return pickup request, return pickup confirmation
Customer actions	**request for service**	**receive confirmation**	**wait for an appointment time**	**receive elderly patient**	**request for return pickup**
Customer-actor interaction	information provisioning				transport orchestration
Actor-actor interaction	transport planning		mobility		transport provisioning

The selected business services that are involved in the JPE are depicted in Table 6-10.

Table 6-10 Selected business services for JPE

Co-production activity	**Actor**	**Business services**
information provisioning	Destination Institute	JPE service arrangement
planning	Municipality	
transport orchestration		
transport provisioning	Transport Provider	Transport management
mobility	Elderly	

Based on the information given in Figure 6-8 and Table 6-10, the second choreography can be generated (as shown in Figure 6-9).

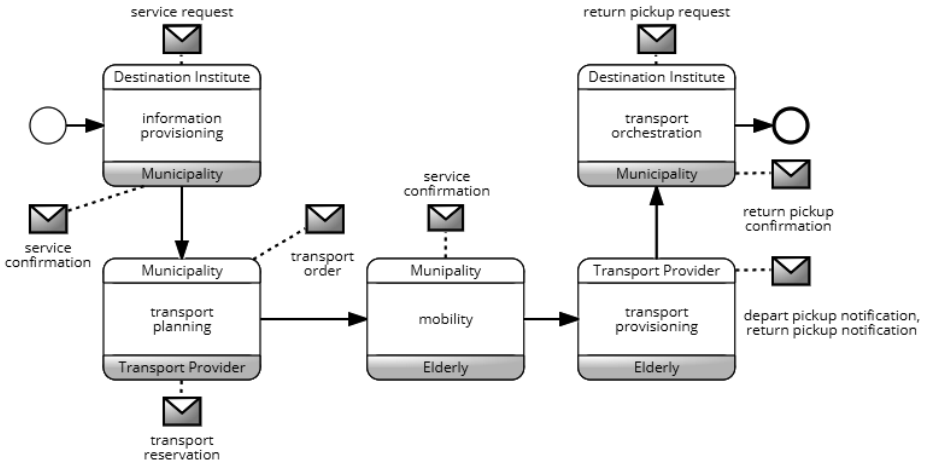

Figure 6-9 Step-2 Choreography for JPE

Step 3: Define Activities and Interaction

The list of business service operation necessary to do business service composition is listed in Table 6-11.

Table 6-11 Business service operations for JPE

Business services	**Code**	**Business service operation**
JPE service arrangement	EO	request for service, book transport, confirm service request, cancel transport booking
Transport management	FP	arrange depart transport, arrange return transport, notify depart pickup, provide transport to destination, confirm return pickup, provide transport to home, cancel transport service

As a first step, the pools for corresponding parties that are involved are created based on the choreography model as given in Figure 6-10.

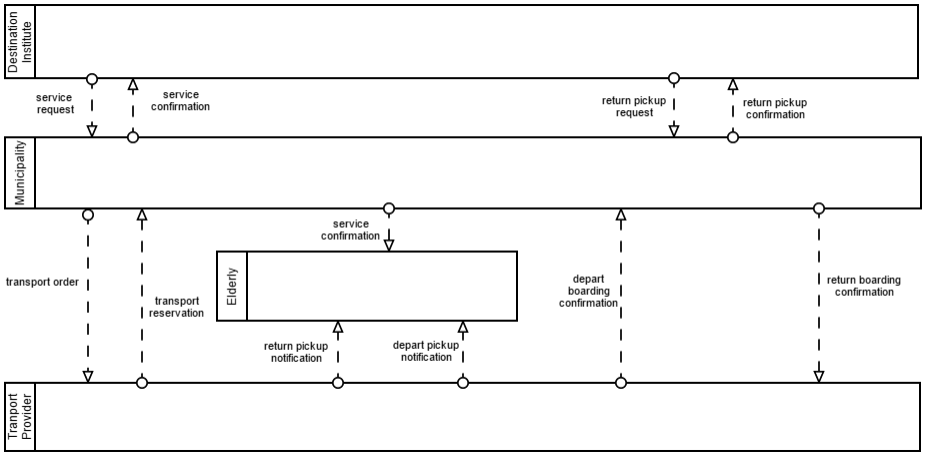

Figure 6-10 Pool configuration for JPE

Step 4: Handle the alternative path, exceptions, and compensation.

A cancellation mechanism is added in the collaboration diagram. The 'JPE service arrangement' business service include the option of canceling the concert ticket in its service operations (see Table 6-11) in case the customer (i.e., destination institute) might decide to cancel the appointment. The resulting conceptual process model is depicted in Figure 6-11.

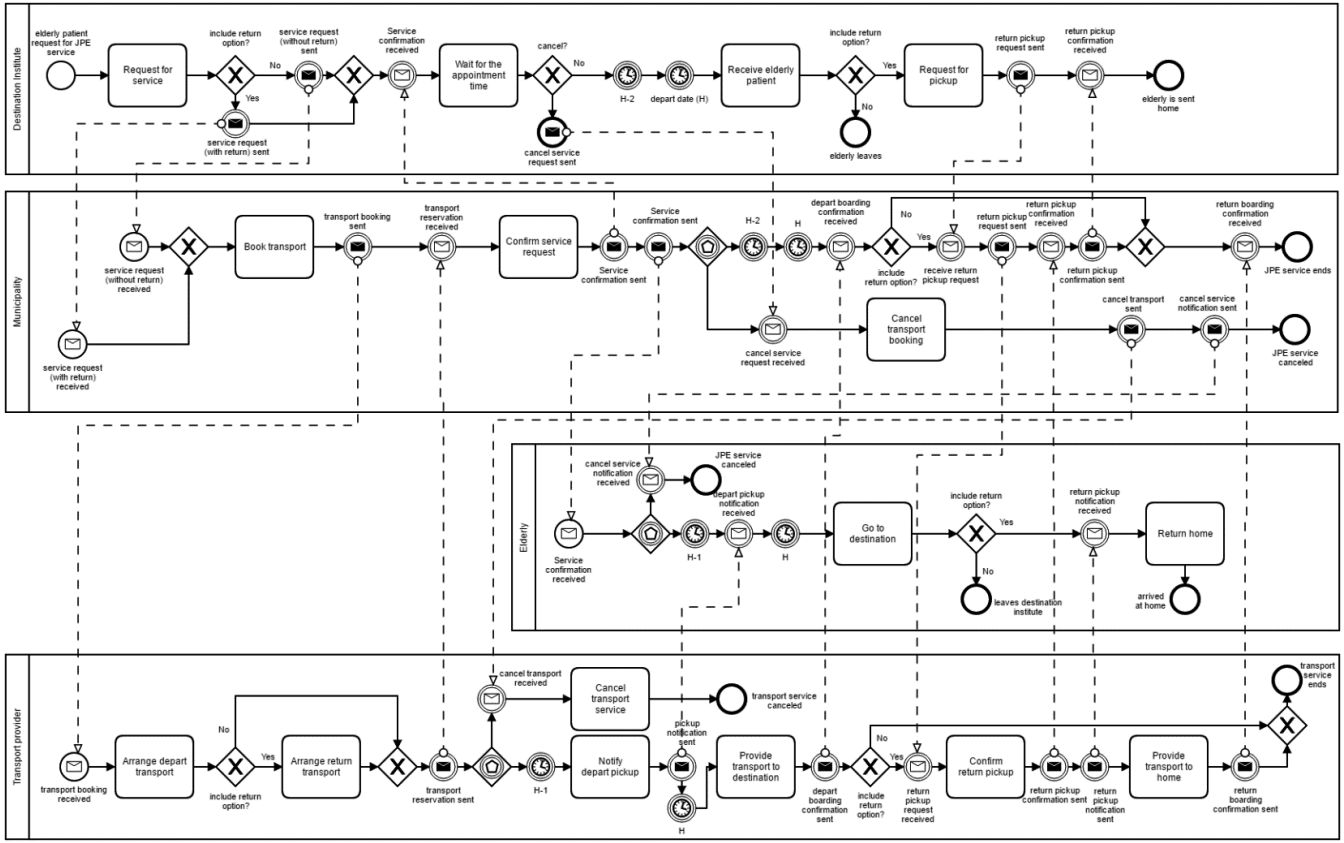

Figure 6-11 Conceptual process model for JPE

The application of the SDBMOM in two real-life business scenarios shows that the method is applicable to generate valid conceptual process models that can be used as a primary input for the subsequent implementation of software systems (see Section 5.1 for the explanation of these subsequent steps) that support the operation of the corresponding business models.

6.3 Evaluating utility through interviews with industry experts

In order to evaluate SDBMOM's utility, we conducted interviews with industry experts to elicit their view on the *usefulness* and its *ease of use* of the SDBMOM as a tool to generate conceptual process models. In conducting interviews, we followed the guide proposed by Rowley [110] and accordingly structured this sub-section into 3 parts: the design and planning of the interviews (Section 6.3.1), conducting the interviews (Section 6.3.2), and the interview findings (Section 6.3.3).

6.3.1 Designing and Planning Interviews

An *expert evaluation* is one of the research methods that can be used to evaluate a design artifact [101]. We regarded that in order for an interviewee to be considered as an *expert* practitioner in this context, s/he should have ample experience either on the business model design or (business) process modeling, or both. We considered that the years of experience in practice can be regarded as an indicator of the level of expertise of the practitioner on these topics.

In contacting suitable interviewee candidates, we followed a two-track path. As a basis, we contacted practitioners working in companies that are members of the European Supply Chain Forum (ESCF)[4] and have previously been invited to one of the events organized by ESCF. To augment this set with experts that have practical hands-on BASE/X business modeling experience, we have contacted a few hand-picked candidates from our network. Out of 16 candidates that were invited, 10 accepted our invitation. This number was considered sufficient to balance the generalizability of the results and the effort invested in conducting the interviews and analyzing the results.

Table 6-12 provides information regarding the profile of the experts. As seen in the table, the interviewees have expertise on various topics relevant to business model design and process

[4] European Supply Chain Forum (ESCF) is the operations and supply chain competence centre founded by TU/e academics with the objective to enable professionals in and around supply chains to create, exchange and integrate knowledge. It has over 50 members consisting of international companies, including Philips, DOW, Unilever, ASML, and DAF. ESCF hosts a number of regular events (workshops, seminars, etc.) on the latest operations and supply chain challenges and opportunities. More information is available at: http://www.escf.nl.

modeling. (The expertise areas shown in the table and the years of experience were confirmed by the experts at the opening stage of the interviews). With the exception of Expert 8, all interviewees had over 10 years of practical experience on the topics indicated in their profile. Expert 8, however, had only around 2 years of experience, but specifically focused on process modeling – a topic closely relevant to the SDBMOM. As also noted in the table, the interviews with 10 experts took place in 8 sessions, where sessions 6 and 8 featured interviews with two experts at the same time.

Table 6-12 Experts Demographic

Interviewee	Industry Domain	Experience in Practice	Expertise	Interview Date/Session
Expert1	Business Intelligence	>10 yr.	IT projects, business model design, software development, data analytics,	29/03/2019 / (Session6)
Expert2	Transport/ Mobility	>10 yr.	Software development, IT projects, business model design, business analytics, service industry	29/03/2019 / (Session6)
Expert3	Mobility	>10 yr.	Business model and strategic design, process modeling	11/03/2019 / (Session1)
Expert4	Mobility	>10 yr.	IT projects, process modeling	13/03/2019 / (Session2)
Expert5	Manufacturing	>10 yr.	Business architecture, process modeling	21/03/2019 / (Session3)
Expert6	Agrofood	>10 yr.	Entrepreneurship, tree surgeon, agro-food business, service industry	25/03/2019 / (Session4)
Expert7	Agrofood	>10 yr.	Entrepreneurship, accounting, production management, service industry	25/03/2019 / (Session5)
Expert8	Manufacturing	~2 yr.	Process modeling, information analytics	29/03/2019 / (Session7)
Expert9	Process Quality	>10 yr.	Process modeling, quality, and assurance, image diagnostic,	29/03/2019 / (Session8)
Expert10	Process Quality	>10 yr.	Process modelling, quality and assurance, auditing, image diagnostic,	29/03/2019 / (Session8)

We aimed at conducting semi-structured face-to-face interviews, with main questions regarding validity and utility of the method, and with an adaptation of questions to accommodate the interviewee's expertise and interests. The questions are delivered in a set order during the discussion, but with some flexibility in the questions asked, the extent of probing, and question order. Each question had two to four sub-questions or prompts, which are used if they are necessary to ensure that the interviewee explores the main question sufficiently.

Questionnaire Design:

In addition to open-ended questions, we prepared a questionnaire with 10 statements that were used to elicit expert opinion on the usefulness and ease of use of the SDBMOM and their intention to use the method in their business environment. The statements are based on the core constructs of the *Technology Acceptance Model (TAM)* [26], [141, 142].

TAM and its derivatives (such as the UTAUT - Unified Theory of Acceptance and Use of Technology [141]) are the theories most commonly referred to in the literature and employed to predict and explain the acceptance of design artifacts, mainly through their perceived usefulness and ease of use. TAM

has been used as a theoretical basis for many empirical studies involving not only technological design artifacts (e.g., [128]) but also *methods* and *models* in the information systems field [89, 90, 109].

The original TAM has three primary constructs: perceived ease of use, perceived usefulness, and intention to use [26]. Perceived usefulness refers to users' perception on the utility of the design artifact in providing gains to its user [142]. Perceived ease of use refers to "the degree to which a person believes that using a particular design artifact will be free from physical or mental effort". Finally, intention to use can be defined as the extent to which a person intends to use a particular design artifact. Intention to use is the most proximal antecedent to the artifact use and believed to be determined by perceived usefulness and ease of use.

All constructs of TAM are operationalized using multiple indicators which have been rigorously evaluated for reliability and validity [26]. Following the work in [142], we used 4 items for perceived usefulness and ease of use, and 2 for intention to use. Adapting the method followed in [89], the wording of the items was modified to accommodate this research. The interviewees could express their level of agreement with each statement on a 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree).

The statements used in the questionnaire is presented in Table 6-13. In order to prevent monotonous responses, a couple of the statements are negated (denoted with an * in the table) as proposed by [89]. For those questions, the results are reversed.

Table 6-13 Utility Evaluation Statements

Criteria		**Statement**
Perceived Usefulness	PU1	I think this method provides an effective solution to the problem of operationalizing business models.
	PU2*	Operationalizing business models in this way would be difficult for users (colleagues, partner companies, etc.) to understand.
	PU3*	Using this method would make it more difficult to communicate to others about how business models can be operationalized.
	PU4	*Overall, I found the business model operationalization method demonstrated in the interview meeting to be useful.*
Perceived Ease of Use	PEU1	Learning to use this way of operationalizing business models would be easy for me.
	PEU2*	I found the way the business models are operationalized as unclear and difficult to understand.
	PEU3	It would be easy for me to become skillful at using this way of operationalizing business models.
	PEU4*	*Overall, I found this way of operationalizing business models difficult to use.*
Intention to Use	IU1	*I would use this method to operationalize business models.*
	IU2*	I would not consider using this method if I have to operationalize a business model in the future.

In addition to the main questions and questions regarding the demography, open questions regarding the strength and weakness of the method were also incorporated in the questionnaire (see Appendix C1).

6.3.2 Conducting Interviews

The steps followed in the interview process were as follows:

1. Sending an invitation and making an appointment for the interview date with the expert.
2. In the day of the interview, starting the meeting with the introduction including the purpose of the meeting and the research.
3. Demonstration of the SDBMOM approach and showing its application by going through a running business scenario (30 minutes on average). The material for the demo-presentation consisted of the SDBM/R design process (if necessary), the steps of the SDBMOM, its application in the TraXP Executive running scenario as an illustration, and the presentation of the supporting software application running on the BPMS platform. The demonstration is in the format of open discussion, where experts were free to ask questions or provide comments.
4. Interviewing the experts to gain feedback through open questions aiming at generating feedback and comments regarding the utility of the SDBMOM. However, in many cases, a significant degree of feedback was collected during the demonstration session as the demo sessions were highly interactive.
5. As a final step, handling in a questionnaire to the interviewee and asking them to express their written feedback in a more structured way. The filled-in questionnaires were collected at a later time.

The SDBMOM was demonstrated using TraXP eXecutive case for the instantiation. These were the materials that the experts reviewed to gain an understanding of the SDBMOM application. The final version of SDBMOM, consisting of a high-level visual diagram (Figure 4-1), explanatory tables (Table 5-5 until Table 5-12), and case application (Figure 5-10), has been demonstrated to all experts.

