Business Modeling for Service Engineering: Toward an integrated Procedure Model

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***Abstract*—Business modeling for service engineering aims at flexible transformation of business logic into software code. The ISE framework is an interdisciplinary approach which embraces this concept to engineer services. This paper discusses work related to business modeling, introduces the ISE framework, and examines three areas for improvements. The first improvement addresses a firm terminology in that it reduces term ambiguity. The second improvement proposes additional concepts and meta models to advance the framework's semantic. The last improvement presents an initial integrated procedure model with eleven steps, which will guide and support the modeler through the service engineering process.**

Keywords: service engineering, procedure model, modeling

I. Introduction

Business modeling is a discipline which depicts the relationship between business logic and its realization with information technology. The idea is to define business logic in a technology-free fashion and frictionless transform it into technical blueprints, neglecting traditional expensive and interminable software engineering projects, and hence, eases the alignment between business requirements and IT. Recently, business modeling gained momentum in the domain of business process automation [20] and service engineering [9], since globalization and technological change [16] provoke highly dynamic environments as well as high uncertainties [15]. As a consequence, organizations need to adapt quickly and frequently.

In general, business logic is sub-divided into a strategic and a conceptual layer [20]. The strategic layer describes *what* needs to be done, whereas the conceptual layer states *how* this is accomplished [5] but still ignoring information technology which is only considered afterwards.

However, while much efforts were made to explore the relationship between the conceptual layer and information technology, few approaches exist which target the relationship between strategic aspects and their conceptualizations [20].

Kett et al. [9] took these new developments into consideration and developed the Inter-enterprise Service Engineering (ISE) framework in order to address these new challenges and to embrace the concept of business modeling.

This work's contribution is an enhancement of the ISE framework [9] in that it provides a finely granulated semantic for both the strategic and the conceptual perspective, proposes an initial procedure model to integrate the various aspects of services, and to guide the service engineering process.

The remainder of this paper is structured as follows: section II reviews related work and section III introduces the ISE framework. Section IV presents available concepts for improvement and discusses the final framework, whereas section V introduces the initial integrated procedure model. Section VI concludes this work as well as offers prospects about future work.

II. Related Work

Prior to dive into the ISE framework and the procedure model, this section discusses available work in the area of business modeling.

Bergholtz et al. [2] claim that two types of models exist in the e-commerce domain: business models and process models. The authors define business models as means to describe actors and their value exchange, whereas process models define for each actor how to realize value exchanges. Subsequently, they analyze the relationship between the two models and propose a formalization for each model. The findings are that business models relate to UN/CEFACT UMM and that process models relate to ebXML BPSS.

Likewise, Andersson et al. [1] distinguish between business models and process models in the e-commerce domain. They associate business models with business analysis, and ascribe process models with low-level activities and their ordering. Andersson et al. find evidence for a relationship between the two models and propose a systematic method to generate process models from business models. The presented formalism for business models refers to the e^3 Value approach (an approach to evaluate e-commerce ideas) [6], whereas process models are described as patterns which origin in UN/CEFACT UMM. The outlined routine has five steps: (1) Start with a e^3 Value model, (2) check custody, (3) check evidence, (4) identify a set of processes, and (5) for each process, select a pattern from the UMM.

Dorn et al.'s work [5] targets business-related and technical-related specifications in the business-to-business e-commerce domain. They acknowledge a relationship between these two types of specifications. Furthermore, a survey shows available

specifications and their possible overlaps. This survey is based on a refinement of the open-EDI reference model, which distinguishes two views: (1) Business Operation View (BOV) and (2) Functional Service View (FSV). They refine the BOV into business models and process models and the FSV into deployment artifacts and software environments. This refined model groups existing methodologies and technologies. Lastly, they suggest a methodology to design e-commerce applications, starting with the design of business models, developing business processes, deriving system architectures, and finally implementing e-commerce applications.

