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# Collaborative Business Service Modelling in Knowledge-Intensive Enterprises

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## ABSTRACT

Nowadays, knowledge-intensive enterprises, which offer knowledge-based products and services to the market, play a vital role in the knowledge-based economy. In the global networked age, collaborative business services have raised as one of the most important knowledge-intensive services that help enterprises to gain the competitive advantage. These services greatly depend on the ability to use network architectures to collaborate efficiently with business partners. This paper introduces the KB-CBSM (Knowledge-Based Collaborative Business Service Modelling) approach, which aims at providing a conceptual foundation for modelling effectively and improving incrementally collaborative business services in knowledge-intensives enterprises. The paper begins by presenting the necessity and principles of the KB-CBSM approach. Next, it presents the conceptual foundation that consists of three levels: Service value creation network, Service system and Service levels. The paper continues with a discussion and review of the relevant literature and ends with the conclusion and suggestions for further research.

### KEYWORDS

Collaborative Business Services, Conceptual Framework, Knowledge-based Service, Knowledge-intensive Service, Service Modelling, Service Science, Service System, Service Value Creation Network

## INTRODUCTION

The term knowledge-based economy was coined as a result of the recognition of the importance of knowledge in economic growth (OECD, 2007). In the knowledge-based economy, the role of knowledge is considered more important than other resources such as natural, physical, and low-skilled labour resources. For this reason, the creation, use, and transfer of knowledge greatly contribute to the growth of the knowledge-based economy. Consequently, organizations heavily invest in knowledge to enhance the productivity and promote innovation (Steinmueller, 2002). Effective collecting and using knowledge become the core success factor of organizations and the national economy. A new industry, called knowledge-intensive industry, was established based on the creation and utilization of knowledge that motivate the positive changes in organizations. Knowledge-intensive enterprises (KIE) play a vital role in this industry that aim at offering to the market the use of fairly sophisticated knowledge or knowledge-based products and services (Doloreux & Shearmur, 2011).

On the other hand, the service sector has dominated modern economies and has rapidly grown worldwide (Spohrer *et al.*, 2007). Services mean opportunities, but enterprises that have been leading the charge still lack a strong foundation for their work, especially for collaborative service design for a value creation network (Bitner *et al.*, 2008; Le Dinh & Pham Thi, 2012).

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Our research focuses on providing a conceptual foundation for modelling collaborative business services in knowledge-intensive enterprises. We consider that knowledge plays a crucial role in the service systems of knowledge-intensive enterprises and their value creation networks. In the service development process, information could be transformed into knowledge, and this knowledge could be used and applied to provide added value to customers. For this reason, this paper proposes an approach based on the knowledge development process and knowledge sharing within and between service systems of knowledge-intensive enterprises. We call this approach KB-CBSM (Knowledge-Based Collaborative Business Service Modelling). The main contribution of the paper is to provide concepts and guidelines to facilitate the use and adaptation of service description languages, and to specify different dimensions of collaborative business services in knowledge-intensive enterprises.

The remainder of the paper is structured as follows. First, the background and principles of the KB-CBSM approach are presented. Thus, the paper explains the approach according to its three levels: 1) Service value creation network level for service proposal; 2) Service system level for service creation; and 3) Service level for service operation. We describe a running example of collaborative business services in a Continuing Education Institution. The paper continues with a discussion and review of the literature and ends with the conclusion and suggestions for future research.

## KNOWLEDGE-BASED COLLABORATIVE BUSINESS SERVICE MODELLING APPROACH

### Background

Table 1 presents the concepts of the KB-CBSM approach. There are three principal viewpoints: the *strategic viewpoint* focusing on value proposition and exchange of services; the *organizational viewpoint* focusing on information; and the *technological viewpoint* focusing on knowledge.

*Service Science, Management, and Engineering* (SSME) is a term used to describe service science that is comprised of three elements: science, management and engineering *(*Spohrer *et al.*, 2007; Maglio *et al.*, 2008). The *management* dimension concerns strategies to add more value to existing business services and to provide new business services. The *science* dimension deals with the structure of service systems and clarifies the process of service creation that aims at applying competencies from an economic entity for the benefit of other entities. The *engineering* dimension covers the invention of new technologies to improve the quality of existing business services and create new and innovative ones.

In the service-dominant logic, *services* are defined as the use of an economic entity's specific competencies, such as knowledge, skills and technologies, for the benefit of another economic entity (Vargo & Lusch, 2004). A service, therefore, is information-driven, customer-centric, electronic-oriented, and productivity-focused (Tien & Bergl, 2003). Consequently, the traditional supply chain is re-conceptualized as a *service value creation network*, which is a group of autonomous organizations working together to achieve not only their own goals, but also a collective goal (Lusch *et al.*, 2008;

**Table 1. The concepts of the KB-CBSM approach**

| *Viewpoint* | *Focus* | *Dimensions* | *Level* | *Objectives* | *Knowledge-component* |
|---|---|---|---|---|---|
| Strategic viewpoint | Value | Management | Service value creation network | Service proposal | Know-with, know-where and know-when |
| Organizational viewpoint | Information | Science | Service system | Service creation | know-who |
| Technological viewpoint | Knowledge | Engineering | Service | Service operation | Know-what, know-how and know how-why |

Provan & Kenis, 2008). In this situation, value creation occurs when a resource is turned into a specific benefit, called resourcing, that is performed by a service system. A *service system* is defined as a "value-coproduction configuration of people, technology, other internal and external service systems, and shared information." (Spohrer *et al.*, 2007).

In the KB-CBSM approach, service modelling starts with the service proposal stating where and when services can be offered and by whom. The modelling process continues with the service creation describing who provides services and ends with service operation describing what and how these offerings are created and operated (Gordijn *et al.*, 2012).

## Principles

Today's information and communication technologies effectively support a shift towards collaborative business services (Spohrer *et al.*, 2007; Roodt *et al.*, 2012). Those technologies supply information and knowledge that facilitate communication and collaboration and strengthen relationships between economic entities. A *collaborative business service* is defined as a business service provided as "a result of the collaboration between different economic entities in a network in order to achieve a collective goal."

In the context of *knowledge-intensive enterprises* (KIE), those enterprises are generally organizations that assist others in solving problems and making business decisions that require external sources of knowledge (Miles, 2005). There are three characteristics of KIEs (Miles *et al.*, 1995). Firstly, activities of KIEs are mainly based on professional knowledge. Secondly, KIEs use their own sources of information and knowledge about their activities or collaborate with external knowledge sourcing in services to their clients or suppliers (Clausen, 2013). Finally, the competitive edge of KIEs is that they are the primary knowledge suppliers, who work in collaboration with their clients to help them perform better and innovate (Harris *et al.*, 2013).