Throughout our utility evaluation process, we collected the feedback from the experts in two ways, i.e., interview records (see Appendix B) and questionnaire (see Appendix C). The feedback that was gathered from the experts during the demonstration and discussion afterward is used to assess the validity, and utility of the SDBMOM. Of the ten experts that were interviewed, all filled out the survey which yields a participation rate of 100%.

With the consent of the interviewees, all interview sessions were audio recorded. As mentioned above in Section 6.3.1, Experts 1 and 2, and Experts 9 and 10 were interviewed in the same sessions (with their consent) leading to 8 sessions that were recorded.

6.3.3 *Interview Findings*

For the analysis of the data resulted from the interviews and questionnaire, we used the *content analysis* technique [24]. While in general there is no commonly accepted "right way" to perform content analysis [144], we followed a set of structured steps with the aim to locate feedback regarding the utility (as well as validity) of the method.

As a first step, the interview recordings were transcribed into a text form (available in Appendix B). Next, from the transcribed interviews and questionnaire responses, we identified feedback quotes that can be considered relevant for the evaluation of SDBMOM. Removing the duplicates, a total of 98 quotes were identified as significant.

We analyzed these quotes to tag their relevancy for the utility concerns of usefulness, ease of use, and intention to use. In doing so, however, we also identified additional concerns that can be of relevance for the evaluation. These are clarity [39], completeness [8], complexity [39, 151], traceability [42, 108], and consistency [8, 28]. Hence, we analyzed each quote to examine its relevancy for one or more of these concerns.

Figure 6-12 shows the results of the analysis. The percentage shows the frequency distribution of significant feedback items that are collected from experts' quotes.

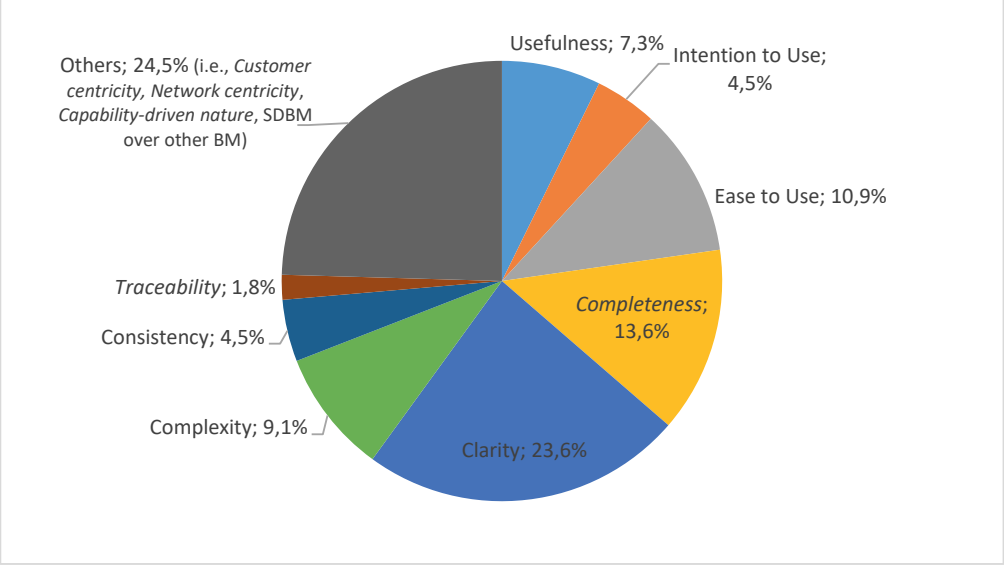

Figure 6-12 Feedback Items Distribution for SDBMOM

The responses from the experts on the TAM-based statements regarding the utility of SDBMOM are presented in Table 6-14. The results indicate a positive view of the experts towards the measured

constructs, i.e., perceived usefulness (PU1-PU4), perceived ease of use (PEU1-PEU4), and intention to use (ITU1, ITU2).

Table 6-14 Utility Evaluation Results

Criteria		Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Perceived Usefulness	PU1	0%	0%	0%	90%	10%
	PU2*	0%	30%	10%	60%	0%
	PU3*	0%	10%	10%	80%	0%
	PU4	0%	0%	0%	80%	20%
Perceived Ease of Use	PEU1	0%	10%	40%	50%	0%
	PEU2*	0%	0%	0%	80%	20%
	PEU3	0%	0%	60%	40%	0%
	PEU4*	0%	0%	10%	80%	10%
Intention to Use	IU1	0%	0%	20%	60%	20%
	IU2*	0%	0%	10%	60%	30%

Below we provide a set of representative quotes regarding each concern:

***Perceived Usefulness*:** The positive results on the 'perceived usefulness' statements indicate that the experts consider the SDBMOM to be useful (PU4). All experts considered that SDBMOM supports organizations that adopt Process Modelling principles to more effectively perform their activities with the help of BMO techniques (PU1). However, three experts indicated that the way the guideline shows 'the shift of paradigm from interaction view to activity view' might be difficult for some users to understand (PU2). One expert indicated that the resulting model of the SDBMOM might be difficult to communicate with others (PU3). In general, however, the experts agreed that the structured method (i.e., the SDBMOM) is useful to help Business Process Design practitioners more effectively perform their activities in a business engineering project.

> *"Interesting approach and has the potential to work in practice." [Expert 8 - Appendix B7]*

> *"It also resonates with a couple of things that we do. It will resonate with a couple of other people other than just me in the organization. [Expert 5 - Appendix B4]*

Not only do they think that this structured way of conducting business model operationalization is useful for Business Process Design practitioners, but that it can be potentially useful for organizations that have not adopted SD logic principles.

> *"I also see some opportunities to use this one as well within the company itself. It is the opportunity to use the choreography as a means for improvements within the existing way of how the process works." [Expert 8 - Appendix B7]*

Perceived Ease to Use: The positive attitude also holds for the 'perceived ease of use'. Most of the experts believed that the guideline is easy to use (PEU4) and is clear (PEU2). As presented in Table 6-14, many experts believed that learning and becoming skillful at using SDBMOM is something that they can do (PEU1 & PEU3). However, over half were neutral or disagreed with the statements. For them, the concept of choreography (interaction) in process modeling was new and they were not (yet) familiar with it. Yet, they acknowledged the need to incorporate and gradually build complexity to handle real-life cases:

> "*Gradually building complexity.*" *[Expert 3 - Appendix C2]*
>
> "*It's challenging for me to understand choreography.*" *[Expert 3 - Appendix B2]*
>
> "*It's not easy to comprehend. I think you just have to try it several times. In small projects on small improvements, I think you can also very easily use one. [Expert 8 - Appendix B7]*

***Intention to Use*:** The responses to the 'intention to use' statements indicate a positive view as well. None of the experts seemed to disagree with the statements. The majority indicated a positive attitude towards using the method (IU1) or preference for its use over another approach (IU2). Furthermore, the experts indicated that they would recommend SDBMOM to Business Process Design practitioners. As can be seen in a significant number of quotes, many experts consider that the method can readily be adapted in their business operations:

> *"Would be nice to run a pilot once at our company for one of our value streams." [Expert 5 - Appendix B4]*
>
> *"I would be interested to look for opportunities for application." [Expert 9 - Appendix B8]*

Overall, the results obtained from the analysis of the expert interviews and the data from the questionnaire (as presented in Table 6-14) are closely aligned. Despite the challenges regarding the ease of use, the responses from the experts indicate that they found the method useful and they had intentions to use it.

In addition to the concerns that are depicted in Table 6-14, the responses involve other quality attributes as well, as discussed in the following paragraphs.

***Completeness*:** The experts saw the SDBMOM as a method that connects Business and IT. It starts with the customer value analysis and results in business process models that are also proven to be implemented as software applications. The completeness of the steps of SDBMOM was considered to be at the right level:

> *"It is a 'total' approach from idea to operationalization, including feedback/correction opportunities. [Expert 1 - Appendix C2]*
>
> *"It's a method which looks very complete in all actions which need to be done." [Expert 7 - Appendix C2]*
>
> *"It's a complete and powerful concept." [Expert 9 - Appendix B8]*

Clarity: The clarity of the concepts and steps of SDBMOM is something that the experts appreciate most:

> "*Clear tasks in each of the steps.*" *[Expert 3 - Appendix C2]*

"*Natural flow of the process, no unexpected tasks.*" *[Expert 3 - Appendix C2]*

"*The power of this (method) is by using these simple symbols and all these kind of things. That makes it very powerful. I think that's why when you use the radar, you make it very clear. Explain the complex story in a simple way. [Expert 10 - Appendix B8]*

"Very structured approach." [Expert 5 - Appendix C2]

***Complexity*:** Connected to the ease of use, several experts considered the complexity as an issue. They consider SDBMOM as a method that integrates several concepts from different research domains, which increases the effort to understand. They suggested that providing simplified and easy to read the explanation of the method will make the method easier to understand, particularly regarding the process modeling part:

"I think you noticed already, I like it. My only concern is the complexity. Try to reduce it because I want to tell this story as well. You need the flow of course. You need the explanation from beginning to end." [Expert 1 - Appendix B1]

"Might be a bit too complicated with the distinction between activities in message and process models". [Expert 5 - Appendix C2]

However, there were also experts that considered the inputs required to apply the SDBMOM as simple and a strong point.

"Seems relatively modest in terms of required information inputs" [Expert 3 - Appendix C2]

***Consistency*:** The experts saw that consistency is something that is properly addressed in SDBMOM through the control checks in-between the steps:

"I'm convinced (about the output validity from each step) by your explaining about checklists between each step where you have some rules for that". [Expert 3 - Appendix B2]

"If you do this nicely from the beginning, you can prevent a lot of failures". [Expert 9 - Appendix B8]

Traceability The experts also saw the traceability between different intermediate artifacts of the method as a property that is properly addressed in the SDBMOM:

"This is genius in itself in the way you made the connection from strategy to business, to value, etc. All the way to the end game and you can track it back even". [Expert 2 - Appendix B1]

"And it's all linked. That's the goal. So you can go back to the radar". [Expert 1 - Appendix B1]

Other concerns: In addition, beside the utility and other quality attributes, our analysis of the interview content and questionnaire responses revealed other important concepts regarding the SDBMOM. These include, for instance, the customer centricity, network centricity, capability-driven nature, the clarity of roles, and the use of the choreography.

"We know this (process-aware software development) for ages. But you guys add these actually to the beginning where you have multiple actors and that makes it more complex. Companies are not used to it. You start modeling over the value chain, that's new." [Expert 2 - Appendix B1]

"It's a model out of cooperation" [Expert 7 - Appendix C2]

"You can also learn to prioritize and identify your missing capabilities." [Expert 5 - Appendix B4]

"I am very excited about the way you map the business model scenario to choreography model. First, I didn't know that before. For me in my work, I go straight to the business process models."[Expert 8 - Appendix B7]

Many experts also pointed out the strength of the SDBM/R approach in providing suitable input for the SDBMOM (particularly when compared to the commonly known approach: Business Model Canvas [97]):

"For me, it (SDBM/R) makes more much more sense than using a Business Model Canvas." [Expert 7 - Appendix B6]

In addition to several positive responses, a number of experts also criticized -for instance- the unclarity regarding the decision making of the domain experts that are involved in the design process.

"Thing to improve: Identification/highlighting of domain expert induced information and BM(P) designer decisions." [Expert 3 - Appendix C2]

6.4 Chapter Summary

A DSR artifact should be able to show its validity and utility. Therefore, three activities were conducted to evaluate SDBMOM. The evaluation of "validity" comprised of two activities. First, we aimed at evaluating if the output generated through the application of SDBMOM (i.e., conceptual process model/business service composition) can indeed be taken as input for the development of a process-aware information system. As a result, this step went through Level-2 by extending the model into an executable process model (using Camunda Modeler), and Level-3 by implementing it in a business process management system (BPMS) platform (i.e., Camunda platform supported with Intellij Idea coding assistant).

Second, we applied the SDBMOM in two real-life business cases (i.e., Free Ride Amsterdam event and Just-in-Time Present of Elderly). Thus, the second activity involved Level-1 operationalization (i.e., the scope of SDBMOM), to show that the method can be applied in real-life business cases to generate usable outputs in the form of business process models.

The third activity was to evaluate the 'utility' of SDBMOM. Semi-structured interviews with 10 industry experts were conducted in 8 sessions. During the interviews, the experts were presented the SDBMOM, and how it has been applied in 2 real-business cases, and asked for their view on the its utility. At the end of each interview session, the experts were asked to fill in a questionnaire that was developed following the TAM constructs (namely: perceived usefulness, perceived ease to use, and intention to use). The interviews were recorded, and the resulting recordings were analyzed using content analysis technique. The results obtained from the analysis of the expert interviews support the responses gathered through the questionnaire. Despite the challenges regarding the ease of use, the responses from the experts indicate that they found the method useful and they had intentions to use it. In addition, in addition to the utility and other attributes (i.e., completeness, complexity, clarity, traceability, and consistency), the analysis also revealed that experts associated the SDBMOM with such terms as the customer centricity, network centricity, capability-driven nature, clarity of roles, and use of the choreography.

7 Conclusions

In this concluding chapter, we first briefly present the contributions of this research by going through the research questions that drove this work. Next, we discuss the limitations of the study and future work that can be undertaken to further extend the research.

7.1 Contributions to Research and Practice

The research presented in this thesis has been guided by the following main research question: "*How can we facilitate the operationalization of service-dominant business models into conceptual business processes in the form of business service compositions given a set of business services?"*

In this research, we address this question with the Service-Dominant Business Model Operationalization Method (SDBMOM). This method has been developed following the design science research methodology. The SDBMOM comprises three essential components: conceptual underpinnings, step-wise method, and relevant role definitions. In the following, we summarize our contributions to research and practice by going through the (sub)questions that have been derived from the main research question.

7.1.1 Research gaps in the operationalization of service-dominant business models

The first research question (RQ.1) is posed to identify the aspects of business model operationalization that have already been addressed in the existing academic literature and the research gaps that remain to be covered. In order to address this question, we examined the background on business models and service-dominant logic, and conducted a systematic literature review in the academic literature on the concept of business model operationalization (BMO).

Our findings indicate a lack of foundational conceptualization in the BMO field that establishes the associations between the theories, views and tools of business research domains to those of the process management and IS domains. In addition, whilst the plethora of research on business models and relevant tools, only a handful of works consider the multi-stakeholder perspective in a service-dominant context, and none explicitly address the need for their operationalization. Moreover, although the current research on BMO acknowledges the role of business processes within the business model transformation process, existing methods address operationalization only in the software design and development context and do not elaborate on business processes as a core element of information systems that enable business models. There signifies a need to explicitly relate the elements of business models and business processes for their traceability.

This contribution not only guided the definition of solutions objectives to be addressed by the method proposed in this research work, but also provides a comprehensive source that offers pointers for gaps to be fulfilled by future research studies. In the time of writing of this thesis, there was no research in

the academia that provide a comprehensive list of approaches used for business model design together with the methods used for their operationalization in different contexts.

7.1.2 Conceptual foundation for the service-dominant business model operationalization

The second research question (RQ.2) addresses the need to establish the conceptual underpinnings of the proposed method by defining the core concepts and their relationships that are deemed essential for the operationalization of service-dominant business models. This is also reflected as one of the five objectives of the proposed method (Obj-2). This is to ensure that the proposed method fosters a common understanding of the core concepts, and effective and repeatable application in practice. This is particularly important, as the underlying concepts are typically referred to in diverse research disciplines, such as service science, service systems engineering, business process management, and information systems.

To address this need, we defined a set of core concepts - based on the literature on these disciplines-, that includes service-dominant business model (SDBM) and radar (SDBM/R), business service, business service operation, customer-service scenario, business service composition, conceptual process model and their formal relationships to lay the foundations upon which the proposed method is built. Clear definitions of these concepts and explicit definitions of their interrelationships would help to establish a common understanding of these terms and to advance the research in this field.

7.1.3 A method for the operationalization of service-dominant business models (SDBMOM)

Based on the research gaps identified through the literature review, and the background on service-dominant business and business engineering, five design objectives have been defined to be addressed by SDBMOM. As discussed in 7.1.2 the second design objective relates to the conceptual foundation that is necessary for the proposed method. In the following, we organize and explain our contributions in this direction with respect to the remaining four objectives.

Objective-1: The method should support taking a service-dominant business model as input for operationalization. This entails a multi-stakeholder model where the customer is also involved in the proposed value co-creation.

Our artefact, SDBMOM, takes a multi-actor business model - represented as a Service-Dominant Business Model Radar (SDBM/R) blueprint - and it's associated Customer Service Scenario as primary inputs, together with a catalogue of business services as given inputs of the method. The application of the method results in conceptual process models that delineate the operational scopes for each actor in the form of individual processes as implied by the model and the customer service scenario. Thus, SDBMOM can effectively be used to operationalize service-dominant business models as represented in SDMB/R blueprints. Furthermore, the operational processes generated by the method do not stand as isolate objects but are conceptually linked to the BASE/X business engineering framework thanks to the service dominant conceptual underpinnings that it builds on.