Likewise to the ISE framework, all these approaches acknowledge the existence of a business model layer and a conceptual layer, which are both technology-agnostic. The business model layer comprises strategic aspects and addresses organizations as well as their suppliers, customers, and competitors, whereas the conceptual layer targets individual organizations and the internal configuration of the value creation process. Unlike the ISE framework, all of these approaches focus mainly on business process automation and are limited to behavioral aspects. The differences between the proposed idea in this paper is that it targets on service engineering and incorporates next to processes, descriptions for rules, data, human resources, and services' value.

III. The ISE Framework

Based on a state-of-the-art study of existing frameworks, Kett et al. [9] argued that existing frameworks for service engineering either address the business perspective or the technical perspective. To overcome the gap between these approaches they introduced the Inter-enterprise Service Engineering (ISE) framework (cf. figure 1), a framework for service ecosystems, which embraces the Zachman framework [22] and a service engineering methodology for service products [3].

The horizontal axis shows four perspectives of the engineering process and is named *abstraction layers*. Each perspective relates to a specific role with appropriate skills and offers different sets of tools and methods. It also implies the chronology of the framework. Additionally, the perspectives are linked to phases of the service engineering process. The vertical axis (dimensions) shows five different descriptions of a service. Each description is valid for each perspective. Any intersection in the matrix is placeholder for a model, a notation, and a modeling technique, which is appropriate for the respective perspective and the modeling aspect.

A. Dimensions

The *service description* dimension embodies services' value proposition toward potential customers. This includes functional, financial, legal, marketing, and quality of service properties as well as other meta data for service proposition, discovery, selection, contracting, and monitoring. The *workflow* dimension addresses services' behavioral aspect, which include core capabilities and sequence flows. The *people* dimension offers means to model and to refine human resources, and to assign tasks. Intangible assets, terms, and

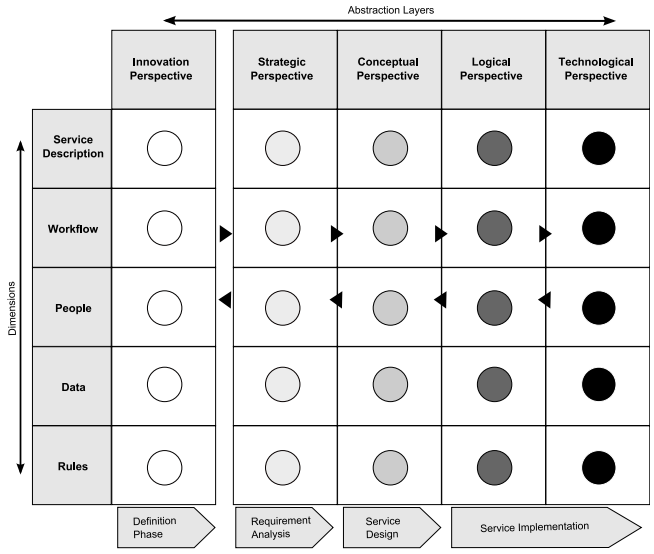

Fig. 1. ISE Framework [9]

concepts as well as their relationships are defined in the *data* dimension. The *rules* dimension addresses structural and organizational rules. These are defined to elicit and formalize domain knowledge to guide services' behavior.

B. Perspectives

The *innovation* perspective is out of scope of the ISE framework. It marks the interface to service innovation [10] and defines a first proposal for a new service. Business strategists pick up new service ideas and focus on requirement analysis in the *strategic* perspective. Kett et al. [9] depicted a basic underlying model for this perspective: the Business Model Ontology (BMO) [14]. Eventually, a decision is made whether to implement a new service or not. The *conceptual* perspective focuses on operationalizing and implementation of strategic artifacts from the owner's perspective. Proposed modeling notations were Business Process Modeling Notation (BPMN), Unified Modeling Language (UML), and Event-driven Process Chains (EPC) [17] to transform domain experts' perceptual requirements into appropriate models. The final artifact is a service design which is neither technical nor platform-specific. Conceptual artifacts are transformed into abstract technical models during the *logical* perspective by IT analysts. This perspective offers a bridge between service design and technical service implementation. Finally, the IT developer transforms the logical artifacts into platform-dependent software artifacts, e.g., WSDL, SOAP, etc., during the *technical* perspective.