Accordingly, business services in KIEs concern different levels of knowledge development: data, information, knowledge, and understanding (Le Dinh *et al.*, 2015). *Data* are captured and stored inside the organizational memory through research, creation, gathering, and discovery. Data are turned into *information* by adding semantics and organizing it so that we can easily draw conclusions. *Knowledge* has the complexity of experience, which comes about by seeing the service from different contexts. *Wisdom* is the ultimate level of understanding. In our approach, we use the term "understanding" instead of "wisdom" (Le Dinh *et al.*, 2015) because our research still focuses on the first level of understanding. At this level, enterprises understand how to create or increase values in business services by using their knowledge and knowing. In the remainder of the paper, the term *knowledge* could refer to data, information, knowledge or understanding depending on its development level.

Consequently, *knowledge sharing* is the foundation of collaborative business services as well as their service systems and service value creation networks (Chang & Chu, 2014). Firstly, collaborative business services in KIEs are knowledge-based. Secondly, shared knowledge is one of the three elements that form a service system. Thirdly, knowledge sharing in a service value creation network reflects the configuration and operation of the network and plays a crucial role in the service value chain. Finally, information can be transformed into several types of knowledge that are indispensable for service improvement and innovation. Therefore, to implement a service value creation network, service design should take into account the creation, management and sharing of knowledge in service systems. The more knowledge is available, the more services are improved, and values are created. Once shared knowledge in a service system is clarified, other elements, such as people and technology, become more apparent as well. Furthermore, once shared knowledge between service systems in a service value creation network is clarified, the processes of network creation and operation also become more evident.

## KB-CBSM Approach

The KB-CBSM approach is defined as a knowledge-based approach that primarily focuses on the role of knowledge sharing in a service value creation network. In other words, shared knowledge assumes the responsibilities of leadership in service design, service system configuration and network management. Collaborative business service modelling is a crucial component of service design to identify and specify how knowledge-intensive enterprises work together to provide collaborative business services. Therefore, the KB-CBSM approach focuses on the interdependencies of business services in the context of a service value creation network. The interdependencies are reflected in knowledge sharing between elements of a service system, or between service systems in a service value creation network.

The KB-CBSM approach proposes a conceptual foundation, which consists of a set of interrelated concepts that can be used to present a thorough understanding of services, service systems and value creation networks. Enterprises can evolve and adapt these concepts to model their own business services according to their specific requirements.

Figure 1 shows three elements of the KB-CBSM approach and how it completely covers all the three parts of SSME (service science, management and engineering).

The KB-CBSM approach consists of three elements: service proposal, service creation, and service operation. The *service proposal* element, corresponding to the management aspect of SSME, uses the knowledge and understanding to create and increase the values of business services in a service value creation network by applying effective management practices. The *service creation* element, corresponding to the science aspect of SSME, focuses on the elements of a service system (shared information, people and technology) and aims at organizing business services in a service system. The *service operation* element, corresponding to the engineering component of SSME, transforms the shared information into knowledge to improve the quality of business services. Accordingly, depending on the levels of business services, focal points of service modelling could be different knowledge components (Garud, 1967; Le Dinh *et al.*, 2015): 1) Value creation network level: know-where, know-when and know-with; 2) Service system level: know-who; and 3) Service level: know-what, know-how and know-why.

In order to facilitate using this approach, we propose a process for service modelling in three steps, each step respectively covers a level in our approach (Table 2).

The first step concerns the *service value creation network level* for service proposal. The second step deals with *the service system level* for service creation. The third step involves the *service level* for service operation. Each level has different objectives. Depending on its objective, each level contains

**Figure 1. Three elements of the KB-CBSM approach**

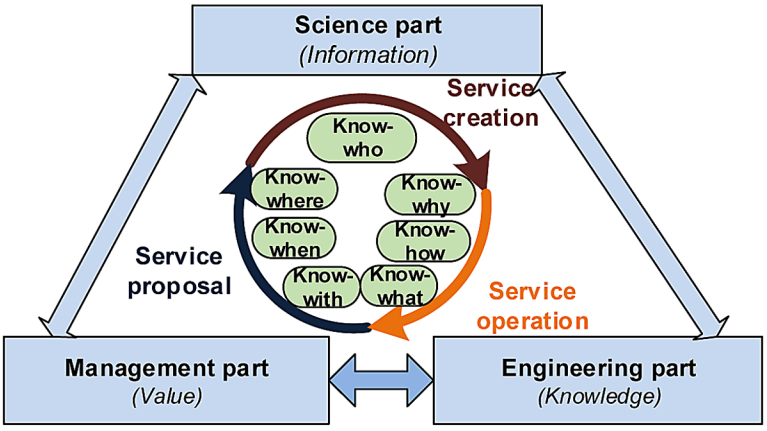


**Table 2. The service modelling process**

| *Level* | *Elements* | *Knowledge component* | *Dimension* |
|---|---|---|---|
| Service value creation network | Service proposal | Know-with, know-where, know-when | Value dimension, network dimension, collaboration dimension |
| Service system | Service creation | Know-who | Implementation dimension |
| Service | Service operation | Know-what, know-how, know-why | Information dimension, operational dimension, legal dimension |

certain dimensions of business services and corresponds to different knowledge components. The service value creation network level depicts particular networks of service systems and shows how values are proposed and exchanged between economic entities. The service system level describes what service systems are and clarifies the roles of people, technology, and knowledge sharing. The service level presents what is provided to customers and how it is provided.

## SERVICE VALUE CREATION NETWORK LEVEL

The *service value creation network level,* concerning the service proposal, aims at modelling services as a chain of value creation and exchange in which service systems co-produce common results.

This level relates to the knowledge about the business environment of the enterprise, which are represented by the following knowledge components: know-with, know-where and know-when. Know-with is the relational knowledge that concerns with the knowledge in interfirm relationships such as knowledge about the interactions in partner relationships, knowledge about the management of supply chain functions, and knowledge about its external operating environment (Johnson *et al.*, 2004). Know-where is the situational knowledge about positional relationships that indicates where to request business services (Le Dinh *et al.*, 2015). Know-when is the conditional knowledge that informs the enterprise about the value and situational appropriateness of various strategies for working with business services (Paris *et al.*, 1984). Know-where and know-when help the enterprise to request/provide the right knowledge-intensive services in the right place at the right time (Le Dinh *et al.*, 2015).

At the service value creation network level, the knowledge components as mentioned above are specified using the following dimensions: Network, value and collaboration dimensions (Le Dinh & Pham Thi, 2012). Therefore, this level consists of the *network dimension* (to specify the network configuration), the *value dimension* (to represent value creation and exchange), and the *collaboration dimension* (to specify the network operation).