These underpinnings define and relate the concepts of the method to those of the business engineering framework. As a result, the operational process models can effectively represent the artifacts of the operational perspective of a business model in concert with the macro or strategic perspective. The accomplishment of this objective has been confirmed by experts, in particular with the evidence that supports the completeness of the method.

Objective-2: Build the method upon conceptual foundations for BMO.

SDBMOM is built upon the BMO concepts and their associations, hence conceptual underpinnings for BMO, which were addressed by the second research question (RQ.2). SDBMOM relies on this set of constituent BMO elements defined from a service dominant perspective. It takes them into account in conceptualizing the inputs and outputs of the method, as well as in contextualizing the environment for SDBMOM use. This helps improve the common understanding of the method, the assets that are required and generated by method execution and their tractability, and its effective and repeatable application in practice.

Objective-3: The method should enable the composition of services of multiple parties involved in the business model. In addition, the output of operationalization should be a technology-agnostic in order to allow for subsequent operationalization levels to apply the most suitable technology that is relevant and applicable for the specific context.

SDBMOM employs standard BPMN v2 conceptual process modelling elements for representing the intermediate and final outputs of the operationalization steps defined in the method. BPMN is a technology-agnostic language that has been commonly adopted in practice. SDBMOM delineates the operational scope for each value co-creating actor in the form of conceptual process models serving as a specification for its executable processes to be supported by information systems.

On the other hand, many technology providers, in particular workflow management system (WfMS) vendors or more advanced business process management system (BPMS) vendors take conceptual and executable BPMN models as main inputs for information systems development. In our artifact evaluation, we have demonstrated how the process models generated by SDBMOM can seamlessly be further completed with execution-oriented details and implemented on a BPMS platform. Such conceptual process models can also be used for the evaluation of business models before they are implemented as process aware information systems. For instance, process *simulations* can be used to quantitatively predict the operational performance of the designed process (and thereby of the business model) [1].

Process model driven development provides many opportunities for SDBMOM users to operationalize their business models also in the form of information systems, taking SDBMOM conceptual process models as input. This attribute is also well-confirmed in expert evaluations, highlighting the backward traceability of the operational process models and forward traceability of the business models, and their consistency in general.

Objective-4: The method should offer a step-by-step iterative guide for the operationalization of the business model and should enable explicit traceability between inputs, outputs and all intermediate models.

SDBMOM follows a bi-focal business model operationalization approach. In the first focus, it concentrates on the decomposition of SDBM/R blueprints into the elements of multi-actor operational process models. The second focus maintains the traceability of the intermediate and final outputs from each decomposition step and thus maps them to the elements of service dominant concepts manifested in conceptual underpinnings. This way, it aims to maintain the emergent characteristics of the business model, such as co-production activities, interactions and their association to business services, so that the SDBM/R value propositions hold and ultimately the desired value-in-use can be created for the customer of the business model. To help ensure traceability and consistency, control checklists are included after each method step to guide SDBMOM users.

Objective-5: To support its application in real-life business settings the method should include an organizational structure that describes the (organizational) roles that are expected to be involved in the application of the method, including their responsibilities and necessary skills.

As with the design of business models, their operationalization does not happen in a vacuum: it is performed in a specific business context. In order to facilitate the adoption of SDBMOM in real-life settings, we have defined a number of business engineering roles with related responsibilities and skills, and mapped them to the corresponding SDBMOM activities.

The evaluation activities that comprised the application of the method in real-life business cases and expert interviews have confirmed the validity and utility of the SDBMOM in this respect.

The SDBMOM and its conceptual foundation provide a concrete basis for researchers and practitioners who aim to apply business modeling concepts to engineer service-dominant business for implementing innovative solutions enabled by multiple stakeholders. These contributions should be considered as further steps to align business goals and models to the concepts relevant to business operations and supporting technology. Establishing explicit traceability between these business concepts is significant for effective business-IT alignment [4]. The SDBMOM has been designed as a pragmatic approach that can help practitioners to quickly design and implement their new solutions to the market, or rethink their existing value propositions and redesign their offerings.

7.2 Limitations and Future Research Directions

The research presented in this thesis forms a coherent whole of results, achieved by following a well-defined design science research methodology. Given the fact that this work presents a novel approach to the operationalization of service-dominant business models, there is a number of limitations to this work, however. These limitations imply directions for future work to reduce or eliminate these limitations. We discuss this below, organized in a number of topics.

Applicability to other service-dominant business engineering approaches

SDBMOM takes SDBM/R blueprints as explicit inputs. It relies on the core concepts of the BASE/X business engineering framework that it builds upon. It is specifically catered for the operationalization of service-dominant business models represented as SDBM/R blueprints (with customer service scenarios). Therefore, its effectiveness in operationalizing SDBMs that are represented using *other approaches* (as discussed in Chapter 2 of this thesis) has not been evaluated and, hence, is undetermined.

Quality and availability of SDBMOM inputs

Related to the abovementioned limitation is that the level of effectiveness that can be achieved in operationalizing SDBMs depends strongly on the quality of the artefacts that it requires as input. Incomplete and inconsistent inputs would hamper its applicability. Future work in this direction that addresses the applicability in practice is the specification of quality criteria for each of these inputs.

The SDBMOM also assumes that the network parties collaborating in a service-dominant business model already have a well-structured business service catalogue in place that can be used as input for the operationalization, and hence for the composition of these services. However, given the importance of this assumptions, more research is required on the methods and frameworks that can be used by organizations in defining and managing their business services and maintaining them in the form of business service catalogues. This research is located at another level of service-dominant business engineering, though. At the time of writing of this thesis, it is addressed by a companion research project to the one presented in this thesis.

Applicability in other business domains

We have applied the method in an illustrative business scenario and two real-life business cases that originate in the *mobility* domain. Although these cases can be considered generic, we currently have no evidence that the method can be effectively applied in business models that originate in other business domains. Therefore, future work should consider applying the method for the operationalization of SDBMs that have emerged in diverse business domains. This will strengthen our conclusions regarding its generalizability and validity. Existing work on the application of service-dominant business model engineering in other business domains (such as smart logistics from the BESTFACT project [131] and advanced manufacturing from the HORSE project) can provide a good starting point for this.

Completeness of evaluation

For evaluating the utility of SDBMOM, we have interviewed experts from different business domains. In the interviews, we have demonstrated the use of the method and have investigated the view of the experts on the usefulness and ease-of-use of the method. Given limitations in throughput time of the project and availability of the experts, there was no room for having the experts work with SDBMOM

themselves, i.e., have them develop business processes from business models themselves. Consequently, future work should incorporate additional evaluation activities where industry practitioners are asked to use the method themselves for the operationalization of their SDBMs. This would not only provide additional feedback regarding the ease-of-use of the method but also additional guidelines for strengthening its utility.

Completeness of structured literature review

Finally, there are also limitations regarding the structured literature review that we performed to review the contributions in the relevant research domain.

A common validity threat to all literature reviews is the completeness, i.e., not being able to locate all relevant studies. To mitigate this risk two measures were taken. First, we have performed an exhaustive research on a considerable number of well-known digital libraries that are frequently used in systemic reviews. We consider that they have sufficient coverage on the topics under investigation. The second measure relates to the definition of the search terms and the structure of the query. We have based keyword selection on the discussions among researchers and other related secondary studies. Other than the keyword "business model" there was only one block of keywords joined with an OR-construct retrieving more papers at a cost of precision. We tackled the precision problem by adding further inclusion and exclusion criteria such as imposing restrictions on fields of research. Due to these measures, we consider that our search terms sufficiently capture an extensive set of relevant papers addressing the subject.

A limitation regarding the literature review also exists due to the used exclusion criteria. For reasons of quality control, we have excluded white papers, grey publications and non-academic books. However, given the practical nature of the topic, such sources may provide useful insight into the approaches or techniques that are currently not covered or reported in the scientific literature. Future work can consider conducting a multi-focal review of the academic and grey literature to reflect also the state of practice.

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A. Appendix A – SLR Protocol and Selected Publications

In this Appendix A, details regarding the SLR protocol introduced in section 2.3.2 are presented.

Search Strategy: In order to gain an understanding of BMO, we performed an exhaustive literature research on seven major digital libraries (ACM, ScienceDirect, Scopus, SpringerLink, Web of Science, IEEE, and Wiley). We targeted journal articles, workshop and conference papers, and peer-reviewed book chapters as the publication types to be covered. The search terms were organized into two parts: T1 AND T2. T1 includes one term "business model" which is a well-known concept and represent a very large population of publications that potentially include all relevant publications. T2 includes terms operationalization, transformation, implementation, "service composition", and "business process model" represent operational aspects of business models, thus when combined with T1 is very likely to return a sub-population that includes relevant publications that cover operational aspects of business models with higher precision and recall. The first three terms included in T2 are generic terms which are frequently used in BMO studies. We included "service composition" as a related term to include studies in the service engineering domain [28] and "business process model" to increase the coverage of papers from business process management domain. As a result, we formulated the following logical search string: *"business model" AND (operationalization OR transformation OR implementation OR "service composition" OR "business process model").*

We applied the logical search string to the specific vocabularies of the selected digital libraries. Then, we applied the inclusion and exclusion criteria in the entire process of study selection. Table A-1 presents the inclusion criteria (IC) and the exclusion criteria (EC) for the selection of the related primary contributions to be included in the systematic review which follows from the review scope and research sub-questions.

Table A-1 Inclusion (IC) and exclusion (EC) criteria relevant articles

Criteria	Description
IC1	The paper is electronically available.
IC2	The paper is in the English language
IC3	The paper is published between 2000 and 2018 (January)
IC4	The study is peer-reviewed.
EC1	It refers to business models and service composition or business process modeling but does not address their relationship to BMO (i.e. only addresses the technical aspect).
EC2	The paper does not cover methodological aspects of operationalization in its scope (e.g. leans on organizational change, success factors, business model innovation, exploration, leadership, etc.).
EC3	The paper is proceeded by a more recent paper by the same (set of) authors with a similar or enhanced contribution.
EC4	The paper is categorized in non-relevant research domains (e.g. medicine, energy, chemical engineering).

***Study Selection Process*:** We retrieved all potential papers found from the selected digital libraries adopting the logical search string to the search structure of the library search engines and searching for peer-reviewed publications that include the search terms in their abstract, title or keywords. Further filtering was applied using the filtering options on search forms that match our inclusion/exclusion criteria. However, searches in Springer Link and Wiley required manual filtering since the searches returned an impractical number of results after using all available search options (>1500). Springer Link supports searching only full-texts and titles: we decided to run a full-text search sorted by relevance and started examining papers by title and abstract screening until we find a cut-off point where we are convinced that we can stop searching. The paper in the 266th rank was the last item to include in the initial search results and we stopped the process after 400th paper. Similarly, Wiley returned a large number of results mainly due to limited filtering options. We examined the first 400 papers by title and abstract screening which resulted in the inclusion of 6th paper in rank as the last selected item. In total, we retrieved 4.344 publications in our search. After applying the inclusions and exclusion criteria and eliminating duplicates, 41 publications were found to be eligible for full-text screening. After reading the full texts an additional 14 papers were excluded from the study by checking against inclusion/exclusion criteria, eventually resulting in 27 relevant studies. The entire study selection process is given in Figure A-1.

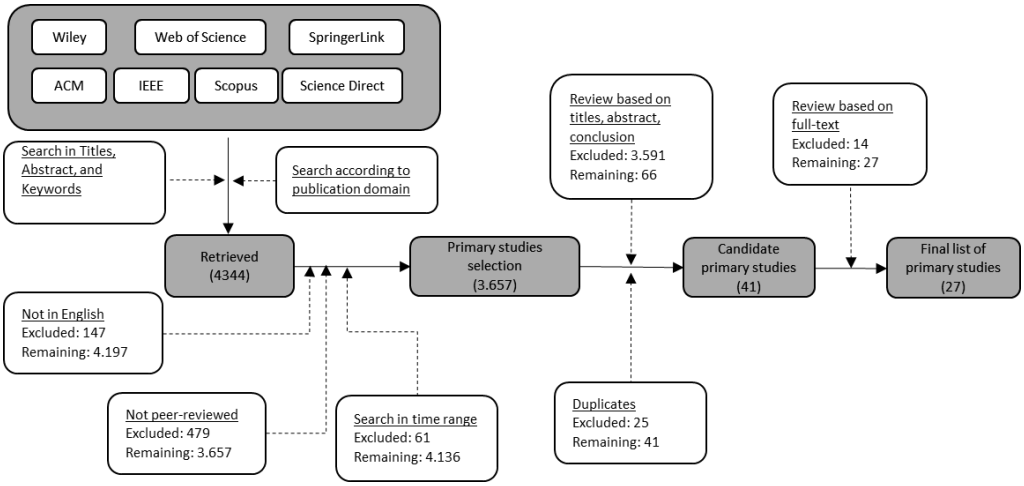

Figure A-1 Selection of BMO studies

The complete list of the 27 studies selected for review are as follows:

[S1] Fayoumi, A., & Loucopoulos, P. (2016). Conceptual modeling for the design of intelligent and emergent information systems. *Expert Systems with Applications*, 59, 174–194.

[S2] Y. Rhazali, Y. Hadi, and A. Mouloudi, "A Model Transformation in MDA from CIM to PIM Represented by web models through SoaML and IFML," in *4th IEEE International Colloquium on Information Science and Technology (CiSt)*, 2016, pp. 116–121.

[S3] Y. Rhazali, Y. Hadi, and A. Mouloudi, "CIM to PIM Transformation in MDA: From Service-Oriented Business Models to Web-Based Design Models," *Int. J. Softw. Eng. It's Appl.*, vol. 10, no. 4, pp. 125–142, 2016.

[S4] Y. Rhazali, Y. Hadi, and A. Mouloudi, "Model Transformation with ATL into MDA from CIM to PIM Structured through MVC," *Procedia Comput. Sci*., vol. 83, no. Fams, pp. 1096–1101, 2016.

[S5] N. Zope, A. Kumar, and D. Lokku, "Enabling Service Business Models through Service Processes," in *IESS*, 2016, vol. 5, pp. 60–71.

[S6] Y. Rhazali, Y. Hadi, and A. Mouloudi, "A methodology for transforming CIM to PIM through UML: From business view to information system view," in *Proceedings of 2015 IEEE World Conference on Complex Systems, WCCS 2015*, 2015, pp. 0–5.

[S7] Z. Li, X. Zhou, A. Gu, and Q. Li, "A complete approach for CIM modelling and model formalising," *Inf. Softw. Technol*., vol. 65, pp. 39–55, 2015.

[S8] N. R. Salazar and B. H. Heyl, "Integration and Implementation of an EA strategy based operating model with BPM technology-Case Study: Housing credit process, Banco Estado Ecuador," *Proc. - Int. Conf. Chil. Comput. Sci. Soc. SCCC*, 2015.

[S9] M. López-sanz and V. De Castro, "Alignment of Business Models and Software : Using an Architecture - Centric Method to the Case of a Healthcare Information System," in *24th International Conference on Information System Development*, 2015.

[S10] C. Di Valentin, T. Burkhart, D. Vanderhaeghen, D. Werth, and P. Loos, "Towards a Framework for Transforming Business Models into Business Processes," in AMCIS 2012 Proceedings, 2012, p. 10.

[S11] S. Solaimani and H. Bouwman, "A framework for the alignment of business model and business processes: A generic model for trans-sector innovation," *Bus. Process Manag. J.*, vol. 18, no. 4, pp. 655–679, 2012.

[S12] M. Schief, A. Bonakdar, and T. Weiblen, "Transforming software business models into business processes," Proc. 14th *Int. Conf. Enterp. Inf. Syst.*, pp. 167–172, 2012.

[S13] V. De Castro, E. Marcos, and J. M. Vara, "Applying CIM-to-PIM model transformations for the service-oriented development of information systems," *Inf. Softw. Technol*., vol. 53, no. 1, pp. 87–105, 2011.

[S14] J.-S. Ulmer, J. Belaud, and J.-M. Le Lann, "Towards a pivotal-based approach for business process alignment," *Int. J. Comput. Integr. Manuf.*, vol. 24, no. 11, pp. 1010–1021, 2011.

[S15] S. Wu and Q. Zhong, "A meta-model for developing business-model driven management information systems," in *International Conference on Logistics Systems and Intelligent Management, ICLSIM 2010*, 2010, vol. 1, pp. 282–286.

[S16] Z. L. Li, G. Ping, P. Q. Ben, and Z. Li "The Research and Implementation for Model Transformation of Service Oriented," in *International Conference on Computer Design and Applications (ICCDA 20)*, 2010, vol. 5, pp. 63–67.