IV. A clear Semantic for the Strategic and Conceptual Perspective

This section advances the semantic for the strategic and conceptual perspective in the ISE framework in two aspects in order to ease the framework's application. First, new names are proposed in order to establish term coherence and to reduce ambiguity. Second, to advance the semantics for the descriptions and for two perspectives, additional concepts are

proposed. Furthermore, for each cell exists a meta-model which are not shown here due to space restrictions.

The term *service description* in the ISE framework is revised into *value description* in order to avoid ambiguity: a service is described by the union of all descriptions, whereas the value description is restricted to services' propositions toward potential customers (cf. [7], [18]). The term *people description* is revised into *actor description* to stress the point that this description includes next to human beings also companies as well as governmental institutions. The term *workflow description* changes into *process description* which relates to the Zachman framework. Table I shows the resulting framework together with its formalization concepts.

TABLE I
REVISED FRAMEWORK

	Strategic Perspective	**Conceptual Perspective**
Value Description	BMO [14]	Service Properties [18]
Process Description	BMO [14]	BPDM [12]
Actor Description	BMO [14]	Org. Charts [21]
Data Description	BMO [14]	ERM [4]
Rule Description	BMM [11]	SBVR [13]

A. Strategic Perspective

The strategic perspective utilizes different concepts from BMO [14], which was already motivated by Kett et al. [9]. BMO is an ontology with nine abstract concepts to accurately describe companies's business models. However, novel in the strategic perspective is the application of OMG's Business Motivation Model (BMM) [11] for the rule description. BMM offers a coherent scheme to manage and communicate business plans and a government structure which relates to business rules.

Value Description: Kett et al. [9] proposed the following concepts from BMO [14]: (1) value proposition, (2) distribution channel, (3) relationship, and (4) revenue model. However, considering that the value description is targeted at service consumers, the target customer concept from the BMO is added as well (cf. table II).

Data Description: A data description depicts a shared terminology within companies for resources which are input and/or result of process activities. It is important to note that the terms data and resources are synonymical in the context of this work. Kett et al. [9] proposed BMO's immaterial resource concept [14]. In contrast to Kett et al., this work considers also material resources in order to represent a complete terminology. Relationships between resources, however, are omitted and firstly considered in the conceptual perspective.

Actor Description: The strategic perspective's meta model uses the BMO concepts partnership, actors as well as capabilities. Both, the actor node as well as the capability node embody the attributes name and description. Actor and capability nodes may be linked in order to declare which actors provide what capability. Yet, the actor node is a general concept and is refined by the partner node and the role node. The partner node depicts *outside* organizations whereas the role node represents human resources from *inside* organizations.

Process Description: Kett et al. [9] proposed to use the value configuration and the capability concept from BMO. A subtle refinement is made here: capabilities are modeled within the actor description since the capability concept has a close relationship with actors. Additionally, the BMO's activity concept is added to the process description.

Rule Description: As aforementioned in this section, the meta model for the strategic perspective is motivated by parts of BMM [11]. According to OMG, *ends* represent anything organizations seek to achieve, whereas *means* refer (among other things) to instruments to *realize* ends [11]. Hence, according to the definition by Kett et al. [9], the ends concept fits into the strategic perspective and the means concept into the conceptual perspective.

B. Conceptual Perspective

The conceptual perspective takes advantage of existing specifications and available approaches. Contrary to the strategic perspective, meta models in this perspective are richer as well as more expressive for this perspective focuses on information and its interrelation.

Value Description: Service offers in the conceptual perspective reflect a firm establishment with concrete values. The meta model for the conceptual perspective builds on two approaches. Scheithauer & Winkler [19] investigated properties to describe services to allow service offering, discovering, selection, and consumption. Scheithauer et al. [18] propose a meta model for these properties and their relationships (cf. table II).