### Network Dimension

The network dimension includes key concepts such as economic entity, network governance form and role. Each *economic entity* is a stakeholder of the network and has distinct goals. An economic entity could be an individual, an enterprise, a government, or an economy. A service value creation network is comprised of a variety of economic entities. Each economic entity assumes a subset of *roles* in the network. A collaborative business service requires at least one service provider and one service client. The service client seeks to reduce costs and improve services. The service provider aims to increase income and customer satisfaction. Each network is subject to a *form of network governance* (Le Dinh & Pham Thi, 2012). There are three forms of network governance: market, hierarchy and network. A market is a system of agents, in which an agent can provide products and

services to other agents (Williamson, 1975). A hierarchy is a system, in which each part is precisely defined as performing a specific function (Williamson, 1975). A network is a system that helps its members to collaborate, based on a relationship of trust (Powell, 1990).

## Value Dimension

Each economic entity may provide one or several business services. A *business service* offers a value proposal. A *value proposal* is a value produced by transferring things or by improving some states of service clients (Ma *et al.*, 2010). A *contract* defines what to offer and to whom. It is the responsibility of a *business object* to carry out a contract, such as a SLA (service level agreement), related to a business service (Glissmann & Sanz, 2010). The value proposal concerns also the service productivity that is defined as the ability of a network of service systems to use its inputs for providing outputs and services with quality matching expectations of its customers (Becker *et al.*, 2013). There are two categories of business services: independent and dependent services. Independent services or autonomous services are those whose realization is independent from the services provided by other economic entities. Dependent services require cooperation with other economic entities for their realization.

In the KB-CBSM approach, collaborative business services are provided by *knowledge spaces*, which are defined as a virtual and physical working space for a group of knowledge workers who manage a highly structured and interrelated set of data, information, knowledge, and wisdom concerning an organizational situation (Bellenger, 2004; Le Dinh *et al.*, 2015).

## Collaboration Dimension

The collaboration dimension specifies the interdependencies between economic entities in a service value creation network and the way they work together. As mentioned previously, each service is offered by an economic entity and provided by a knowledge space. Knowledge sharing between different knowledge spaces is unavoidable when several economic entities co-produce values and share a common subset of knowledge.

Knowledge sharing reflects the interdependencies between economic entities in a network. Therefore, the collaboration dimension consists of two concepts: the overlap situation and the overlap protocol that operates the overlap situation (Le Dinh & Léonard, 2004).

An *overlap situation* occurs when there is at least one business object involved in several knowledge spaces (Le Dinh & Le Tang, 2007). There are two possibilities of overlap situations: with-border and with-overlap situations. In a with-border situation, there are common business objects, but no common business activities. In a with-overlap situation, there are common business objects and common business activities, which perform operations on those common business objects.

An *overlap protocol* is a protocol that allows each economic entity to perform its own business processes locally, but also enables them to be aware of the business processes performed in other economic entities. Based on the theory of coordination, there are three types of overlap protocols (Le Dinh & Léonard, 2004). The ownership-based overlap protocol, corresponding to the hierarchical form of network governance, determines the economic entity that will play the role of the owner for each common object. The market-based overlap protocol, corresponding to the market form of network governance, determines the economic entity that will play the role of the custodian for each common object. The network-based overlap protocol, corresponding to the network form of network governance, allows each economic entity (as the co-owner) to monitor the effects caused by other co-owners' actions.

## Example

Our approach can be illustrated with an example on Continuing education services, in which a Continuing education institution provides knowledge-intensive services in terms of professional learning programs (Table 3). The institution has a number of programs related to different domains

such as Business, Computer Science, Marketing, etc. A program includes a number of modules and a work placement project. The institution hires staffs who are experts in the domain to deliver lectures to students. The institution also collaborates with a large number of companies that receive students for work placement at the end of their program.

Students register for a specific program and pay a fee, then they must take the related modules and sit the exams. For the work placement, students need to spend six months in a company as internship in order to complete their study program. At the end, the final result of students is evaluated based on their exam results, the work placement reports and grades provided by the hosted company.

The value proposal of the Study program package is to provide a quality service based on the knowledge shared between service providers. The institution considers the materials, equipment, technologies and staffs as principal resource capacities.

The economic entities in this example include the *Education institution, Student* and *Company Partner*. The *Education institution* provides services to *Student*, the service consumer. In addition, *Company Partner* is also a service provider providing *Work placement* service.

Hence, this Education network is governed by the market form of network governance and organized by the *Education institution* as a network administrative organization. Each economic entity participating in the network may provide different services. The *education institution* service provider supplies *Study program* services (including the service provided by itself, and a service provided by Company partner) to the *student* service client. Table 4 presents the overlap situations and overlap protocols related to *Study program* business object and its specializations.

Note:

- R: requester, C: custodian, O: owner, RR: referrer
- *with-border* situation: sharing business objects
- *with-overlap* situation: sharing business object and activities

The *Study program* business object is owned by the Education center and shared among stakeholders with the *with-border* overlap situation. A *program in course* is actually a specialized of *Study program* that is offered to students for the time being, and there are students already registered to this program. After their registrations, students become service consumers who receive the education service.

**Table 3. Collaborative business services in a Continuing education network**

| *Element of a service system* | *Framework level* | *Continuing learning package service* |
|---|---|---|
| Service operation | Service level | - Study program<br>- Academia learning or Modules<br>- Work placement |
| Service creation | Service system | Technical implementation of services including implementation of related business activities such as Opening study program for registration, Receiving student payments, Providing lectures, Organising exams, Organising Work placement and Final Evaluation |
| Service proposal | Service value creation network | -Network of collaborative business service providers which are Education centre and Partner companies<br>- Collaboration between service systems based on network configuration and shared knowledge. |

**Table 4. Some overlap situations in the Education service network**

| *Overlap situation* | *Education Centre* | *Student* | *Partner Company* | *Overlap situation* | *Overlap protocol* |
|---|---|---|---|---|---|
| - Business object: *Study Program* | O | RR | RR | *With-border* | *Ownership-based* |
| - Business objects: *Program in course*<br>- Business activities: *Register* | C | R | - | *With-overlap* | *Market-based* |
| - Business objects: *Student*<br>- Business activities: *Pay* | C | R | - | *With-overlap* | *Market-based* |
| - Business objects: *Student*<br>- Business activities: *Sit exam* | C | R | - | *With- overlap* | *Market-based* |
| - Business objects: *Work placement*<br>- Business activities: *Take Work placement* | R | R | C | *With-overlap* | *Market-based* |

The business object *Work placement* is provided by Company partner who also shares the *Take work placement* activity, thus there is the *with-overlap* overlap situation in this context.