[S17] J. Dorn, C. Grün, H. Werthner, and M. Zapletal, "From business to software: A B2B survey," *Inf. Syst. E-bus. Manag.,* vol. 7, no. 2, pp. 123–142, 2009.

[S18] V. De Castro, E. Marcos, and R. Wieringa, "Towards a service-oriented MDA-based approach to the alignment of business processes with it systems: From the business model to a web service composition model," *Int. J. Coop. Inf. Syst*., vol. 18, no. 2, pp. 225–260, 2009.

[S19] J. Touzi, F. Benaben, H. Pingaud, and J. P. Lorré, "A model-driven approach for collaborative service-oriented architecture design," *Int. J. Prod. Econ*., vol. 121, no. 1, pp. 5–20, 2009.

[S20] K. Decreus and G. Poels, "Putting business into business process models," in *Proceedings - International Computer Software and Applications Conference*, 2008, pp. 1005–1010.

[S21] A. Edirisuriya and P. Johannesson, "On the alignment of Business Models and Process Models," in *BPM 2008 Workshops*, 2008, pp. 68–79.

[S22] V. Gacitua-Decar and C. Pahl, "Service architecture design for E-businesses: A pattern-based approach," in *International Conference on Electronic Commerce and Web Technologies*, 2008, vol. 5183 LNCS, pp. 41–50.

[S23] F. Azam, Z. Li, and R. Ahmad, "Integrating value-based requirement engineering models to webml using vip business modelling framework," in *Proceedings of the 16th international conference on World Wide Web - WWW '07*, 2007, p. 933.

[S24] A. Lo and E. Yu, "From Business Models to Service-Oriented Design: A Reference Catalog approach," *26th Int. Conf. Concept. Model.*, vol. 4801, pp. 87–101, 2007.

[S25] B. Shishkov, M. Van Sinderen, and D. Quartel, "SOA-driven business-software alignment," in *IEEE International Conference on e-Business Engineering (ICEBE 06)*, 2006, pp. 86–94.

[S26] J. Barrios and S. Nurcan, "Model Driven Architectures for Enterprise Information Systems," in *CAiSE 2004*, 2004, vol. 3084, pp. 3–19.

[S27] K. Terai, M. Sawai, N. Sugiura, N. Izumi, and T. Yamaguchi, "Business process semi-automation based on business model management," *Int. J. Intell. Syst. Accounting, Financ. Manag.*, vol. 11, no. 4, pp. 215–234, 2002.

Threats to Validity: In order to reduce the impact of the validity threats associated with the systematic literature review, the validity threats are addressed using the four validity types presented in [149]:

Internal validity: Internal validity concerns the relationship between constructs and proposed explanations. A common internal validity threat to all SLR is finding all relevant studies. To mitigate this risk two measures were taken. The first measure is related to the selection of digital research libraries. We performed an exhaustive search on five well-known databases and two index providers (i.e. ACM, Science Direct, Springer Link, IEEE, Wiley and Scopus and Web of Science). These are frequently used in systemic reviews in information systems, process management and management research and are considered to have good coverage of the topics under investigation. The second measure relates to the definition of the search terms and the structure of the query. We based keyword selection on our experience, discussions among researchers and other related secondary studies (e.g., extensive business model reviews). Other than keyword "business model" there was only one block of keywords joined with OR retrieving more papers at the cost of precision. We tackled the precision problem by adding further inclusion and exclusion criteria such as imposing restrictions on fields of research. Due to these issues, we consider that our search terms well capture an extensive set of relevant papers addressing the subject. Another source of bias may be timeline restrictions, as we only included the most recent studies due to effort limitations. However, the justification for the timeline restriction is that initial research on the topic revealed that potential work in this area started after the late 90s following the research hype that investigates the concept of business model.

External validity: External validity concerns the possibility of the generalizability of the results within and beyond the scope of study. Our review excludes publications written in another language then English. The issue here is whether the works included in our study can represent all literature in the area of BMO. For these issues, we argue that relevant literature we included in our paper pool contained sufficient information to represent the knowledge reported by previous researchers.

Construct validity: Construct validity relates to the data collection strategy and how well the data represent the investigated phenomenon. Threats related to this type of validity in our study relate to the RQs and data extraction scheme used in the study. To limit the threats to the validity of the constructs, we have operationalized the main research question into sub-questions that links the main research question to the elements of the data extraction scheme. Furthermore, we have explicitly mapped each sub-question to the data items.

Conclusion Validity: Conclusion validity concerns whether conclusions are reached through rigorous and repeatable treatment. In order to limit the threat, we have developed a structured protocol using a widely recognized and used SLR guidelines [13, 64]. Regarding the threat of researcher bias in data extraction, a second researcher with expertise in the research domain reviewed the extracted data. Disagreements in extracted data were discussed between reviewers until consensus was reached. In the case of a conflict between the two reviewers, a third researcher with expertise was consulted. This decreased the risk of miss-classifying any relevant papers.

B. Appendix B – Interview Records

B.1 Interview 1 – Business and Data Analyst & Supply Chain-IT Analyst

B.1.1 General Information

Date	29 March 2019
Length of the interview	02:00:41
Name of interviewee	[EXPERT1], [EXPERT2]
Experience	>10y, >10y
Name of interviewer	[INTERVIEWER]
Subject	Evaluation of SDBMOM
Goal	To get feedback on SDBMOM validity and utility

B.1.2 Introduction

[INTERVIEWER] The reason why we have this meeting is that we have been working on this framework the so-called BASE/X framework and that framework is as its name implies a framework. Right now, it's a frame that we are filling in. We are developing piece by piece all these parts, all these components and then connect these components at the same time into each other. One of (that we think) the very important parts of this framework is how to go from a business model (radar) to process models, towards implementation. Toward really making it happen.

[INTERVIEWER] And one of the very important parts of this activity, what we call operationalization is to again take the radar as input and create a process model that tells exactly which party has to do what and what are the interactions that should take place among these parties. Of course everybody can do this in fact but we want to come up with something that would guide people and do it in a much more structured way instead of like ad-hoc.

[INTERVIEWER] We want to come up with something structured and provide help for companies to do it. We have been in fact confronted with all these problems. So these problems are not something that we created ourselves. We would be confronting with these problems all the time. When we have these workshops in different places about creating the radars, one of the next question is this a good idea (evaluation) and is this going to work or under what conditions does this work. That's the first thing and the second thing, how we going to do it and who are going to do what, in detail.

[INTERVIEWER] That is the kind of challenge that we always face and that's the reason why we are working on it. So we'll share what we have been doing with you and get your opinion. So both of you have been very close to us in fact in this journey. So that's the reason why we also ask you. We have been interviewing experts for the last couple of weeks I think we have six now. Now you are here.

[EXPERT2] Two of us.

[EXPERT1] How many people that you want to interview? Are you successful?

[INTERVIEWER] At least ten. Yeah very much. We are very happy with the results so far.

[INTERVIEWER] So, can we hear it from you as well? Perhaps for you to introduce yourself.

[EXPERT1] Yes. My name is [EXPERT1]. I am the co-founder of two companies. One is called Company A. The other one's called Company B. Company A was founded in 2002. I graduated in 1989 from Tilburg University, Information Management. From day one actually I entered consultancy, especially business intelligence/data warehouse. That word didn't exist at that time. It was invented later. We called it the Decision Support System at that time. My whole life I've been involved in data, helping companies do something with data, to transform data into information. Initially, I worked for large system integrators like Origin. But I left Origin and it became Atos. I left and I founded Company A. And that's been working very well actually. We used to work for the high-tech industry, such as Phillips and NXP. But, they also got in trouble in 2008, the crisis. They were not willing to pay our tariffs. So we said sorry, then we leave. We went on and we went to the banks, insurance companies, and health care companies. That's been doing well actually. But also in 2008 we founded Company B, because there was another thing happening in my arena. We have a lot of consultants doing a lot of programming, still developing solutions. Then you get into high risk because it's always been a manual. You do it differently than I do it. So we developed software for the market to automate, to generate solutions instead of program -configuration over programming-, which by then was quite new. Actually yesterday, I gave a lecture at the summit. We talked about this topic because we now move on to release four of our software which is quite promising. It's a platform with good building blocks.

[INTERVIEWER] What is the solution that you offered?

[EXPERT1] It's a platform. On top of which you can build building blocks. These building blocks only work if you can recognize patterns in problems. So if you have a key problem and underlying that problem you can identify patterns we can automate solution. So whether it's a data migration question, whether you want data to the cloud, to big data, whether you want the data warehouses, you can generate it. You can do it really fast. It's amazing, you can save hundreds of thousands of euros on consultancy. It's not new because there is a company in Eindhoven do the same thing. They automate machinery without the of need programmers. They only need architects and supervisors.

[INTERVIEWER] You need someone to define the problem and the concepts to be programmed.

[EXPERT1] As an example they modeled a bridge over a river in the Netherlands. Even you and I, we can model the bridge graphically. Once we're finished, pressed the button and the code comes out that runs the bridge. And if you know how a bridge works you can operate it just on the screen by clicking and dragging. You are programmed. We're doing a similar thing but for data management. So when I got involved with TU Eindhoven long time ago, I learned about BASE/X and I was like 'wow'. That really happened to me because when I look around, *I see so many (business) opportunities. But if I want to realize the opportunities, I need to*

cooperate and it always struck me that it's so hard to cooperate with other companies because trust comes in and there no means in how to organize and communicate and also abstract a little bit and take out emotion and just put it on paper so that everybody understands what's going on. And of course we've been using this as a moral compass but it's so focused on my company only my partners are left there hidden away and left. But my partners are very important and they're equally important to us, as I am. So then I saw BASE/X I said 'wow', this is it. So, I started explaining to the business people that I know and they are all understood quite quickly. And that's what happened when I introduced BASE/X in some sectors, like the latest agriculture sector, where he is now being celebrated. These farmers are like 'wow'. They had the same experience but then the only problem is that after putting the pieces together, how to do it and how to operate it? Because coming up with models is nice but now implementing is still hard. I employ 28 people.

[EXPERT2] I'm [EXPERT2], working for a small company owned by the port of Rotterdam and port of Amsterdam. A neutral company, not a profit motive. We exploit, builds, runs the port systems for the Dutch ports, which basically information up for everyone and every organization that does something with cargo through the Dutch ports, such as: customs harbormasters, infrastructure managers, deep CC vessel lines, shippers, importers, exporters, etc. We connect to one central information or a digital infrastructure (platform). On top of that we have several process solutions. So, basically what we did is that all those different processes in the supply chains, we connected them with each other. We reused the data and now we are able to share data between companies. One day, they don't even need to talk the same language or do not even know that they're in the same supply chain because everybody knows the first and then the next step. But they can't look any further. That is something that we provide. Trust is the key element and they trust us because we are not commercial and we have an agreement that we don't do anything with the data without the consent of the data owner.

[EXPERT2] What we are doing now is that we have process solutions and now we want to extract the data out of it and provide data solutions. That's where BASE/X comes in. This is excellent because now we have the vision that you can make compositions. So, we have process but basically, they consist out of different building blocks. Now, we want to offer those building blocks to the community (innovation ecosystem) so they can build their own applications.

[EXPERT1] A question, because you have a lot of data, are you not saying that you're going to make data shop? So to say that you make data sets already prepared so that people can buy or download.

[EXPERT2] Yeah. So we pre-defined logical data sets. Lots of data sets. Now, we are going to offer it to the market. So we made a separate platform next to port system so that we can share those data services.

[INTERVIEWER] This data set is like a live data set, isn't? It's like you just plug your information system to the source of the data set.

[EXPERT2] Yeah. It's an API. You take subscription.

[EXPERT2] So, BASE/X approach brought us together as well. Indeed, execution is very hard. We can make the (business) model. It is easy to understand even if you're not a sophisticated IT Business Analyst. You just need to be an expert in your own fields. The model explains almost itself. So that's very easy and everybody understands its own role and how it works but then how are you going to use it.

[INTERVIEWER] Of course our point of view here in operationalizing this business model is eventually to come up with any information system to support that thing. But we don't go that far. Here we just go to a level where we think from there on you can develop your software from scratch if you like or you can use different type of ready-made systems to configure them. You can have a business process management systems that you can execute. You can develop software to support these processes. So different types of options exist on that side. We want to come to a point where we handed it over to an IT (e.g., programmer). And say, "Hey this is what everybody would do. This is the message exchange that will take place among these parties. Do something about that." These systems can of course be completely apart from each other. They can't use web services to communicate. The implementation is less of a concern.

[EXPERT1] That mostly the case. People tend to immediately jump to the architectures and technology. However, this is the least of your worries because technically we can do it. But the other problem is organization, governance, processes, setting data, change management. That's hard. If I look at my roles in the last year or so as I grew older, I noticed a shift in it. Initially, I was more of a technical guy, working to realize solutions. Today, I'm being hired as a program manager to make that change. And I'm no longer talking to I.T., 90 percent of my time I'm running in business. To get those people involved and participate, because that's where the challenge lies. And also when we talk about BASE/X, I think it's the same problem.

[INTERVIEWER] Yeah. We have also very similar path that we were started as a consultant (Oracle), configuring systems, databases and a lot of programming. Over the years, you just realize that the business, communication, management, governance, process is much more important and much harder.

[EXPERT2] Yeah, and what we did with the help of the knowledge of the BASE/X is how can we increase the value for the data owner. So, now we have a shared business model. They get a kickback revenue on their own data. They've already did make use of the processes. So, now we have the data and we can sell it to other parties so they can earn some money out of that.

[EXPERT1] You develop this (application) yourself?

[EXPERT2] We found an innovative company. They said that we can build all kind of cool graphics. Well, let's do so.

[EXPERT1] Nowadays you can do this quite easily.

[EXPERT2] Yeah that's true.

[INTERVIEWER] It is a very nice application of what we will also be talking about.

[EXPERT1] A question, because you are obviously a strong partner in many radars. Are you always the orchestrator? Because sometimes maybe people can come up with an idea but they need you.

[EXPERT2] Not in every case. But for the data services we are more confident. To say as service providers.

B.1.3 Demonstration & discussion

[INTERVIEWER] Now, let's talk about this thesis (method).

[INTERVIEWER] So, this presentation that ,we have been doing also caters for the needs of the other people who are less familiar with the term of service or with the concept of service dominance logic and also the radar and things like that. Of course I would like to keep that part short for you.

[INTERVIEWER] So, we were talking about the implications of those dominant logic. In fact, I heard a lot of examples that you also know what the examples of companies that are using this or adopting the service dominant logic has increased significantly in many domains. At least, in the mobility domain, I see it happening. You see the like of car sharing, bike sharing, etc. It's very prominent right now, everywhere.

[INTERVIEWER] Now, the implications you have to focus on the value, not the ownership. So, ownership is not important for the user, just the value that this thing brings when it's being used in a particular context. You have to have your business network. You can't do everything yourself. Just do the things that you do best and leave the rest to who are expert on those parts. Of course, agility is very important that you have to change your solution very quickly and adapt yourself very quickly.

[INTERVIEWER] These are very important requirements. And we have been working on those BASE/X framework for quite a long time now. As a kind of recap, you remember this BASE/X pyramid. What of doing business and how of doing business. Business strategy in one part, business services (BS) in the bottom part. These two are kind of relatively stable parts of the organization that you don't want to change these things too much. So, these (BS) are your capabilities -what you actually do and what you can provide as a company- and these are what you want to be, and these are relatively stable part and you expect evolutionary changes here.

[INTERVIEWER] In the other hand, these parts (BM and SC) are what's your market offerings and the way that you provide these offerings should change very fast. You should be able to adopt these two things very quickly. So, this is much less relatively stable. This is an agile way. But at some point in time, you also have to think whether we are really aligned with our strategy, whether the business models are really aligned with what we are doing.

[INTERVIEWER] And the same goes for the bottom part as well. The things that we would like to offer, can we really offer them? Do we need capabilities to be able to offer them or do we have extra capabilities that we don't even need, which is a burden of maintaining these capabilities? Unused capability is a big burden and big costs for the company. So, you need to decide on that as well. These are strategic matters of course. These are connected to each other.

[INTERVIEWER] These business models (radar) are very important part of this framework, in fact it's the first proven technique of this BASE/X framework. The created added value for the customer is at the center (of the business model radar) and of course you also have to know who your customer is. It's sometimes clear and sometimes not very clear. The focal organization also the key here, orchestrating what each party brings on the table. Value preposition is what they have to do. Co-production activity is like how to be able to bring that value. Cost and benefits are obviously a very important part of any kind of business model. As an example (Google business model), which Google is not working for the user but for the advertiser. There's the other real example of the Free Ride Amsterdam Event business model that we came up with quite some time ago.