Data Description: In the conceptual perspective a business terminology is refined into a fact model. A fact model expands a terminology with resources as well as attributes. As aforementioned, relationships interrelate resources, which in turn represent business-relevant knowledge. Zur Muehlen et al. [23] refer to this knowledge as *structural rules* whereas the Business Rule Group defines interrelated resources as *facts*. Additionally, it resembles the Entity-Relationship diagram [4].

Actor Description: The conceptual perspective's meta model resembles the strategic's meta model with the difference that the employee node is added to the model and is similar to the organizational chart model depicted in [21]. The node has merely a name attribute and may link to roles in case an employee matches a role's profile as well as directly to capabilities.

Process Description: Evidence for the conceptual process model can be found in OMG's Business Process Definition Metamodel (BPDM) [12], which offers a meta model for business processes in order to compare and align different process notations, such as BPMN and EPC [17].

Rule Description: Contrary to the strategic perspective, the conceptual perspective utilizes the *means* concept, that is how to accomplish defined goals and objectives. The BMM specification [11] offers business rules to support objective's

achievement. The introduced rule concept for the conceptual perspective is informed by the work of the Semantics of Business Vocabulary and Rules (SBVR) specification [13]. It is important to note that the business rule concept relies on the data description with its resources which relate to the SBVR's *business vocabulary*.

V. Integrated Procedure Model

This section introduces an initial procedure model for the ISE framework. It aims at bridging the strategic and conceptual perspectives by means of eleven abstract steps that contain fine-granulated activities (cf. figure 2). This procedure model is influenced by work of zur Muehlen et al. [23]. They offered an abstract procedure model for integrated process and rule modeling. This work is extended for the integrated procedure model for all descriptions spanning the strategic and the conceptual perspective. The steps one to five address the strategic perspective, whereas the steps six to eleven address the conceptual perspective. The following subsections elaborate on each abstract step. Likewise zur Muehlen et al. [23] each step is explained by the triple: activities, challenges, and results.

A. Strategic Perspective

The first five steps support business strategists to transform a service idea (service innovation perspective) into a tangible foundation for business strategists, business analysts as well as business owners to decide whether to implement a service or not (predetermined breaking point).

1) Define Value Offer: The first step includes to define a value offer, which is an abstract service description. All following steps in this perspective take this outcome as a requirement document. *Activities.* The activities for this step include: (1) Establish exactly one value proposition, (2) determine one or more target customers, (3) determine exactly one relationship for each target customer, (4) determine one or more distribution channels, and finally (5) setup one or more revenue models. *Challenges.* In order to identify the concepts for this model, a deep understanding of the business domain as well as marketing is necessary. *Result.* The outcome of this step is an instance of the model described in section IV-A: a value offer which describes the service from a strategic perspective. The artifact serves as a requirement for the following steps in the strategic perspective.

2) Determine Key Business Activities: Once the value offer artifact is provided, business strategists determine a value configuration type as well as business activities. The value configuration type implies the nature of the value configuration; whether the value creation process compares to a value chain, a value shop, or a value network. *Activities.* The activities include to determine all necessary business activities to fulfill the *value offer* (cf. [14]). *Challenges.* Business strategists must understand the business domain's value creation process as well as the own company to determine the value configuration type and necessary business activities. *Result.* The outcome of this step is a value configuration, which determines the process description from a strategic perspective.