## SERVICE SYSTEM LEVEL

The *service system level*, concerning service creation, involves the configuration and implementation of business services in a service system. This level ensures that the service has adequate resources and sufficient technological support.

This level addresses the know-who knowledge component. Know-who refers to a combination of knowledge and social relationship about resources such as individuals, groups, or organizations that may implement a knowledge-intensive service (Le Dinh *et al.*, 2013). Indeed, there are two groups of KIEs that provide two different categories of knowledge-intensive services: technology KIEs and professional KIEs (Shearmur & Doloreux, 2008). Technology KIEs perform the following activities: activities related to information technology, research and development, architecture and engineering activities and relevant consultancy, testing and technical activity analysis. In professional KIEs, the following activities are included: legal sectors, accounting, bookkeeping and auditing activities, tax consultancy, market research, as well as the entire advertising campaign. In general, there are two main categories of know-who: who-know-what and who-know-how (Le Dinh *et al.*, 2015).

Know-who in the proposed approach is specified by the implementation dimension. The *implementation dimension*, consisting of the relations between shared knowledge, technological solutions and the necessary resources, as well as the interaction between the service system and stakeholders. One of the objectives of this dimension is to improve business services through information technology (Piccoli *et al.*, 2001).

### Implementation Dimension

The implementation dimension includes key concepts such as business service, business object, business process, technical implementation, and resources (Le Dinh & Pham Thi, 2012).

A *business object* is an actor within the business layer that represents a part of a knowledge-intensive enterprise that has its own goal and a set of interrelated knowledge as supporting materials. A *process* is a response from the service system to the occurrence of an event provoked by an economic entity. A process could be a commercial transaction. Process measures are a subset of indicators used

to assess the result of a process based on the different aspects of performance measurement (efficiency, effectiveness and sustainability), service productivity, and service quality. Each business process supported by a knowledge space could be implemented by one or several *technical implementations. Resources* are needed for those technical implementations. In general, a *business service* is operated by a subset of business processes, which require resources for the technical implementations of those processes.

### Example

The know-who aspect of the Service system level is described by the implementation dimension. In this dimension, the business processes, the technical implementations and resources of services need to be identified.

The processes involved in this example are Register to a program, Pay, Provide lectures/ Take modules, Organize/Take exams, Take/Provide work placement project, and Final grading. The details are illustrated in Table 5.

The technical implementation of *Register to a program* can be online registration, by phone or in person. Students visit the Institution website to make a registration online, call an officer or call in the Institution. Student can also make a payment online via the Institution website or on site.

## SERVICE LEVEL

The s*ervice level*, concerning the service operation, emphasizes what is provided to customers and how it is provided. In other words, this level deals with different types of knowledge related to the service operation.

There are three types of knowledge: know-what, know-how and know-why at the service level (Garud, 1997; Le Dinh *et al.*, 2015). Know-what refers to facts and artefacts relating to a business service. Know-how refers to the understanding of the generative processes constituting a business service. Know-why refers to the understanding of the principles underlying a business service, especially those related to service quality and contract. In the KB-CBSM approach, know-what is described by the informational dimension, know-how, by the operational dimension, and know-why, by the legal dimension.

To specify the service operation, a business object (BO) as the provider needs to be modelled based on the three aspects of knowledge: the static, the dynamic and the rule aspects (Le Dinh *et al.*, 2013). The static aspect of knowledge relates to the structure of knowledge and knowing, meanwhile the dynamic aspect of knowledge focuses on the transition of knowledge. The definition of the rule

**Table 5. Implementation dimension of the Study program service**

| Event/Business process | Technical implementation | Resources |
|---|---|---|
| Register to a program | Online | Web site |
| “ | By phone | Centre Officer, phone, computer |
| “ | In person | Centre Officer, computer |
| Pay | Online | Web site |
| “ | In person | Centre Officer |
| Take module | In person | Lecturer, Lab room, Lecture room |
| Take exam | In person | Centre Officer, Room |
| Take work placement | In person | Company partner’s resources |
| Final grading | Computer and in person | Computer, Exam board, Program coordinator |

aspect is based on the two previous concepts and concerns the governance of knowledge structure (Le Dinh *et al.*, 2013). In the context of knowledge-intensive enterprises, the static aspect of a BO is stated as a subset of interconnected dependent business objects, representing by the informational dimension. The dynamic aspect of a BO is stated as a subset of processes, representing the operational dimension that uses activities of those business objects. The rule aspect of a BO is stated as a subset of business rules, representing the legal dimension, of which scopes are defined based on business objects and activities.

## Informational Dimension

The informational dimension representing know-what knowledge corresponds to the static aspect of information that describes the existing types of shared knowledge, their structures, and their interrelations (Le Dinh & Fillion, 2008).

A *business object* is defined as a type of an intelligible entity being an actor inside the business architecture and a set of instances of this type. An *attribute* of a business object is a function corresponding to every instance of this business object and to a set of instances of other business objects. The *key* of a business object is defined by a set of special attributes, which can be used to distinguish one instance from other instances in the same business object. A business object can define its specializations (e.g. subclasses*)*, interpreted as the subset of objects of their generalization (e.g. superclass) for which the dynamic specialization condition is evaluated to be "true."

## Operational Dimension

The operational dimension representing know-how knowledge addresses the question of how to perform business service operations. This dimension corresponds to the dynamic aspect of information describing the behaviour of a business service, called *service behaviour*, and the behaviour of a service system, called *system behaviour* (Le Dinh & Fillion, 2008).

*Service behaviour* includes concepts such as *dynamic state* and *method*. *Dynamic states* of a business object are conditions, modes or situations during which certain business activities are "enabled" and others "disabled." A dynamic state represents a subset of instances of a business object; therefore, it is a specialization of this business object. A *business activity* is an operation of a service used to transit from a set of dynamic states to another set of dynamic states.

*System behaviour* includes the concept of *processes*. A process uses a set of business activities and transforms a set of dynamic states of instances of business objects inside the service system. A precondition is a necessary condition for performing a process, while a post-condition is a necessary condition after a process.

## Legal Dimension

The legal dimension of know-why knowledge consists of different factors in the environment of the service system, such as goals, regulations and policies, and contracts. These factors could be translated into business rules in service systems and then into integrity rules in information systems. The legal dimension corresponds to the rule aspect of knowledge, which guarantees the coherence of shared knowledge (Le Dinh & Fillion, 2008).

*An integrity rule (IR)* represents the implementation of a business rule in an information system. IR' s*copes* represent the context of an IR that covers a subset of relative business objects. *Risks* are the possibilities of suffering from incoherent knowledge that may lead to fail points of certain activities.