[EXPERT1] Has it been implemented?

[INTERVIEWER] Unfortunately no. It because political reasons. Because there are so many parties, particularly in this mobility domain. You have these service providers, parking providers, all these kind of people who provide goods.

[INTERVIEWER] Yeah. So, basically there is conflict of interest with other types of business models.

[INTERVIEWER] There are very important companies that are member of some association or a part of this project, such as: provider of traffic lights, construction companies which does roads, so on and so forth. So, if you come to this organization and say, "Hey, we have a better idea. We don't need lights anymore." It's like, sorry.

[INTERVIEWER] But, what we're going to show today is not how to deal with the organizational concerns or not how to deal with the barriers that are originating from some other type of ways. Unfortunately, that's too wide topic and that's like another PhD thesis. Here, we want to first come up with like focus on the functional matters. Focus on the control flow and focus on detailing the business model. There are so many things that you can list that that would prevent the implementation. This is something else.

[EXPERT1] Then, I leave it there but that problem is what I face most.

[INTERVIEWER] Indeed. So, in this work, we are mostly come from the engineering perspective. How to engineer this thing. There is another research in our group touching these points. The work is related to these type of points, such as: how to make a strategic decision, how to make parties convinced in collaborating, how to align business models with their strategy.

[INTERVIEWER] Next, just an example of this is how the executive business model looks like. We have executive traveler business model radar and the customer service scenario accompanying this thing. We define how the customer experiences this service/system/solution in it. This is rather an informal document that explains (in short) that explains what we expect the customer to go through in this process. Not only the interactions and the experience but also how this value-in-use looks like. So it gives you a feeling of this value in use, what the customer gets, enjoys, benefits, etc. There are different versions of it but the version that we're using is almost like a promotional thing that shows how the value is experienced by the customer.

[INTERVIEWER] Now, given these inputs, let me show very briefly what this method that we are trying to build. We use the term SDBMOM (service dominant business model operationalization methods). So in general what this means is how you go from take these radar and the customer service scenario and come up with a process model and the system that really implements and support it.

[INTERVIEWER] That's an entire set of what we foresee comprise the operationalization activity. So we have three levels. The first level, we get these two things as inputs, business model radar blueprint and the customer service scenario. It's in written form, to make it more understandable for people. So, when you explain how this business model works, you just need to send this radar and a brief explanation of it to all parties to really get an idea whether this makes sense or not.

[EXPERT1] *That (customer service scenario) is good because when we talk about the outcome economy, you do it (service) for somebody and usually in the end it's a customer. It's somebody who doesn't understand radar. You could leave out the data (in customer service scenario) and it's almost like a marketing leaflet.*

[INTERVIEWER] That is the customer service scenario, in fact.

[EXPERT1] Is this something new?

[INTERVIEWER] Yeah. The name is new. We had this idea from the very beginning but the name and the purpose of that thing is relatively new.

[EXPERT1] Because the good thing is that the 'wow' we understand from a radar is not put in a format that everybody can understand. It's the 'wow' that you're after. Because if you have it then people will come in and start working for it. If I have to sell something and I don't feel 'wow', I'm not going to sell it.

[INTERVIEWER] Okay. There is another input that's necessary for this thing to work. That is called business service catalog. This is a collection of capabilities that you have already defined. This is the kind of input that we take as an assumption. But of course in some cases where you don't have this, you simply say that you first define this thing, in parallel or just before hand. In the pyramid, this is the lowest level, about what can you do. Of course, the collection from all parties, so what can each party does.

[EXPERT1] *I can imagine that you have to describe it (business service catalog) to an extent that not only I understand but also you understand what I mean. Because the partners have to understand.*

[INTERVIEWER] Yes. It is about what is the value that this thing brings rather than how it works. Nobody would need to understand this thing. How do you provide that service is your business but what your needs to provide this service is what matters for the others. Now you say, "I can do that but I need this and this to be able to do it and I will provide you this."

[EXPERT2] Isn't the fact that you're having a data warehouse also a capability you want to describe?

[INTERVIEWER] It depends on what type of services.

[EXPERT2] Those that is considered as asset but perhaps you can sell or use your capability of having a data warehouse also as a service to other companies that can make use of your data warehouse.

[INTERVIEWER] Yes, indeed. Service catalog only lists the things that you provide to outside. So, you might have internal kind of services that you provide to support the services that you provide to the external of parties. But this is another type of thing that's not visible to the outside. But it might be your decision to externalize these services. Like this example, normally data warehouse might be something that you use as an internal service or a background service to feed the service that you provide to external world.

[EXPERT1] But I can also imagine that this is something like communication between partners because for suppose I'm a partner and I say, "I can do this". A lot of the partner could say, "I don't know you. You can say you could do but you need to convince me." Then, I have to explain more. I think it's a communication thing as well.

[INTERVIEWER] Indeed. Definitely. So trust and communication are always a very important thing in the background. If you're not sure that this service will have sufficient quality or whether they are really capable of doing that thing, it will not work.

[INTERVIEWER] What matters for us is in fact the first level (of operationalization). Here, business model, customer service scenario, and business service catalog will eventually generate what we call conceptual process model that explains what each party has to do or is expected to do and what is the communication that should take place among these parties. The rest is rather easy, I must say. There are different parts that you can follow here as well. Once you have this information then the implementation is rather 'mechanistic'.

[INTERVIEWER] In this scenario for instance, you can use BPMS (business process management system) to execute the process or you can get this one and come up with a software from scratch. Different options exist. But again the focus is on this part, how to do that.

[INTERVIEWER] Actually what we think here is that we are not proposing these parts (Level 2 and 3 of the operationalization). This is how operationalization happens in real life. There are different types of operationalization. One could be operationalization at the software specification level which we call an executable process model. The other is operationalization at the implementation level, you have some software. There are different ways of operationalization but they add up nicely.

[INTERVIEWER] So, you conceptualize and then you prepared an executable format. So these are different types of operationalization and they are connected in this way. Now we're focusing on the very first type of operationalization. So, we don't say, "You have to do this and do this if you follow this method. We just say we do this for the purpose of this". And we foresee a path but it can be applied in a number of different ways. So our focus is on conceptual process model generation.

[EXPERT1] Just checking, is there also a data model in there? Because, over 30 years until 2015, everybody was talking about BPM or processes and spending a lot of money on processes and nobody was talking about the data. But if processes do one thing is they depict the process in data and the good news is data stable. If you look at a bank 30 years ago and a bank today, data model is almost the same but processes have changed drastically. So *I think the logical data model should be in there (conceptual process model) as well maybe as an input or an output.*

[INTERVIEWER] Data, I must say it's a second citizen not a first-class citizen in this idea. Data is there particularly when you're talking about the information exchange, the type of information that you exchange among different peoples. But if you're talking about like a data model, like these are the objects and these are the attributes of that thing, not at this stage. One step further then you need that. At this particular stage, it becomes much clearer and then you have to really spend some time on it. But at this stage we haven't foreseen something like a data model. It's embedded in the process model. It's not only control but data exchange is also very important.

[EXPERT1] Here you sort of set up in an initial state (logical-conceptual) then dispersed to the partners and everybody has to do their job and do the work. To give you one example a real-life example (in the harbor domain), my customer making ships/vessels. They implemented a new ERP system worldwide. But one thing they forgot was think about the conceptual model. When they rolled out of the ERP system which he picks again processes, they obviously made the mistake that they didn't put in the same ship type everywhere. So, when management wanted to know what we are earning, how many of these ships we are making, what we are doing, what margins are we, they couldn't say. New ERP system rollout

worldwide and they couldn't tell, they were not in control. So if you if you don't have a model and you don't roll it out to everybody so everybody understands what we need to validate our value-in-use then you could easily also get misunderstanding and even misconceptions.

[INTERVIEWER] I think it's a nice input.

[INTERVIEWER] I can add, there is always a domain model. So, you can always model the domain showing its entities, attributes, and relations but we have a particular conceptual process model. Actually it's the output type we want to really aim for. For that we have service compositions. So the ultimate goal here is to come up with service compositions.

[INTERVIEWER] It's not something this method aims but somehow as you already said the finance is using the very same domain model for years and years, this is part of the domain knowledge. But it could be useful for some other purposes and particularly if you go towards some logical data models and physical data models towards this direction. But our particular focus is composing services. So that's the goal of the method.

[INTERVIEWER] We can still argue that service composition in the background requires data model as well.

[EXPERT1] What we have to think about is, if we don't do it, will you hamper your implementation? Because party A can do something and then party B do something and then in the end they come together and turn out they are not aligned.

[INTERVIEWER] When it comes I'll explain how that information can also be captured. We don't specifically pay much too much attention at this stage. We focus on the control flow and the message exchanges. Data is there but in terms of the communication message exchanges but it doesn't tell exactly whether this data is about this business object or other types of attributes exist in these objects. It's possible if it is very important for that particular scenario. You can capture that as well in the conceptual process model in a certain extent. But, the second step, definitely you have to do it.

[EXPERT1] I agree. *I recognize it in our field. First, we make a logical model and then we make conceptual model and then we make a physical model. That one can be implemented in Oracle, etc*.

[INTERVIEWER] So, this is another representation of this thing. We have this model (conceptual process model) in the first stage of service dominant business model operationalization (SDBMOM). And we have these two inputs, service dominant business model radar/blueprint and customer service scenario. Also business services as inputs. And the thing that we would like to end up is to generate conceptual process model (CPM) or in other words business service composition (BSC).

[INTERVIEWER] Although generate sounds like automation, unfortunately, you can't automate this. You should not automate this. This is the most important part where people's decision is needed. So from then on, you can generate executable process model.

[EXPERT1] From here you can create software?

[INTERVIEWER] Exactly. This (CPM) is the input for the rest of the automation. But perhaps I shouldn't even use the term generate because it sounds like an automation.

[INTERVIEWER] That's the only part I would argue that the part like the development of the business model and detailing the business model is the part where human knowledge and experience is needed.

[EXPERT1] You talk about processes. So my question, what about organization?

[INTERVIEWER] In this model we just focused on the on the functional side.

[EXPERT1] So you leave out the rest for now?

[INTERVIEWER] Yeah, maybe part of the data in there because message exchanges. Because you can't talk about processes without mentioning about data. But, that's not in the form of a data model and the organization is also part of the process.

[EXPERT2] I'm not sure. Because, what we did in our current strategic plan is that we drew up also a pyramid. At the bottom line, for the capabilities, we also describe not only the data sets but also the organizations, the overall capability, the infrastructure, and the data in groups. Then in there we detail what's inside of it. From that point on, we could see for which business model that we need the capabilities. Not only data and knowledge but also some organizational structure.

[INTERVIEWER] What I was trying to say is that we had to be very generic and abstract. However, I agree that you can do it. You can accompany that kind of thinking and modeling together with this process. When you are using this method you should in fact also do that.

[EXPERT1] What about the partners? Does explaining it later also considered part of organization?

[INTERVIEWER] In that sense, we do touch the organization.

[INTERVIEWER] However, this is in network level and not in single organization level.

[INTERVIEWER] Okay, next. So these are the two inputs. We'll just go through this TraXP executive scenario to make it a bit more concrete. We also have business service catalogs from each party. This is an abstract way of showing business services and its relation with capabilities. You expose the capabilities as a set of business service operations. Business service is a collection of coherent set of operations. These are the things that I (actor) can do. So, this is a service and these are operations of the service. Of course, you can have different type of combination of services.

[INTERVIEWER] Another term that explains what the output of that thing (SDBMOM) is conceptual process model or again business service composition. Here (in CPM), the upper part lists the things that you would expect customer to do to interact with your service. It is the representation of a customer journey. Here, customer is a special actor. So we say a

customer is a customer and all other network parties we call them actors. And actors simply, by using their service operations realize the service solution. For instance, in the TraXP example, customer have to interact with the services of the other actors. They use the service of the other actors.

[INTERVIEWER] So, there are two keys. Having understand that the radar captures and organize some essential concepts elements of a business model, there are information captured in a business model radar. Looking at this, we want to capture, for this operationalization method, the interactions first between all actors. Then following these interactions, we want to come up with an activity model, which we call it a process model. But activity is kind of a specific. You don't define them arbitrary. You pick items from your business service catalog. So what you have is a kind of formulation.

[INTERVIEWER] So, you have a business model, a service scenario and things you can do for others, which are included in your business service. So, you want to formulate them in a consistent and structured way so that it satisfies all conditions, all things required in the business model and customer service scenario. That's the goal. So, you will have business services and you have inputs. There are two focus, you start with interaction modeling and then you want to move on with the activity model. In interaction modeling, we use choreographer diagram formalism. It's part of the BPMN specification. In there, each block represents a group of interactions. So, we have a couple of blocks, which look like activities but they're not. They are blocks which are coherent set of messaging/interactions within any actors. Collaboration diagrams will connect to the business model.

[INTERVIEWER] In the collaboration, on the other hand, we introduce individual processes for each actor (in pools), we introduce activities which are operations that are deployed from business service catalog. Then there will be interactions between those processes which are indicated by these dashed arrows. Actually these dashed arrows come from the very first choreography diagram. They are bundled up. They're related.

[INTERVIEWER] This (stakeholder taxonomy) showed the roles but this is the role for the entire BASE/X. About how the entire BASE/X roles are defined and what they are expected to do. At the very beginning, we have these business owners who are responsible to define their business strategy. We have business model designer to define business models. Then, the business process designer would use this method to generate conceptual process models by taking these two inputs (SDBM/R & CSS) and the process engineer to come up with an executable process model.

[EXPERT1] *Absolutely makes sense. What I think is striking and interesting for me is the business architect roles.*

[INTERVIEWER] We think that there should be a need for one role that oversees the entire design process.

[EXPERT2] This is basically what you said at the beginning about programmers will vanish and we need architects, engineers, etc.

[INTERVIEWER] Coming to your question about the outputs and the process, we have the business model designer and business process designer that design. So there was kind of unstructured process going on where too many decisions to make that requires creativity. In the right-hand side we have the engineers with known solutions and known problems. That's why we are still in the design mode.

[EXPERT1] Now, *I'm wondering how you merge these choreography and collaboration*.

[INTERVIEWER] So, in the entire operationalization journey (three levels). We are in operationalization level one. In that level, we have three sub steps. The story behind it is quite simple. Firstly, you define customer service interaction in a bit more formal way. It is in the customer service scenario, but it's an informal and promotional way. You have to make it a bit more formal and a bit easier to communicate with others.

[INTERVIEWER] The second model defined actor-actor interaction. In the first one, you just focus on how the customer interacts with your service. The second one you go deeper and define the interaction among other actors. So you just go one step further. Here (in choreography), you're just talking about the interaction and what message exchanges that should take place. Here (in collaboration), you go one step further and say what each party has to do to really realize this interaction.

[EXPERT1] This resembles a lot what we know in terms of modeling, where you have these blocks and then you click it to go to a more detailed level.

[INTERVIEWER] Yeah, but it's not the same with using sub-processes. So you entered into another type of domain here. Another type of information appears there.

[EXPERT1] *Could you do this (process modelling) already with modeling software that's on the market*?

[INTERVIEWER] Yeah. We already use existing tools. The tools don't matter. What matters is the design process. So, it’s how do you connect the operations and interactions to business model. So actually it's a conceptual traceability, connecting the business model to business service operations. That's what we want to aim. The formulation is the composition itself.

[EXPERT1] I see the value of this (method).

[INTERVIEWER] To be very honest, this is not rocket science. This is not something that people have not been doing, this is something that people have been doing for ages but there is no structured way that says how we do it.

[INTERVIEWER] I mean, if I give a person a customer service scenario they would do it they would come up with something like this (CPM). But if I give it to the second person they would follow a different path and then they would come up with something different. That's what we don't want. We want something that different designer should still be able to follow and there should be a reasoning behind why each step has been taken.

[INTERVIEWER] So, like you need to verify why you have this and you can able to trace back to connect to business model. So it shouldn't happen arbitrarily.

[INTERVIEWER] So, the first step here defining customer service interaction. What you do is itemized the customer service scenario in a structured manner. So, going through the example, in the itemization process of the customer service scenario of the TraXP, you define what actions each customer has to do for each item and what the interaction, the message exchanged is, even further the customer actions.

[INTERVIEWER] Is data properly organized here? I wouldn't say so. We're not talking about business objects here. Like, the travel is a business object. What you have so many other type of objects that are related like booking, airline ticket is another business object so it's quite complicated in the background.

[EXPERT1] At this stage it's easy to translate into data.

[INTERVIEWER] Actually from a research viewpoint that problem has already been solved. There are many tools that you can use to model. What matters is the service composition, that's where the problem lies for us.

[INTERVIEWER] Still within this first step, it is how to set the connection between the business model radar and the co-production activities with the customer service interaction. The end result is a choreography diagram.