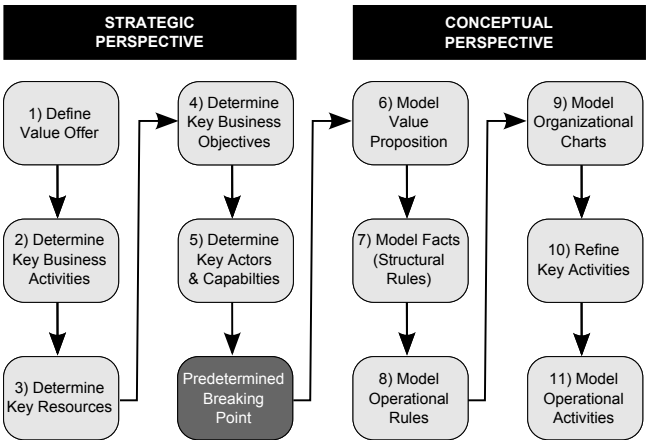

Fig. 2. Procedure Model for Business Service Modeling

3) Determine Key Resources: After the determination of crucial business activities, business strategists need to identify resources which are required and/or produced by these activities. These resources also serve as a general terminology for the service to be developed. In the strategic perspective the terms *business object*, *term*, and *resource* are synonymic. This step refers to the step *Determine Key Objects, Terms, and Definitions* from zur Muehlen et al. approach [23]. *Activities.* The single activity for this step is to identify resources which are needed for determined business activities, to provide each resource with a name and a textual description, and to specify whether it is a tangible or intangible resource. *Challenges.* It is important to know the scope and the implications of each business activity in order to determine appropriate resources. *Result.* The outcome of this step is a business terminology, which determines the data description from a strategic perspective.

4) Determine Key Business Objectives: Business rules codify behavioral business knowledge; things companies want to accomplish. BMM offers three elements: Whereas *visions* describe companies' desired state in the future, *goals* refer to a qualified and long-term statement to achieve a vision. Finally, *objectives* refer to a quantified (measurable) and short-term statement to achieve a goal. *Activities.* The activities to determine business objectives are a refinement process. It starts with establishing visions. For each vision one or more goals must be determined. Finally, attainable, time-targeted, and measurable objectives need to be derived for each goal [11]. *Challenges.* Developing business objectives is a non-trivial part with far-ranging implications. It affects services' internal behavior and routes the value creation process. *Result.* The outcome of this step is a business objective terminology, which determines the rule description from a strategic perspective.

5) Determine Key Actors & and their Capabilities: It is necessary to model actors after the process descriptions, for each business activity needs to be performed by either a partner or companies' personnel. *Activities.* For each business activity from the process description one or more capabilities need to be identified in order to accomplish the activity. Following

this, business strategists identify personnel with appropriate capabilities. Likewise, other organizations must be identified for crucial capabilities which cannot or rather should not be achieved internally. *Challenges.* This step's peculiarity is to derive appropriate capabilities for all business activities. Business strategists need to be aware of their own personnel and its capabilities. Additionally, they need to identify appropriate partners for the service's realization and decide what kind of partnership they want to establish. *Result.* The outcome of this step is a set of business actors, which determines the actor description from a strategic perspective.

B. Conceptual Perspective

The last six steps of the integrated procedure model deal with the conceptual perspective (cf. Figure 2). These steps support business analysts to conceptualize a service, hence determine *how* to implement a service strategy. The outcome of this perspective serves as a means for communication and a support for decisions. It is neither technical nor platform-dependent. Furthermore, it is a starting point for a transformation into technical specifications [20].

6) Model Value Proposition: In this step the strategic perspective's value model is refined. One goal is to operationalize aspects from the strategic perspective into a value proposition which is available to potential customers. Hence, all strategic artifacts with internal knowledge must be revealed, including the value level, the customer equity, and the revenue model. *Activities.* The general order of value modeling is: (1) Functionality, (2) Quality, (3) Marketing, (4) Legal, and finally (5) Financial. Table II shows categories and their properties (cf. [18]). Corresponding to each property are entities from the strategic perspective's value model. This light-weight mapping between the strategic and the conceptual perspective eases the value description modeling. *Challenges.* The challenges involved in value modeling are manifold, since business analysts need knowledge in the domains of marketing, quality of services, pricing mechanisms, and legal aspects. *Result.* The outcome is an instance of a value model (cf. [18]).