## Example

Let us discuss the three key dimensions representing the *Study program package* service at the service level. We use simplified UML notation (Rumbaugh *et al.*, 1999) to specify the informational dimension and the Petri-net diagram (Peterson, 1977) to illustrate the operational dimension.

The **informational dimension** includes the following business objects (BO): *student, registration, payment, study program, modules, work-placement project, results and company partner.* The *study program* service is represented by the *study program* BO and its relevant BO in Figure 2. A student can make several registrations; each registration relates to one study program. Students need to pay for each registration. A study program includes several modules and a work placement program (or project). Each work placement program is provided by one company partner who can offer several work placement programs. Students get results for each module taken by sitting an exam and a result of the work placement program.

The **operational dimension**, including a set of dynamic states, activities, and processes, is depicted by a Petri-Net diagram as in Figure 3, in which a state represents a dynamic state, and a transition, a process of the service system (left side) or a business activity of a business object (right side).

Students register to an opened program. Then they need to pay the tuition fee to be able to follow the modules and take a work placement. They receive the result of each module taken and the work placement done. Finally, the exam board management and the program coordinator award them the certificate if they pass the required criteria based on their study results; otherwise, they need to repeat some modules or another work placement in the next term of that program which requires them to register again and to pay a suitable fee.

The **legal dimension** reflects the regulations related to the *Student* and the *Education institution.* This is represented by the student handbook or the institution's policy. In our example, there are integrity rules specifying what level of the student's mark or results to get a suitable award. There is also an integrity rule indicating that student can pay in maximum two weeks after the first module started.

**Figure 2. Informational dimension of the Study program service**

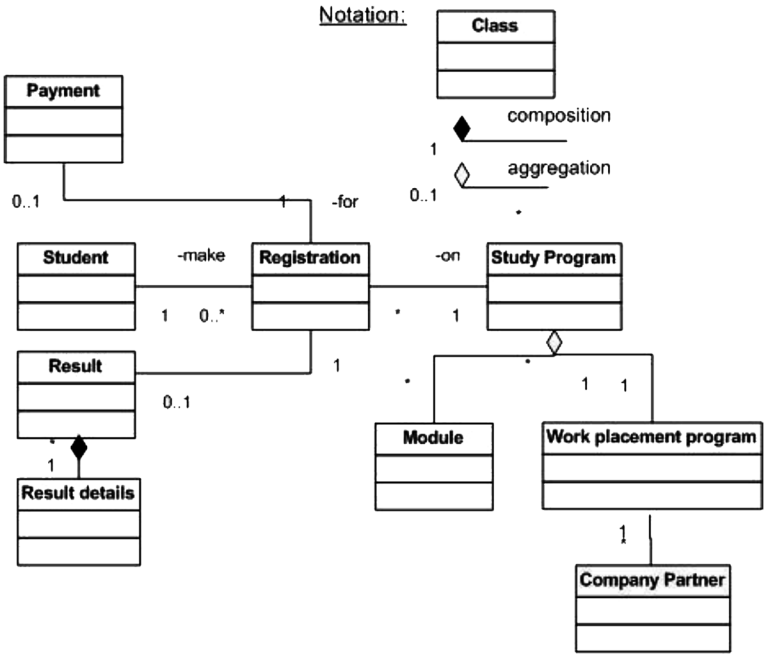
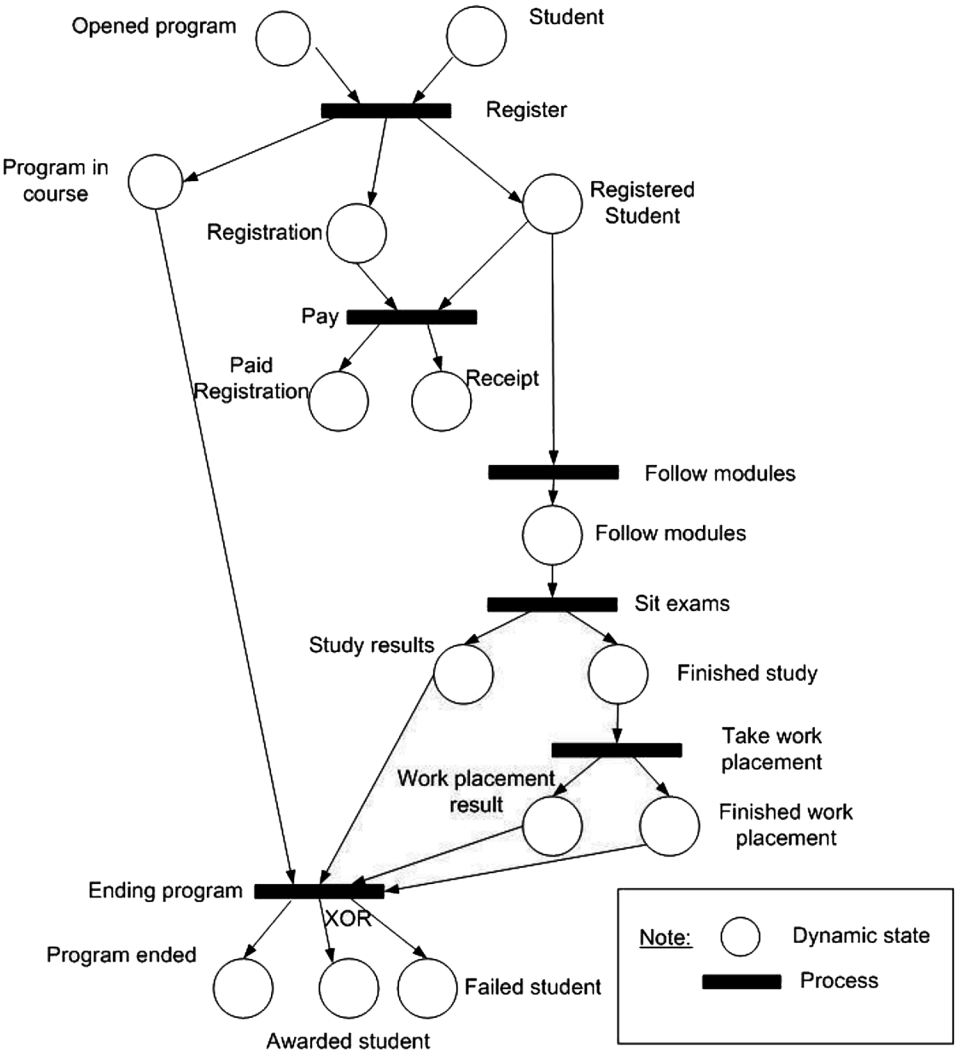