[INTERVIEWER] Each block in here is a co-production activity that is in the radar.

[INTERVIEWER] So that's how we connected it. Because the activities there in the radar. So, which part of these things I'm handling is the core idea. This is how we model this. So each co-production activity is modeled as a kind of bundled interaction. They're also called activities in the choreography context but it’s the activities in the highest level. It just talks about what you have to do with your partners and what you need to send and received from your partners. So it's all about interaction not the specific ways you do with them. So this is interactional modeling. Each co-production activity represents a block here. This interaction involves a couple of messaging. The condition is that there always have to be a customer.

[EXPERT1] But why, in this case, TraXP is not in every block?

[INTERVIEWER] Because the most important one to be there is the customer/executive traveler. From the point of view of the customer, he or she is communicating with the network. Therefore, in here (Choreography Step 1), customer has to be in every block. TraXP is only one of the actor and part of the network.

[INTERVIEWER] So this is the end of Step 1 and at the end of each step we also have a consistency controls particularly to see whether in all interactions there is the customer, whether these interactions are also present in the business model radar (co-production activity).

[EXPERT1] *The good news is I see data all over the place obviously with all these 'envelopes'.*

[INTERVIEWER] Second step. You further dig down into the details of what happens between actors now. This is how it happens in the background. Without the knowledge of the customer. Of course at the end of this, we have checked for consistency with the business model radar. This consistency check is good not only for this one but also because usually we also go back to the business model and found out that we forgot about something. Else, perhaps there is a new actor that's needed that we didn't foresee at that point. So you refine it.

[INTERVIEWER] So in fact this operationalization is more or less a kind of verification or validation of what you have already designed at this stage because it gives you an indication or at least some kind of a clue whether your idea is operationally feasible.

[INTERVIEWER] The last one. Now that's a rather large transformation. What you do is you go down into the actual things that should be done by each party.

[INTERVIEWER] Or as an analogy, you know the choreography so you know the protocol, what the interaction needs to take place all the time. Now you open your tool box which is your business service catalog and tried to pull items from this box to your blocks so that you formulate the solution. We start with adding a blank process pool. This is each actor process.

[INTERVIEWER] We already know the interactions from the choreography. We know who interacts with whom through which message exchanges. So we prepared the template, which is representation of our choreography as a process. So, we are now in the activity mode. We leave the interaction mode. We get what we want from the interaction mode using the choreography.

[INTERVIEWER] We are entering into the activity mode. We start with step one. For each interaction, which is a block in the choreography, that actually what's going on between the processes of two parties would be transformed into this kind of a form (collaboration).

[EXPERT1] *There is a challenge, this is more of a scientific work and in the end, this needs to be done by ordinary people.*

[INTERVIEWER] Yeah, but here we should also mention that we have roles for each part. So, we assume that the entire process of operationalization is oversight by the business process designer. So we assume that this guy has to know process modelling. The notation that we are using is coming from a standard called BPMN. If you call yourself a business process modeler, you should know this. Both diagram, they have to know. Process engineer which has even more perspective on the IT part of the business processes as well.

[INTERVIEWER] I agree that it is not an easy task. But the reason why we define these roles because it's not just the definition of roles but what we expect these roles to know in fact is also is defined here.

[INTERVIEWER] We know what interactions takes place within parties within a context of a co-production activity. So the way we see co-production are just well-defined set of interactions between one or two parties. Now, assuming that there are individual processes for each actor, this is the knowledge about two parties' processes, what should I do with the other

process and when. This information is contained here (in choreography blocks). Now putting this information and looking at our business service operations, I know how to satisfy what has been required here (in choreography blocks) by deploying my business service operations. And I know how and when to send these messages. So, this is a requirement to be fulfilled by composing my services and coordinating them. So that is simply the interaction mode. Next, we're in activity mode but activities are come from our business service catalog.

[INTERVIEWER] That's the key message, start with interactions then you agree on the protocol, handshake on the choreography. Now I as an actor will do this and I know I can do this at the very beginning because when I'm participating in these business models, I already rely on my business service capabilities and operations.

[INTERVIEWER] Small note related to the data. Although we haven't defined anything about how the data is captured apart from few things. The tools and the notation that we use allow us, in the background, to also capture the data model.

[INTERVIEWER] The first thing that has to be done is to come up with a happy path. Because that is what your customer scenario tells. Your customer scenario does not tell if your travel is canceled. Uninterrupted experience. Then later on you enhanced and complete your process model exceptions. The exceptional things that you can foresee might happen. There are also exceptions that you can't foresee. That's something else. But you complete the model in that way. In fact that is the end product of this model. You know the parties, the customer and how the other parties interact among themselves and what type of data exchange that takes place between them.

[INTERVIEWER] The data part in the background of that thing (activity block). For example, travel order, it is a business object and these are the attributes of that business object. This thing is connected to the travel order in the background.

[EXPERT1] What combine these things? You have a tool that can do that? Because we've been looking for those tools and so far, we've only seen good process modelling tools but not being able to capture the models and vice versa.

[INTERVIEWER] We have tools.

[INTERVIEWER] So, these are business process management suites. A tools and the models already contain a module where you model your data. You create forms using this data model.

[EXPERT1] *Can you also then generate that model into your technical system from conceptual model?*

[INTERVIEWER] Yes, you can deploy it.

[INTERVIEWER] So, in fact we wanted to show that it is possible to come up with software systems to support this business model. So that's the reason why we try to go further and come up with an executable process model which is an enhanced version of the conceptual process model with execution details that might be a bit different than the conceptual process. And

then, if you put this executable process model in a BPM system and go one step further you can generate user interfaces to start using it. You can even see where you are in that particular process.

[INTERVIEWER] There are multiple ways to show this thing. This is Camunda.

[EXPERT1] What I take from this discussion is, it's funny, because *we know this (process-aware software development) for ages. But you guys add these actually to the beginning where you have multiple actors and that makes it more complex. Companies are not use to it. You start modelling over the value chain, that's new. Absolutely.*

[INTERVIEWER] Whatever you do here contributes to the business model, in execution.

[EXPERT1] *And it's all linked. That's the goal. So you can go back to the radar.*

[INTERVIEWER] In all these models, you can trace it back to the value. Why this thing is here is very clear. What's the implication of removing it is also known.

[EXPERT2] Now you can see the harm done and the benefit to the radar when you decide to do so.

[INTERVIEWER] You can see why it has to be done and its implication in the business model radar. In fact, it's quite easy to just grab this, drag and drop it to another pool.

[INTERVIEWER] When you change something in the business model or change something in your customer service scenario, you can manage this change and you know why you want the change to happen. So you have a very strong because.

[EXPERT2] *Mentioning about the catalog, is quite interesting if you have one application but perhaps you have later on several (business) models, you can see how many times is this capability being used. In fact, I can decide, if I'm only using this capability once and it's quite expensive, to just buy it from another partner.*

[INTERVIEWER] We also now investigate, given this process model is this business model meaningful, valid, and financially feasible. How do you do this? From example, from the price that I pay for a particular operations, simulations are quite easy. In fact, if I had the data after a period of time that will tell me exactly how much each business model instance cost.

[INTERVIEWER] I can say, "This cost ten right now to me. If another party brings it to nine. Let's drop this actor and change the customer service scenario. OK. We will not be the best complete seamless solution ever because we already know that is not going to work. Let's drop it. Degrade to a certain extent but now it’s feasible. It's reasonable." You are at validation time. So it's not all green checks.

B.1.4 Feedback

[INTERVIEWER] We have already been discussing this thing and the final question that we'd like to ask is does this make sense?

[EXPERT1] *I think you noticed already, I like it. My only concern is the complexity. Try to reduce it because I want to tell this story as well. You need the flow of course. You need the explanation from beginning to end.*

[EXPERT1] *It's a logical story. So there is nothing wrong with that (SDBMOM).*

[EXPERT1] *There is so much value here.* I really believe it. When I talk about this book about the radar that has been produced in the past, what is needed in my opinion, is somebody non-scientific but a marketing person (art director) looking at this and put it into proper colors and maybe simplified it. This is of good value to the world, this is what the world needs, setting up a cooperation. Then it's a story that needs to be easily told. That's why the Business Model Canvas is so successful. If you look at the book, it's all marketing. But it's not enough. *I keep telling people this is not enough. It's good to have a Business Model Canvas.* You should do it. We have them as well. If you come in my office, you see two of them hanging around, the BI for the big companies and the BI for small companies, that's what we do. *But it's only a starting point. This (SDBMOM) is where it has, this is what we should do.* But this is still complex.

[INTERVIEWER] But it takes a business model to bring this thing into it. So until it kicks in, we cannot as researchers do that alone.

[EXPERT1] You have everything in place, what you need to do is find the marketer. I even have this idea, if you do this properly, your future funding will be solved. There will be a book and appropriate materials and it'll sell. We are already selling it but we have nothing to sell yet.

[EXPERT2] I fully agree. *This is genius in itself in the way you made the connection from strategy, to business, to value, etc. All the way to the end game and you can track it back even,* it's marvelous. Job well done. My other contribution is "*think of stakeholders and think about how you can address political things because that's where the end game most comes".* That is a real-life struggle which cannot be challenged by modelling. That's something happening in real life. How do you convince or how do you take companies or organization that are going to be harmed by your business model but you still need them? That's something which is happening in logistics at this moment. The middle person's, like the forward and the agents, they are going to be replaced in the end by transparency, system, etc. But we need them now for the data so we can make them perhaps obsolete or lessen their value. That's where you burden is. And how can you make it visible. Perhaps you cannot solve a model but you can make it visible.

[INTERVIEWER] Indeed. So what we are doing in fact is trying to help companies to mature. We have been working quite long on the concept of maturity. How to you help companies become more mature so that they are engaged into these things in a much better way.

[INTERVIEWER] You as a company need a maturity to be able to properly do business. I mean, for low maturity companies, it's very difficult to do that. You can't expect low maturity

companies to work based on real facts. They usually work based on gut feelings. So, we are working on that but that's also huge work.

[INTERVIEWER] So, it's something that complements or runs in parallel with the BASE/X. BASE/X is in Engineering Framework. So, BASE/X doesn't deal with those type of issues.

[EXPERT1] But please put it in a good book. I'm serious. Maybe turn it into a company and make me a shareholder. Minority share, I'm willing to invest.

[INTERVIEWER] Thank you so much.

B.2 Interview 2 – Business Model & Strategy

B.2.1 General Information

Date	11 March 2019
Length of the interview	01:45:00
Name of interviewee	[EXPERT3]
Experience	>10y
Name of interviewer	[INTERVIEWER]
Subject	Evaluation of SDBMOM
Goal	To get feedback on SDBMOM validity and utility

B.2.2 Introduction

[INTERVIEWER] The objective of this interview to shows you the SDBMOM and ask your opinion about this method.

[EXPERT3] Senior Researcher. Company operates in Research & Technology Innovation area.

B.2.3 Demonstration & discussion

<<Demonstration and discussion session by the interviewer, 39 minute>>

[EXPERT3] *It's challenging for me to understand about choreography* in Step 1 & 2. I can imagine there is some output. But I don't quite get it.

[INTERVIEWER] The model that we use are based on BPMN 2.0 notation. It represents interaction.

[EXPERT3] In the overall process, you indicate there are checks. I wonder what the indicator for make is sure that the output is okay.

[INTERVIEWER] We use different control list for the output in each steps.

[EXPERT3] I was kind of thinking, do the output of Step 2 also determines whether actors are part of the core or of the supporting parties? So, there are actors that only engage in actor-actor relationships and just a few that engage in costumer-actor relationships.

[INTERVIEWER] The core is the customer-actor interaction and the additional is the actor-actor interaction.

[EXPERT3] When you do the mapping of the scenario to services, you mentioned that John Smith is entering something to his mobile phone. But mobile phone provider or telecommunication provider was not an actor. The mobile phone is mentioned, but there's no actor related to this.

[INTERVIEWER] Yeah. Because we thought mobile phone is just a media. What is important is the application in the mobile phone. The application is not own on by the telecommunication provider. It's owned by the TraXP.

[EXPERT3] OK. This may cause a bit of confusion. You may use apps, website, etc.

[EXPERT3] In the beginning you mentioned that you assumed that the business model is viable. What does that mean and why do you need this assumption?

[INTERVIEWER] It's because if we want to use this SDBMOM, then we will need all of the input which is there including the business service operation list. Therefore each actor should already have this business service operation list. This means that each actor is ready. They already have the necessary thing (to collaborate). And only if the actor ready, then we can create a good business model. So a business model viable means that when we create the business model then every necessary requirement is already present.

[EXPERT3] What I think is if I make a service proposition like you do and I want to know if the business model is viable, I do exactly this work to determine why this model viable. There's no way I can verify the inputs from my business service operations that this is viable.

[INTERVIEWER] Yeah, you're right. There's no need for this assumption to start implementing the method. The operationalization can have a purpose for evaluation.

[EXPERT3] I wonder whether a scenario description is something formal. Because for me it looks quite informal. What you need is a certain set of information to come up with step 1 and step 2.

[INTERVIEWER] Yeah. That is the process of extracting information from the CSS statement. This process of extracting information requires also the domain expert knowledge because sometime the CSS perhaps not always that informative (e.g., interaction, message exchange, etc.) but it will always represent what the customer want to experience. So, this is the part where the domain expert need to know what kind of information that he can extract.

[EXPERT3] Can this method work without the need for the business model radar?

[INTERVIEWER] If you assume that customer service scenario is very well structured and it does not miss anything, then yeah, perhaps. But, I think that would be a bit too unrealistic. So, I mean we can't assure that all of the structured information depicted in the business model radar is in the customer scenario. Because CSS by definition focus mainly on customer-actor interaction rather than actor-actor interaction. Therefore, the combination (SDBM and CSS) complement each other. Most of the time we need them both.

B.2.3 Feedback

[EXPERT3] *The scope of your work is more impressive because it appears to me that what you did is have the service description and the business model radar and also all the information that's in there and then create this conceptual business process model without*

inventing too much information other than the available business services. That sounds rather straightforward what you did. I think it is very good.

[INTERVIEWER] Are you convinced that the output of each steps will be valid?

[EXPERT3] Yeah, *I'm convinced (about the output validity from each steps) by you explaining about checklists between each steps where you have some rules for that.* And because you didn't need to assumes lot of information in order to arrive from the CSS and SDBM/R to this business process model.

[EXPERT3] Do you think the conceptual process model is consistent with the business model and also the customer's service scenario?

[EXPERT3] From the way you explain it *I'm quite convinced that it (conceptual process model) is consistent (with business model)*. The only question is whether this process model is the only the process model that will that consistent with the information provided.

[INTERVIEWER] There must be alternative. This is just the solution. Perhaps, the question is whether following this method would lead to the same conceptual process model by two people. That's the question of consistency. If you give this method to two people and the same inputs whether they will come up with the same operational process model.

[INTERVIEWER] So, for example think that you have a set of requirement and specification for software system and then there could be different implementations of or designs for this solution which produces exactly the same functionality and so on. Which fulfills the same requirement. So, you only see the UI in a consistent way or the interaction that happens on the UI but the backend and other things that are in this black box can be different. It may change from one software designer to another software designer. Or it could be the case, where you don't have that liberty like you have a set of design components like the Business Services and the operations and then you ask two software designers to use this design components to come up with very same model of the solution. These are slightly different. One involves the domain knowledge or different design thinking, some developer may give other priorities to other things and come up with a different process model. But, if you fixed the business services operations and everything, then it just will become question about repeatability (instead consistency).

[EXPERT3] Then what are the domain expert's main design decisions and what are the arbitrary design decisions?

[INTERVIEWER] As long as it works, design decision doesn't really matter.

[EXPERT3] Then, *I think it's important to track and highlight the points where you assume that domain expert decision influence the flow of the business process also whether your own choices as a business process designer influenced the flow of the business process. This will highlight also the degrees of freedom in optimize the business process.*

[INTERVIEWER] Okay. Thank you.

B.3 Interview 3 – Intelligent Transport System

B.3.1 General Information

Date	13 March 2019
Length of the interview	01:55:55
Name of interviewee	[EXPERT4]
Experience	>10y
Name of interviewer	[[INTERVIEWER]
Subject	Evaluation of SDBMOM
Goal	To get feedback on SDBMOM validity and utility

B.3.2 Introduction

[EXPERT4] My name is [EXPERT4]. I work for Company A. Especially responsible for their research projects. Also funding possibilities for their research. We covered the domain of intelligent transport system. That's mobility in general including parking but also energy sector.

[INTERVIEWER] Now, the reason why we're here is that we have been working on this service dominant business model. And a specific part of this is how to operationalize business model into process model (SDBMOM) and we want your opinion about it.