TABLE II
MAPPING BETWEEN STRATEGIC & CONCEPTUAL VALUE DESCRIPTION

Category	**Property [18]**	**Influenced by Strategic Entities [14]**
1. Functionality	Capability	Value Offer Customer Equity
	Classification	Value Offer Target Customer
2. Quality	Performance	Value Offer Price Level
	Dependability	Value Offer Price Level
3. Marketing	Certification	Value Offer Target Customer Revenue Model Distribution Channel
	Expert Test Rating	Value Offer Target Customer Revenue Model Distribution Channel
	Benefit	Value Offer Target Customer
4. Legal	Right	Value Offer Target Customer Customer Equity
	Obligation	Value Offer Target Customer Revenue Model Distribution Channel
	Penalty	Target Customer Revenue Model
5. Financial	Price	Revenue Model Customer Equity Target Customer Value Level Price Level
	Discount	Value Level Price Level
	Payment	Target Customer Life Cycle Step

7) Model Facts: Business analysts augment identified resources in the strategic perspective with attributes and relations. *Activities.* For each resource business analysts make out attributes to describe resources sufficiently. Following this, they model relationships between resources. These relationships are also named *facts* or *structural rules*, that is, knowledge between two or more resources. Finally, meaningful attributes are added to each relationship. *Challenges.* The challenge is to ensure completeness for the fact model. *Result.* The outcome is an instance of a fact model (cf. [4]).

8) Model Operational Rules: Modeling operational rules implies to constrain facts in such a way that it guides services' internal behavior according to business objectives (cf. [23]). *Activities.* Business objectives as well as the fact model serve as a basis for this step. Business analysts augment facts (relations between resources) with constraints in order to codify (formalize) business knowledge which supports coherent decision making in business processes. As aforementioned, SBVR [13] is suitable for this step. *Challenges.* The gist lies in transforming business objectives into constraints, and hence to operationalize them. *Result.* The outcome of this step is a fact model augmented with operational rules.

9) Model Organizational Charts: Business analysts refine the personnel in this step. *Activities.* The personnel element from the strategic's actor description is refined into roles with capabilities. Available employees (person element) are categorized into roles according to their individual capabilities. *Challenges.* Business analysts need to match required capabilities with employees' individual capabilities. *Result.* The outcome of this step is an organizational chart describing roles with considered capabilities and assigned employees.

10) Refine Key Activities: Activities. Business analysts refine strategic perspective's business activities into supporting business processes with a lower granularity (cf. [23]). *Challenges.* The challenge is to identify completely all necessary processes as well as to control the granularity level [23]. *Result.* The outcome of this step is a set of fine granular business processes

for each business activity.

11) Model Operational Activities: The final step in the procedure model is to combine actors, rules, data, and processes by specifying operational activities. Operational activities are assumed to be atomic, and thus, cannot be decomposed into fine granulated activities and can either be assigned to a specific role inside a company or to a partner. *Activities.* For each business process, business analysts start to model each actor who is involved in the business process. Following this, they use operational activities, events, gateways, roles, conditional flow, sequence flow, and message flow elements to define services' internal behavior. Additionally, data flow combines activities and resources and depicts activities's inputs and outputs. *Challenges.* Business analysts need sophisticated knowledge about operation activities [23]. *Result.* The final outcome of this step is a complete set of business processes combining activities, rules, and data.

VI. Conclusion & Future Work

A recent study [15] shows that existing software engineering methodologies do not apply to service-oriented design due to highly dynamic environment, high uncertainty, distributed control of processes, many different stakeholders, and finally that decisions cannot be foreseen during design time, which holds also true for service ecosystems and its peculiarities. Therefore, the Inter-related Service Engineering (ISE) framework [9] was introduced, which offers a methodology for service-oriented engineering. Three areas for improvements were identified. The first improvement addresses a firm terminology in that it reduces term ambiguity. The second improvement proposes additional concepts and meta models to advance the framework's semantic. The last improvement presents an initial integrated procedure model with eleven steps, which will guide the modeling process.

Business information science benefits from the incorporation of actual studies in the areas of business service modeling and service engineering in that it interconnects popular modeling notations. Furthermore, the procedure model reduces the framework's complexity and enables industries to apply the framework.

This work's major limitation is a missing verification of the procedure model. This issue will be addressed in the next step of the Theseus/TEXO research project [8]. Additionally, future work also includes to advance the procedure model for the logical and technical perspective. Ideas found in this paper [20] present potential for improvements in this direction.

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