**Figure 3. Excerpt of the operational dimension of the study program service**




## META-MODEL OF THE KB-CBSM APPROACH

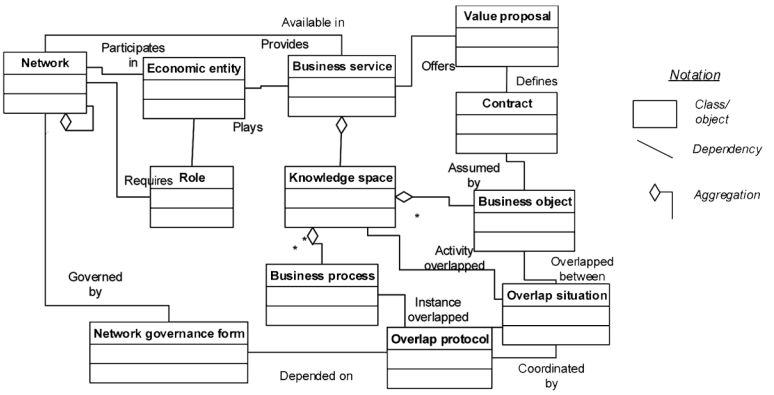
This section presents the meta-model of the KB-CBSM approach based on the three levels: Service value creation network, Service system and Service levels. The purpose of this meta-model is to clarify the interrelations between the concepts and dimensions of the conceptual foundation.

### Meta-model of the Service Value Creation Network Level

Figure 4 summarizes the concepts of the KB-CBSM approach related to the network, value, and collaboration dimensions using simplified UML notation (Rumbaugh *et al.*, 1999).

Each economic entity plays a specific role and provides several business services in a service value creation network. A business service is provided by a knowledge space, which covers a family of all interrelated knowledge. Each knowledge space manages a subset of business objects and corresponding business processes. When knowledge spaces share knowledge related to their business objects or

**Figure 4. Meta-model of the service value creation network level**




business processes, there are overlap situations. A with-border situation occurs when there is a subset of overlapped instances of business objects. A with-overlap situation occurs when there is a subset of overlapped instances of business objects and a subset of overlapped business processes. Each overlap situation is operated by an overlap protocol that will be conformed to the network governance form.

### Meta-model of the Service System Level

Figure 5 summarizes the concepts of the service system level and the links between the implementation dimension and the other dimensions. In fact, a knowledge space is composed of a subset of interconnected business objects, a subset of related business processes, and a subset of related business rules.

### Meta-model of the Service Level

Figure 6 presents the meta-model of the service level. The links between the operational, legal and informational dimensions are also presented in Figure 6. A dynamic state represents a subset of instances of a business object and is a specialization of this business object. A business process uses a subset of business activities. A business activity belongs to a business object. Scopes of an integrity rule apply to a subset of business objects. Each activity may include a set of attributes as its scope and may involve some risks.

## DISCUSSION

This section begins with a review of the literature and then points out the differences between the KB-CBSM approach and other approaches.

### Related Work

Firstly, service modelling concentrates on the representation of relations between what is provided to customers, how it is provided, the technical definition of the service, and the resources needed for operating the service (Vilho, 2006). Secondly, in the context of service collaboration, service modelling also aims at pointing out service systems and service value creation networks, and explaining how those systems and networks arise and evolve, as well as how to coordinate internal and external service systems.

Corresponding to the three parts of SSME, we classify current approaches to service modelling in three categories: management-oriented, engineering-oriented, and science-oriented approaches.

**Figure 5. Meta-model of the service system level**

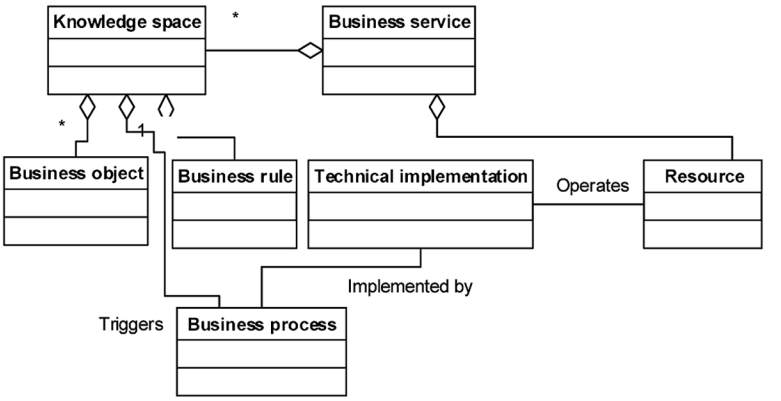
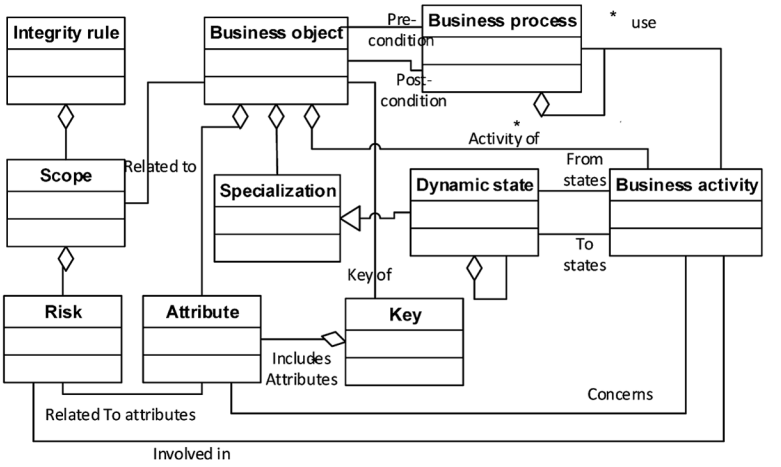



**Figure 6. Meta-model of the service level**




**Management-oriented approaches** have often come from the fields of production and operation management in networked businesses, topology of service networks and interaction patterns between organizations. Tung and Juan (2010) proposed a framework for service innovation based on an ecological perspective which underlines "the destined partnership deriving direct effect in value co-production". He and Yang (2007) classify collaboration patterns based on interaction topology between participants and their role in collaboration. Some approaches have focused on the economics literature concerning information sharing in oligopolies (Buhman *et al.*, 2005) or supply chains (Zhang, 2002; Li 2002). Chituc *et al.* (2009) developed a framework for seamless interoperability in a collaborative networked environment.