B.3.3 Demonstration and discussion

<<Demonstration and discussion session by the interviewer, 54 minute>>

[EXPERT4] What is the reason for you to add this control procedure?

[INTERVIEWER] Because you always need to be consistent with the business model.

[EXPERT4] Why not check that at the beginning? When the business model is defined. Can you already say it from the business model?

[INTERVIEWER] This is a checklist for the output (choreography diagram).

[EXPERT4] So you assume there is already a business model and then you check it?

[INTERVIEWER] I like the assumption that there almost a complete business model and a complete customer scenario.

[EXPERT4] *First time I saw this, I thought it is just for modeling. You can do modelling. You can send message and explain how it will be sent. But it also is a complex system and you can make it structured and make it very clear.*

[EXPERT4] Another thing, if you say implementation, is it for travel agency to use it or you want to build a platform for the whole?

[INTERVIEWER] For the entire network. So this software that runs, it shows how every single party uses the same platform because it supports the entire process.

[EXPERT4] I have been working for EU funded project, it's about platform. The proposal was mainly written by me except part of the work plan. So the concept for this platform, this is IT platform for application in logistics sector. So you have this collaborative model and you assume people would work together. What type of message people really want to exchange. Of course there some security issues. But basically, I open the platform that everyone can enter. But only if I trust you, we communicate. For platform, for me it is always when you funded a product, they always built a platforms. How you are sure that this collaborative community will use this platform?

[INTERVIEWER] First of all, this is not like an open platform for people to start collaborate. This is just a software for a mobile application that you can install in your mobile phone. Of course this should be integrated to other party's systems. We just want to show that if you have this conceptual process model, you can use any platform to execute this.

[EXPERT4] What is the significant contribution of this work?

[INTERVIEWER] So, when I learn about the business model. From what I read, they always said, "Okay then after we design this business model, you can implement them." But there is none that completely explain that if you have a business model then what is the operationalization will look like? When you have the business model can you automatically operationalize them? Some said that you can just use process model to implement this kind of thing but there is no structured one where you have business model, you have steps and then at the end the process model is consistent with the business model itself. So I tried to work on that thing.

[INTERVIEWER] With this, when you have a (SD) business model there is already a method to easily operationalize it if you follow it and even before you implement the business model you can already have this operationalization where you can see and evaluate whether this will work or not.

[EXPERT4] For me, it's perfect of you from industrial engineering or computer science for doing this kind of work. *What important is you have to convince the people that this has really practical uses, for implementation and for others.*

B.3.4 Feedback

[INTERVIEWER] What do you think about this method? Is this clear for you?

[EXPERT4] Yeah. *For me it (the method) is very clear.* But, I'm not sure people without background of industrial engineering or computer science can understand, but it is basically just process with message exchange and people can understand it. But for people that not in that domain, they may think why you do that? There might be question about why do you need coding to operationalize this SDBM/R, such as those.

[INTERVIEWER] Do you find it easy to use? Is it useful?

[EXPERT4] *For me it is very easy to use. Very transparent. I didn't find any major weakness in your design. Some minor point, it is better for presentation to use other case study. This one is a weak example.*

B.4 Interview 4 – Business Architecture

B.4.1 General Information

Date	21 March 2019
Length of the interview	01:13:12
Name of interviewee	[EXPERT5]
Experience	4.5 yr.
Name of interviewer	[INTERVIEWER]
Subject	Evaluation of SDBMOM
Goal	To get feedback on SDBMOM validity and utility

B.4.2 Introduction

[INTERVIEWER] For introduction, can you tell about yourself?

[EXPERT5] All right. So, I've been working for this company for almost 4.5 years now in the same position. I'm here at the Operations Strategy and Excellence group. So, four years ago we started in this position with a very small team. With the assignment to determine what are the most important improvements that we have to start doing for this company operations. So, this company is divided in a couple of sectors. Operations has six factories. So, for that part of the company we are responsible for supporting the CEO for what do we need to do in the coming years in order to be able to provide our products to the customers. So, our products are developing pretty rapidly but the market is also developing. Before we were here we just started projects. We didn't really think about are these the best projects to run because we're executing projects. This was a competence center for executing project management things. And we are kind of responsible for looking forward.

[INTERVIEWER] So, that used to be a competence center or center of excellence?

[EXPERT5] We still are. Large part of our group is working on the execution of projects and we are a small group with the assignment of advising the decision makers on what are the best things to improve. Currently, may be interesting to know is that almost all improvement that we run, we cannot only do an operations. We also need support from the development engineering group and often we need support from corporate groups and IT. So, basically now what we're doing is to see if we can put it on a higher level.

[EXPERT5] We are very strong in product roadmap. We know exactly what we need to do for the coming 10 years in improving our products. We even sell products that we cannot even make yet. So, we sell based on engineering and progress but we're not good at developing our company. We are very good at developing our company but we don't have a very mature process on determining what we need to do in order to meet the challenges of the future. We can definitely improve them.

[EXPERT5] What we do, maybe one thing is that every year we publish this booklet. So, it's not only for this year. It seems like a sweet issue but it's just the addition 2019. So, we look

forward like three to five years. We have a couple of things, such as: a strategy of this company, house of capabilities, roadmap.

B.4.3 Demonstration and discussion

<<Demonstration and discussion session by the interviewer, 58 minute>>

[INTERVIEWER] So, basically in these steps you start with interaction, you bring them together, you identify the actor, decompose them and then match them with the business service operations.

[EXPERT5] *What could be very interesting for us (regarding this method), because it is similar with what we call value stream analysis where we have this particular customer scenario/demand and you basically spec everything required to fulfill that demand.* And then you do bottleneck analysis in this value stream and you know where you need to improve most.

B.4.4 Feedback

[INTERVIEWER] The key question that we have in mind, there are two types. One question, about the utility, such as is it easy to use? And we have a kind of questionnaire for you today to do that. But before hand, we would love to hear whether it really makes sense, it's logical, something is missing, whether we can improve that thing in some way.

[EXPERT5] For sure you can. *I think it makes a lot of sense* and *it also resonates with a couple of things that we do* so. *It will resonate with a couple of other people other than just me in the organization*. That might be interesting for you. Because, we are emphasizing this customer value more and more. What we have been doing in the past is basically modeling what we currently do and how we do things, the process framework, and then we force everybody to model their line management processes. So we have a huge database in ARIS with all the linemen in the processes. Then we have to do that in the current way of working as a baseline description. But honestly, more important is finding new processes. So, we have a couple of large improvement projects going on right now in the organization and that's where we define future processes. They are not being created based on future vision because the people that create them are more on the right side of the operationalization (technical). It's often, what we call them subject-experts, they are guys who are working in that process for a long time who know what's going on and then they work together with IT and they know what the future building blocks of IT are. We will sit together and say, "Is it possible maybe to give a demo? Is this possible?" and then they said, "OK let's model it." And then what you get is that you basically get the current process because you are focusing on this on this very local

optimization, based on maybe new IT tools. But it's not challenging because it can't answer questions such as: Is this really the best or is this really the process that we need to run?

[EXPERT5] So this subject-expert inform IT about what they need to build and then IT comes back and says, "Oh we have a new module for that which is better" and then they show it and they replied, "Oh that nice. I want this other feature and this other feature and then the color of this button needs to be different." Then, you have a solution. Project team is happy. They produce deliverables. You can build it. Not so much customization because IT team is involved. But, it is not going to be used at all in the world. We have 60 sites, they have their own way of work. They are not using the software that IT developed. They have their own processes and their own tools and everything. It has to do with the growth of the organization and things like that. So, *we can very much improve there (solution that is not used) and then this model that you've developed could definitely help.*

[EXPERT5] *Might be nice to just pilot it once for one of these value stream.*

[EXPERT5] We have a couple of thing that we want to work on. The most important one is strategy development. Right now, we don't have connection between the strategy that we define and the improvement that we do. So, if you ask the projects, "How do you contribute to this strategy" and they'll say, "I don't know." It is very immature. The link of strategy development to improvement project is my biggest focus for now.

[EXPERT5] *You can also learn to prioritize and identify your missing capabilities* by doing these value stream analysis. This (method) seems like value stream analysis for me. *What I like about it is that you don't start with modelling the process but you start with asking what the value for the customer. And then you eventually go to process model. And IT solutions should fit the process.*

[INTERVIEWER] Thanks a lot.

B.5 Interview 5 – Agribusiness Entrepreneurship

B.5.1 General Information

Date	25 March 2019
Length of the interview	01:03:41
Name of interviewee	[EXPERT6]
Experience	>10y
Name of interviewer	[INTERVIEWER]
Subject	Evaluation of SDBMOM
Goal	To get feedback on SDBMOM validity and utility

B.5.2 Introduction

[EXPERT6] I'm [EXPERT6]. I am working for different companies because I'm an entrepreneur. I'm working for myself. Company A is one of my clients and I do a lot of work for them and Company A is a stichting (foundation). It is owned by 20 companies. It consists of two municipality, the Agricultural Association, the rest of them are the more innovative entrepreneurs in the agro food sector in this area. What we do is we want to inspire them. We want to make connections for them. We make groups so they can work together much more. I have a lot of sessions with these individual members about their strategy and where they are going and what they want.

[INTERVIEWER] So they consult you?

[EXPERT6] Yeah. Me and my partner. We used to do this together and we make a lot of connections. We used to also work with a limited companies (B.V.). We used to manage projects for them but we only do the beginning. If they really want me to be involved with the projects when the project is really going on than they have to hire me through my own company. It was for Company A members that for the first time a masterclass about BASE/X and outcome economy is given. And from there, I think that there are a lot more sessions that follows. One of my other clients is the society for farmers, here in the Limburg. For this group, there are two masterclasses (about BASE/X) and a session in small groups of five youngsters to think about their own individual business models. I'm starting a new company with three other entrepreneurs. That's about measuring data in the soil with sensors and then we send this information to the cloud and turn it into valuable information for tree owners. It's mostly about trees. We want to green cities and we want to help people that plant trees. So I do quite a lot of different things.

B.5.2 Demonstration & Discussion

<<Demonstration and discussion session by the interviewer, 49 minute>>

[INTERVIEWER] The idea that we want to show you is how to make the blueprint (radar), which is for service-dominant business, closer to implementation in a structured way. We focused on a particular aspect of operationalization, which are the functional, what each actor needs to do, what message the need to be exchanged. This is because service-dominant logic brings several implications (i.e., focus on value-in-use, organize into business networks, increased need in agility).

[EXPERT6] *We also found many companies try to do like us, that's why we need to move faster.*

[INTERVIEWER] Yes. That's one of the implications of service dominant logic.

[INTERVIEWER] In the radar, when we sliced it, there is one actor that a bit different with another actor that we call customer. This customer interacts with other actors. There are also other actors that is not interact with customer.

[EXPERT6] I realize that what we are doing, me myself with my three partners, I am doing a lot of advice and working with companies that are innovative and my role mainly have relation with the little bit of knowledge that I have about trees because I'm also a tree surgeon and I have knowledge about agriculture, but I'm not a specialist. Then we have in our team an ICT guy who has his own company with specialist on that part. Then, we have a real tree expert who is also expert about soil and then we have bio-geologist that really understands the soil and the stones and the minerals and what's happening there. So that's core and what I realize is what we are now doing is we going to make a new company. But maybe we need some more actors.

[EXPERT6] *It is good that I already have some sessions (about BASE/X). Now, I have good understanding of what you tell me.*

B.5.3 Feedback

[INTERVIEWER] The reason why we are here, of course, first, to present and then get your idea and opinion about the entire process/method. About how it looks like, whether it makes sense, etc.

[EXPERT6] *We really realized the value of this process* and what I really like is that I never really into the (Business Model) Canvas because, I don't know, I just I never did.

[EXPERT6] I have a friend, he asked me, "Well [EXPERT6], I met this guy and he told me about BASE/X and I really would like to know more about it and I think it is also a good idea for the whole of our group (Company A)." So, our entrepreneurs are really innovative companies and they really got this, they really thinking about it. So I think there might be a lot more coming out with this.

[INTERVIEWER] So we have been using this thing (BASE/X) largely for the last four or five years now, largely in the mobility domain. But, we also use this in healthcare, finance, and energy.

[EXPERT6] *What I really like about it is that you are thinking in a radar and that you think about cooperating in a network structure.* That's what I really like about it. *I never can find my way with the (Business Model) Canvas*. I didn't go as far yet as implementing. It was just only thinking about business models, so get the radars here, and get the engine on. *But it sounds really logical because especially when you are cooperating in a network structure, you will have a lot of interactions with each other and it's not just within the same company.* Even within the same companies, big companies have departments that hardly speak to each other sometimes. So even for within one company this might be very useful to do it like this. Because, what you do is *you really reason it through* because if you make the reviews and you go back to see whether all the actions are in there and then because when you only think about a business model you easily forget one or two important tasks. And when you work it out like then you go back it will be more solid and complete.

[INTERVIEWER] It's definitely an iterative process, so it has to be updated. So that you are able to go back and then change the things and then run through again.

[INTERVIEWER] So there are two modes of deploying or executing this method actually One mode is just to validate the operational aspects of the business models. That's why it is inherently talented. So you don't have to say OK this model is complete. We are also now less operations. You can use it that way also, "Yes we think it should work but let's see some action if it's going to work or not."

[EXPERT6] But you also said that you have to move fast if you want to do this kind of business. So it will keep changing.

[INTERVIEWER] Yeah it will. That is also very important. And it will be quite easy to implement this using the support of software later on.

[EXPERT6] I think it's very interesting.

B.6 Interview 6 – Production and IoT

B.6.1 General Information

Date	25 March 2019
Length of the interview	01:25:03
Name of interviewee	[EXPERT7]
Experience	>10y
Name of interviewer	[INTERVIEWER]
Subject	Evaluation of SDBMOM
Goal	To get feedback on SDBMOM validity and utility

B.6.2 Introduction

[INTERVIEWER] This work is related to BASE/X. I believe you've been attending workshops about it?

[EXPERT7] I attended BASE/X workshop sometimes ago. Then, I'm interested to discuss how to go further because I like the (business) model used in it. I like to also use them for what we are doing in the market because I believe this is much easier than using any other kind of system, I think. *For me, it (SDBM/R) makes more much more sense than using a Business Model Canvas.* I'm always trying hard to understand this business model canvas but, in my opinion, there is much more to look at SDBM/R and it could be much easier.

[INTERVIEWER] Maybe some background about yourself?

[EXPERT7] My study is accounting. That's what I did in the past. So, learning from models and processes is what we had to do. After that, I had my own company for 21 years, a production company in pet foods. I sold the company two years ago to start with this company. Going back to something new again, believing in the Internet of Things. This is interesting new methodology, how IT could be helpful for agro food to get another future. To know much more not only about the product (plant) itself but also about the markets. There is still a lot of issues in the markets that we could try to make it better, i.e., freshness, the way to deliver logistics, the way they act in their own companies. It could be much more efficient. Now, many decision still based on gut feeling. What we are creating is that all the decisions they are making will be put in the system which could do self-learning. And after that of course making the decisions through the system.

B.6.3 Demonstration and Discussion

<<Demonstration and discussion session by the interviewer, 1 hour 10 minutes>>

[INTERVIEWER] The main topic that we want to introduce is about this method. We want to operationalize business model blueprint in a much more structured way.

[INTERVIEWER]

Eventually we come up with a conceptual process model and if you follow this step then you can give this conceptual model to a company and build software to support or you can build from scratch.

B.6.4 Feedback

[EXPERT7] I can imagine it in what we do in our company, I'm very happy with this. *For me it's very helpful to know that I see all the steps, how the interaction is, who my customer, what's the outcome that my customer needs, what the customer has to do, and what they need at one point.* It is always a struggle to know whether we already cover all the steps or do we know that all the actors are involved, can we add actors somewhere during the steps, etc. And *that makes sense for us to work in this way*.

[INTERVIEWER] Your statement already answering our first question, which is whether this makes sense.

[EXPERT7] Yeah, and *I would love to use it.*

[INTERVIEWER] Whether that would be useful or whether the entire story is clear?

[EXPERT7] Yeah, makes sense absolutely. I would be happy to apply it and find out how it's going to work for me

[EXPERT7] I think agriculture or agro food markets also develops. It goes more towards "what they can do for you" and also "who the customer, who does he wants to be", because they (farmers) are not only produce but also figuring out 'why' they are doing something. The 'why' is not always the same. For 60-70 years they (farmers) seem doing exactly the same. But they are really completely different. One person prefers producing organic (vegetables) and the other one wants to produce as much as possible, some goes for more efficiency or productivity. The outcome of everything is that there is no better business case because these all are valid business models.