**Engineering-oriented approaches** have come from the field of industrial engineering, which usually focuses on modelling traditional services such as person-to-person and single channel services. Firstly, the *service blueprint* approach is a method proposed by Shostack (Shostack, 1982; 1984) and developed by several authors (Bitner *et al.*, 2008; Kingman-Brundage *et al.*, 1995; and Patricio, 2008). A blueprint is a two-dimensional picture of a process: the horizontal axis represents the chronology of actions, and the vertical axis, different areas of actions. Another approach is the *lean consumption* approach developed by Womack & Jones (2005) as a service counterpart to the manufacturing concept

of "lean production." Regarding complex engineering services which are defined as "the long-term provision of a set of technical capabilities based on a complex engineering system to a customer at a contractually defined performance" (McFarlane & Cuthbert, 2012), the 12-Box model for service information requirements has been developed for capturing, organizing and assessing information requirements of those complex services.

**Science-oriented approaches** have mostly come from the fields of information science and computer science that focus strongly on the system being developed and on its functional requirements. Some of those approaches are based on the *business process perspective* for designing service-based systems (Piccinelli *et al.*, 2002; Terai *et al.*, 2003). Others have tried to capture *business goals and requirements* and translate them into system design (Mylopoulos *et al.*, 2002). Meanwhile, Roland and Souveyet (2010) proposed an intentional approach to service engineering by adding to IT services some business descriptions such as intentions and strategies to achieve the goals of the service. This approach aims to help business users in service composition, service publication and service discovering.

Recently, the *value-driven or goal-driven* approaches have used value or goal models as the foundation for designing services (Henkel *et al.*, 2007; and Ma *et al.*, 2010). Addressing collaboration in networked services, Yao *et al.* (2011) focus on monitoring the collaboration based on the service level agreement between stakeholders and their business processes. Meanwhile, Yan *et al.* (2010) proposed using ontology of collaborative manufacturing to align the IT (service-oriented framework) with business (service-dominant logic) in a collaboration context.

## Comparison Between the KB-CBSM Approach and Other Approaches

The evolution of inter-organizational research implies that an organization is a system that is enabled by information technology and characterized by information sharing. Thus, the interoperability of technology, business processes and people needs is to be developed to create higher value from value creation networks (Chesbrough & Spohrer, 2006). Therefore, information sharing in a network has drawn the attention of some researchers; however, there is still little attention on knowledge sharing in a service value creation network.

Our framework describes a systematic way for collaborative business service modelling in knowledge-intensive enterprises that takes into account different levels from service analysis, design and implementation in a service value creation network. The comparison of our approach with the existing ones is described in Table 6.

Compared to management-oriented approaches, our research focuses on knowledge sharing in a service value creation network, as opposed to the traditional supply chain, and different from approaches with collaboration patterns and maturity levels. Furthermore, our framework concentrates on identifying sharing requests between economic entities, and then designs knowledge sharing based on *overlap situations* (Le Dinh & Léonard, 2004). Working with knowledge sharing has the advantage of being more natural and effective because knowledge sharing determines the interoperability of technology, business processes and knowledge workers in a value creation network based the network governance model.

Compared to science-oriented approaches, our approach focuses on *shared knowledge* instead of business models, goals or values (as in Mylopoulos *et al.*, 2002; and Henkel *et al.*, 2007). We consider that knowledge sharing in a value creation network obviously and completely reflects the process of network creation and operation, especially for a network of knowledge-intensive enterprises. Therefore, knowledge sharing is more general than business and goal models and can be used as the foundation for service modelling in a service value creation network. In addition, our framework allows to start from business perspectives to derive IT solutions for a value creation network, so it supports the alignment between business with IT, which is more general than Yan *et al.* (2010) approach. In the KB-CBSM approach, we consider a value creation network as a variable and complex network of service systems with several network governance forms at different network levels. We believe that

**Table 6. Comparison between the KB-CBSM approach and other approaches**

| *Approach* | *Authors* | *Description* |
|---|---|---|
| Management-oriented approaches | • Buhman *et al.*, 2005<br>• Zhang, 2002; Li 2002<br>• He and Yang (2007)<br>• Chituc *et al.*, 2009 | - Focusing on information sharing in oligopolies or supply chains.<br>- Concerning topology of service network and collaboration patterns |
| Science-oriented approaches | • Terai *et al.*, 2003<br>• Piccinelli *et al.*, 2002<br>• Mylopoulos *et al.*, 2002<br>• Henkel *et al.*, 2007<br>• Ma *et al.*, 2010; Yan *et al.*, 2010<br>• Yao *et al.*, 2011<br>• Roland & Souveyet, 2010 | - Focusing on business process perspective, business models, goals or value proposals.<br>- Concerning alignment of business with IT in collaboration and expanding IT service with business description |
| Engineering-oriented approaches | • Shostack, 1982; 1984<br>• Bitner *et al.*, 2008<br>• Kingman-Brundage *et al.*, 1995<br>• Patricio, 2008<br>• Womack & Jones, 2005<br>• McFarlane and Cuthbert, 2012 | - Focusing on the concepts of service blueprints or of lean consumption.<br>- Concerning a new information requirement analysis approach for complex engineering services. |
| KB-CBSM approach | | - Focusing on shared knowledge in service systems and in a service value creation network.<br>- Concerning the service modelling and improving for knowledge-intensive services |

the proposed framework is able to specify complex and modern types of collaborative knowledge-intensive services in the global networked age.

Compared to engineering-oriented approaches, the knowledge-based approach is at a higher level of knowledge development and focuses on business perspectives instead of IT solutions. The specifications based on the key concepts of the proposed approach could be mapped into service modelling languages and then implemented in a specific IT service platform. In fact, recent research emphasizes that IT solutions need to be derived from business perspectives (Mylopoulos *et al.*, 2002; and Henkel *et al.*, 2007). Accordingly, we follow this direction in our work: we start from a business perspective and then continue with IT solutions.

At this point, our approach shares the common strategy of the approaches of Quartel *et al.* (2007) and Bottcher (2010), serving as a semantic meta-model to enable the use of different service modelling languages. These three approaches share a common objective: encouraging enterprises to invest in the informational and knowledge levels, independent from technology choices. Compared to Quartel *et al.* (2007), the knowledge-based approach follows the hierarchy of service science in defining its levels: service, service system and service value creation network. The approach proposed by Quartel *et al.* has three levels: single interaction, choreography and orchestration. Our approach covers more dimensions than this approach, including dimensions related to network configuration and collaboration. Compared to Bottcher (2010), the proposed approach also has more dimensions at different levels. The approach proposed by Bottcher is essentially based on four dimensions: resources, components, products and processes at the same level of abstraction.