B.7 Interview 7 – Information Analytics

B.7.1 General Information

Date	29 March 2019
Length of the interview	01:32:51
Name of interviewee	[EXPERT8]
Experience	<2 yr
Name of interviewer	[INTERVIEWER]
Subject	Evaluation of SDBMOM
Goal	To get feedback on SDBMOM validity and utility

B.7.2 Introduction

[INTERVIEWER] The reason we're here is to introduce the method that we're developing that will help companies to take business models and generate conceptual process model, which represent which party involved and what type of message exchanged between these parties. You can do it however you want, but we want a structured way to do it.

[INTERVIEWER] For introduction, perhaps can you tell us about your work?

[EXPERT8] My position here is Information Analysis and Logistics. It's a mix between business and maybe data analysis. So what I do is I look at the process and the improvements and I translate that to our I.T. systems. And there can be more improvements like a screen that needs new field of information or can be bigger improvements.

B.7.3 Demonstration & Discussion

<<Demonstration and discussion session by the interviewer, 54 minute>>

[EXPERT8] I like the story. *I am very excited about the way you map the business model scenario to choreography model. First, I didn't know that before. For me in my work, I go straight to the business process models. I like that step in between to check yourself if you're completed.*

[EXPERT8] So that's what I very much like and if I look in my field, I'm looking at improvements in logistic processes, which you can also maybe call it services to my business clients, *I also see some opportunities to use this one as well within the company itself. It is the opportunity to use the choreography as a means for improvements within the existing way of how the process works.*

[INTERVIEWER] You recognize the function of this choreography?

[EXPERT8] Yeah. But also the steps that you mentioned, within the company we also have internal customers, the different parties, which also quite interesting to see how it works with.

That's what I like. I know the process to model within IT is very important, that's also very interesting.

[EXPERT8] One question is the question about what business roles that are involved because what I see here is that there is still quite a wall in between business and IT. Maybe I misunderstood it, but I also see the steps like a waterfall type design and what we are trying is bringing both parties together. I would also involve IT at the starts (of the design process).

[INTERVIEWER] That's exactly the reason why we've put business architecture. So we think that while creating this role model is that you definitely need certain expert knowledge at different points in time. So you can't expect process engineer to come and design a business model and you can't expect the business people to know where there's something in the I.T. would work or not, whether we really need that service, etc. So, you need this specialty in any case, but this specialty, as you just mentioned, also create some sort of role in between these people. However, in an ideal world, 'job separation' would work but in reality, it's almost never works. So, that's the reason why we said that there is a need for a business architect to orchestrate this entire process. He/she knows also the business and the IT at the same time. Of course, this is a very important role and not very easy to fill in. This is the one other way to handle this situation. This kind of role is to involve in every step. So this person has to communicate with the business and IT people. It's not just a matter of interaction but also kind of validation. So, this person has to communicate with this person to make sure that what is developed here is make sense, correct, and validated. So every step has to be validated with the person that comes in before. So, those are at least two things that we did to bring these two worlds, business and IT, together.

[INTERVIEWER] The information directly or indirectly can flow between any two actors. All actors are somehow connected more closely or through other type of knowledge.

[INTERVIEWER] So, what do you do here (in the company), (if we use this stakeholder taxonomy) as representation)?

[EXPERT8] Yeah, I'm in this position (business process designer). What I see is that *if we are trying to achieve something, either in the company or indeed in a higher level, communication works if we really working as a team*, so I see this perhaps as a team effort.

[INTERVIEWER] Indeed, that's the case. This is a team. Someone who can speak both languages, that's a Business Architect. Business Model Designer is responsible of the entire business model. Implementation of the entire business model. Perhaps the initiator of the idea but he or she has to bring people together, in a workshop, to define the thing (business model) with the help of the business owner. Business Owner defines the strategy and then they sit down and discuss that with the business model designer.

[INTERVIEWER] So, this stakeholder taxonomy definitely doesn't show any kind of hierarchical relationship. This doesn't mean that business architecture is in a higher position than a business owner.

[INTERVIEWER] One thing perhaps missing is that it seems like Business Owner or Platform Administrator does not communicate with the others, this is because we didn't want to complicate things too much. But, indeed, you would not expect communication happens by passing the roles. You'll break the traceability if you do that, it'll become immediately inconsistent. You have a person that can be involved in two or three roles. Although, that's not always possible.

[EXPERT8] Then I understand.

B.7.4 Feedback

[INTERVIEWER] So we are going to ask the question whether this makes sense. I think we've got the answer, but if you want to add something then we would be glad to hear it.

[EXPERT8] Indeed, I think it makes sense. Like I said, I like process centric approach. Sometimes in practice, we skip that one very easily just because we want to go this way and just do it. So it's very important and often forgotten. So, that's why I really like this approach.

[EXPERT8] *It's not easy to comprehend. I think you just have to try it several times. In small projects on small improvements, I think you can also very easily use one.*

[EXPERT8] Also for the strategic approach, if I look at areas that we are working at, we are interested in the service-oriented business, but we do miss a structure of that and that's why I like this. Also, our company like to do everything themselves instead of first looking out there (and try to collaborate with others).

[EXPERT8] And *I'm also very much like the customer centric approach.*

B.8 Interview 8 – Quality and Assurance & Auditing and Compliance

B.8.1 General Information

Date	29 March 2019
Length of the interview	02:02:33
Name of interviewee	[EXPERT9], [EXPERT10]
Experience	>10y, >10y
Name of interviewer	[INTERVIEWER]
Subject	Evaluation of SDBMOM
Goal	To get feedback on SDBMOM validity and utility

B.8.2 Introduction

[EXPERT9] I'm [EXPERT9]. Until December last year, I was heading the Quality of Regulatory department in Best for the MRI division. So, we are in the medical device business. But, as of January, I moved into what is called Quality Regulatory (Q&R) Advance Development which is actually looking into all topics that relate to content quality when it comes to products that we are making. So, we have been heavily focusing on compliance over the last years. But one of the intentions of Philips is to move into a more quality oriented way of doing the Q&R business. That's where I am currently focusing on and that ranges from looking into new models, new approaches, new techniques, different ways of operationalizing processes and everything in between.

[EXPERT10] I am [EXPERT10]. I was also part of the team of [EXPERT9] until January. My main area in the last year is Auditing and Compliance. I did also the last year on area of quality management systems, not only in our business but also beyond. We have also a business group (i.e., Diagnostic Imaging) and I still involved in a different way for the quality management system and also to the audits. My real area is more to use or improve the audits to have a good benefit for the business because it's required by the regulations of the association and also the European regulation. Now, in the last year, I'm trying to train people in order to maximize the benefit for the business.

B.8.3 Demonstration & Discussion

<<Demonstration and discussion session by the interviewer, 1 hour 37 minute>>

[EXPERT10] I saw a lot of interaction. What happens if one interaction is interrupted? The system might crash.

[INTERVIEWER] In Step 3, we add control flow and exceptions to anticipate this.

[EXPERT9] *This method is combination of business design and process design. It brings them together.*

[INTERVIEWER] Yes, indeed.

[EXPERT10] *You make it very simple and very easy to understand but also you can see how important it is to make things easy.*

[EXPERT10] *The power of this (method) is by using this simple symbols and all this kind of things. That make it very powerful. I think that's why when you use the radar, you make it very clear. Explain the complex story in a simple way. I think it's very good.*

[EXPERT9] *This is nice. Very complete and powerful concept. And it put structure.* I mentioned that before, typically the front end in industry is very fuzzy. The product manager just comes up with an idea. Let's do this, and then he goes to R&D, "Can you make this? What do you mean? I mean this." Along the way you discover that you don't have everything completely in mind. You missed things. You don't have sufficient capabilities. You miss details. You make assumptions that proved to be incorrect. *If you do this nicely from the beginning, you can prevent a lot failure issues.* In this case service issues.

B.8.4 Feedback

[INTERVIEWER] The first question that we ask people is does this make sense for you?

[EXPERT9] Yeah, absolutely.

[EXPERT9] *It's good to do (operationalization) like this and also to explain it in this way*, using slides. Because if you write this down, probably you lose people after page one, I mean industry people. *It's well explained.*

[EXPERT10] Company A use BPMN, but it's completely off topic. Because they do all these small activities where they make all these building blocks. You can imagine one activity for example receiving data and then sending data, if you put all these things we have hundreds of these thing and they are all doing this and then it will be very difficult to have a good overview. That's a problem. But for this purpose I think is perfectly fine because you do it in a very intelligent way. You find your interaction and also your actors because they are important elements in your system. It's focusing on that and try to build a model there and I think you succeeded already to do that.

[EXPERT9] You will not give that diagram (collaboration) to your traveler (customer), right?

[INTERVIEWER] No.

[EXPERT10] I think it is a good exercise maybe to have another kind of application, like music.

[INTERVIEWER] Yeah. We apply on two other. One is Free Ride Amsterdam and the other is Just -in-Time Presence of Elderly.

[EXPERT9] It is very interesting. I see some opportunities to also implement this in quality domain. You could use it for different purposes.

[INTERVIEWER] Actually, the context of this is where you have free agents and they collaborate to create some value. However, we think it is possible to also implement them within organization, between departments. Because nowadays, business centered on services. But we haven't explored this line of research.

[EXPERT9] *I would be interested to look for an opportunities for application.*

C. Appendix C – Questionnaire

C.1 Questionnaire on the *Service-Dominant Business Model Operationalization Method (SDBMOM)*

Date: ____ /____ /_____

Please provide feedback about the service-dominant business model operationalization method (SDBMOM) demonstrated during the interview meeting.

**Please note that, in below questions the term 'business model' refers to the 'service-dominant business model', and the 'operationalization' refers to the generation of conceptual process models that depict how the business model operates in terms of necessary activities and their logical sequence.*

	Strongly Disagree	*Disagree*	*Neutral*	*Agree*	*Strongly Agree*
1. I think this method provides an effective solution to the problem of operationalizing business models.	☐	☐	☐	☐	☐
2. Operationalizing business models in this way would be *difficult* for users (colleagues, partner companies, etc.) to understand.	☐	☐	☐	☐	☐
3. Using this method would make it *more difficult* to communicate to others about how business models can be operationalized.	☐	☐	☐	☐	☐
4. Overall, I found the business model operationalization method demonstrated in the interview meeting to be useful.	☐	☐	☐	☐	☐
5. Learning to use this way of operationalizing business models would be easy for me.	☐	☐	☐	☐	☐
6. I found the way the business models are operationalized as *unclear* and *difficult* to understand.	☐	☐	☐	☐	☐
7. It would be easy for me to become skilful at using this way of operationalizing business models.	☐	☐	☐	☐	☐
8. Overall, I found this way of operationalizing business models *difficult* to use.	☐	☐	☐	☐	☐

Appendix C – Questionnaire

	Strongly Disagree	*Disagree*	*Neutral*	*Agree*	*Strongly Agree*
9. I would use this method to operationalize business models.	☐	☐	☐	☐	☐
10. I would *not* consider using this method if I have to operationalize a business model in the future.	☐	☐	☐	☐	☐

11. What is your position in your current organization(s)? ----------

12. How long have you been working in this position?

☐ Less than 2 years

☐ 2-4 years

☐ 4-7 years

☐ 7-10 years

☐ More than 10 years

13. How long have you been working in the industry?

☐ Less than 2 years

☐ 2-4 years

☐ 4-7 years

☐ 7-10 years

☐ More than 10 years

14. In which industry does the organization/company you work for operates? ----------

15. What is the size of your company?

☐ Below 10 employees

☐ 11-50 employees

☐ 51-100 employees

☐ 101-250 employees

☐ 251-500 employees

☐ 501-1000 employees

16. How familiar are you in using any technique or approach in designing business models?

☐ Not at all familiar

☐ Slightly familiar

☐ Somewhat familiar

	Strongly Disagree	*Disagree*	*Neutral*	*Agree*	*Strongly Agree*
☐ Moderately familiar					
☐ Extremely familiar					

17. How familiar are you in using any technique or approach in designing conceptual business process models (using a process modelling notation, such as BPMN)?

☐ Not at all familiar

☐ Slightly familiar

☐ Somewhat familiar

☐ Moderately familiar

☐ Extremely familiar

18. Please indicate what you would consider the strong points of the demonstrated method?

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19. *Please indicate what you would consider a <u>weak</u> point or points that <u>can be improved</u> about the demonstrated method.*

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20. *Any additional remarks.*

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Thank you for your participation!

C.2 Feedback from the Questionnaire

ID	Feedback
Expert1	It is a 'total' approach from idea to operationalization, including feedback/correction opportunities.
	The theory should be 'marketed' using more intuitive visualizations. Please consider involving a 'marketer'. I believe a bestseller could be produced when putting it in writing (a book or whitepaper).
Expert2	Connection between value, capabilities and the actual process model/application.
	It needs 'marketer' and clear pictures to make it less academic and more user friendly. Also consider rethinking the names of the elements in the model.
	Exceptional work done! I keep being highly interested and available to support! I'm available for the drawing!!
Expert3	Clear tasks in each of the steps.
	Possibility to update/append service scenario/business model (feedback loops).
	Gradually building complexity.
	Seems relatively modest in terms of required information inputs.
	Natural flow of the process, no unexpected tasks.
	What are prerequisites for a company to use this? What are you assuming in terms of available systems?
	Demonstrate the use/availability of the list of operational services.
	Introduces the WHY of the method.
	Identification/highlighting of domain expert induced information and BM(P) designer decisions.
	The stepwise process feels like an 'algorithm' or data transformation. What would you say is the guaranteed output of this transformation? Stg. Like the output of this process is either a specification of [a] way to operationalize the BM and SS or detection of the viability of the business model OR detection of the incompleteness of the provided inputs.
	The method builds on the BASE/X business model radar as a means to capture the definition of a (S-D) business model. Other authors prefer 'systems of activities' or (value) networks as a means to define a business model. What would this method add to such methods of defining a business model? Or could these also be considered as operationalization or something in between?
Expert5	Start from customer value instead of trying to model current ways of working in a baseline.
	Very structured approach.
	Might be a bit too complicated with the distinction between activities in message and process models.
	Would be nice to run a pilot once at our company for one of our value streams.
Expert6	Strong point of the SDBM (Base/X) to me is that it focus on added value and network cooperation (flexible).
Expert7	Valuable per partner = is clear servitization gets its value +/- what are the cost and benefits for each value.
	It's a model out of cooperation
	It's a method which looks very complete in all actions which need to be done.
	Is it a complete model?
	Are the partners the best in the market? Gives no indication of the strength of partner involved.
Expert8	Business Process management approach is strong, should be basis for any IT solution.

Appendix C – Questionnaire

	Forces you to think about partners working together in a network.
	Business & IT working together.
	Provide a way to train in taking the steps from Business Model to Choreography to BPMN, it is not easy.
	Emphasize the importance of working as a team & the role of Business Architect.
Expert9	The RADAR identifying all entities that have a role/interest in the business scenario.
	The presence of a catalog of capabilities that is scalable or tailorable to a scenario at hand.
	No specific issues.
Expert10	Radar contains essential elements to be collected and analyzed.
	Using catalogue (capabilities) in conceptual process model.
	Using only 'Best' scenario. Include in the model 'Worst' scenario as well. By using both scenario's makes the model more robust.
	Apply this model on a different applications, small & big. For example: healthy lifestyle, healthy food, sport, health check, diagnosis.

About the Author

Bambang Suratno was born on September 29, 1984, in Jakarta, Indonesia. He obtained a bachelor's degree in Industrial Engineering from the Telkom University in Indonesia in 2007. It was followed by a Master of Industrial Engineering and Management degree from the Bandung Institute of Technology in Indonesia in 2013, on the topic of utilization of an enterprise information system for managerial benefit and exploration of its potential for developing knowledge management. Before pursuing his master, Bambang had experience working in an NGO and consultancy company as a team leader, focusing on performing market research, information system management, and standard operational procedure development (ISO 9001). After obtaining his master, Bambang started his academic career as a teaching assistant and head of the ERP laboratory in Universitas Islam Indonesia. This work lead to his decision to pursue a Ph.D. degree.

He has pursued a Ph.D. at the Information Systems group of the School of Industrial Engineering, department of Industrial Engineering and Innovation Science, TU Eindhoven – of which this thesis is the main outcome. His research interest is in developing approaches to operationalize high-level business models using service compositions or business processes, covering elements from Information System Engineering, Business Process Management, and Business Engineering. He has the curiosity to explore the unique business models of virtual enterprises that rely on collaborations between organizations with different ownership, and the operationalization of these business models. This collaboration has the potential to produce business services with a greater capability than just the sum of the capabilities of each individual organization. Part of his work so far was presented at the 2017 International Conference on Advanced Information Systems Engineering in Essen, Germany and the 2108 International Symposium on Business Modeling and Software Design Symposium in Vienna, Austria.

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