We believe that our approach is more suitable than existing approaches for certain collaborative business services in the context of a service value creation network such as knowledge-intensive services. Furthermore, our approach comprehensively and clearly covers all three parts of SSME. Therefore, the KB-CBSM approach is effectively useful in applying scientific understanding, engineering discipline, and management practices concurrently. In summary, we propose how to use different modelling languages to model the dimensions of our approach. Table 7 summarizes the

**Table 7. Formal specifications for each level of the information-driven approach**

| *Dimension* | *Level* | *Modelling Concepts and Representation* |
|---|---|---|
| Management | Service value creation network | - Collaborative business process with responsibility for business activities (actors) using UML or BPMN (BPMN, 2009).<br>- Overlap situation on business objects and business activities using table or natural language. |
| Science | Service system | - Implementation of each business activity in a service and corresponding resources needed using table or natural language. |
| Engineering | Service | - Class diagram using UML, ER or IASDO (Pham-Thi & Helfert, 2007).<br>- State transition diagram using UML or IASDO.<br>- Business process, Activity diagram using UML, BPMN (BPMN, 2009), Petri nets or IASDO.<br>- Business rules description using First order logic, OCL of UML, Table decision, or predicate logic. |

concepts to be modelled in each layer of our approach. These modelling concepts can be described with different modelling languages of the user choices with respect to the concepts and syntax described in the corresponding meta-models proposed in our framework.

## CONCLUSION

Nowadays, the service sector dominates the global economy. Consequently, there is still a need for a strong foundation for service design and innovation, especially for knowledge-intensive industry (Bitner *et al.*, 2008). For this reason, our research focuses on proposing an approach for understanding, modelling and improving collaborative business services for knowledge-intensive enterprises based on knowledge sharing. The purpose of the proposed approach, called KB-CBSM (Knowledge-Based Collaborative Business Service Modelling), is to provide an effective framework best suited for designing complex and networked knowledge-intensive services in a coherent manner.

This paper deals with the main objective of the KB-CBSM approach: modelling and improving collaborative knowledge-intensive services. It proposes a conceptual foundation to understand and model knowledge-intensive services in order to facilitate the design, elaborate and collaborative business services in a service value creation network. The framework includes a set of concepts at three levels: the *service value creation network level* for service proposal, the *service system level* for service creation, and the *service level* for service operation. The concepts are organized into several dimensions, such as the informational, operational, legal, implementation, value, network and collaboration dimensions. These dimensions clarify the role of shared knowledge, people, and technology in service systems and in a service value creation network.

We believe that our approach enables and facilitates the improvement and creation of innovative collaborative business services that are crucial for knowledge-intensive enterprises in the global networked age. The three levels of the proposed approach help knowledge-intensive enterprises to model thoroughly the value proposition and exchange in a network, to use recent technologies to improve their existing services or to create innovative ones, and to manage efficiency their service operations. With respect to the implications of our work in practice, when a knowledge-intensive enterprise intends to create or to join a service value creation network, the KB-CBSMK approach provides principles and guidelines to specify collaborative business services, identify shared knowledge, and decide how to collaborate with business partners.

Concerning the implications for research, we are currently working on applying the approach on a broader scale. In accordance with the main objective of our research, we have stressed on validating the framework in practice, especially to model collaborative knowledge-intensive business services

in specific areas such as educational, marketing and financial services. Furthermore, we are also developing a service-based knowledge management platform to help knowledge-intensive enterprises to perform their activities related to service operation, service creation and service proposal based on the traditional knowledge and the new knowledge extracted from big data.

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## REFERENCES

Becker, J., Beverungen, D., et al. (2013). On the ontological expressiveness of conceptual modeling grammars for service productivity management. *Information Systems and e-Business Management*.

Bellenger, G. (2004). Creating knowledge objects. Retrieved from http://www.systems-thinking.org

Bitner, M., Ostrom, A., & Morgan, F. (2008). Service blueprinting: A practical technique for service innovation. *California Management Review*, *50*(3), 66–94. doi:10.2307/41166446

Böttcher, M., & Fähnrich, K. (2010). Modeling of Service Systems. *International Journal of Service Science, Management, Engineering, and Technology*, *1*(4), 1–11.

BPMN. (2009). *Business Process Model and Notation* (dtc/2009-08-14). Retrieved from http://www.omg.org/spec/BPMN/2.0

Buhman, C., Kekre, S., & Signal, J. (2005). Interdisciplinary and Interorganizational research: Establishing the Science of Enterprise Networks. *Production and Operations Management*, *14*(4), 493–513. doi:10.1111/j.1937-5956.2005.tb00236.x

Chang, M. C., & Chu, Y. M. (2014). A Case Study of a Knowledge-Sharing Web-Based Platform for Energy Education. *International Journal of Innovation in the Digital Economy*, *5*(1), 60–70. doi:10.4018/ijide.2014010106

Chesbrough, H., & Spohrer, J. (2006). A Research Manifesto for Services Science. *Communications of the ACM*, *49*(7), 35–40. doi:10.1145/1139922.1139945

Chituc, C-M., & Toscano, A.A.C. (2009). A framework proposal for seamless interoperability in a collaborative networked environment. *International Journal of Computers in Industry*, 60, 317-338.

Clausen, T. H. (2013). External knowledge sourcing from innovation cooperation and the role of absorptive capacity: Empirical evidence from Norway and Sweden. *Technology Analysis and Strategic Management*, *25*(1), 57–70. doi:10.1080/09537325.2012.751009

Doloreux, D., & Shearmur, R. (2011). Collaboration, Information and the Geography of Innovation in Knowledge Intensive Business Services. *Journal of Economic Geography*. doi:10.1093/jeg/lbr003

Garud, R. (1997). *On the Distinction between Know-How, Know-What, and Know-Why.*In A. Huff, J. Walsh, & C. N. Grenwich (Eds.), *Advances in Strategic Management* (Vol. 14, pp. 81–201). JAI Press.

Glissmann, S., & Sanz, J. (2010). *Business Architectures for the Design of Enterprise Service Systems. P. P. Maglio* (Ed.), *Handbook of Service Science.* (pp. 251–282). USA: Springer.

Gordijn, J., & Razo-Zapata, I. et al.. (2012). Challenges in Service Value Network Composition. In K. Sandkuhl, U. Seigerroth & J. Stirna (Eds.), *The Practice of Enterprise Modeling* (pp. 91–100) . *Springer Berlin Heidelberg*.

Harris, R., McAdam, R., McCausland, I., & Reid, R. (2013). Knowledge management as a source of innovation and competitive advantage for SMEs in peripheral regions. *International Journal of Entrepreneurship & Innovation*, *14*(1), 49–61. doi:10.5367/ijei.2013.0105

He, D. D., & Yang, J. (2007). Security policy specification and integration in business collaboration. *Proceedings ofIEEE International Conference on Services Computing 2007*, Salt Lake City, Utah, USA (pp. 20–27). doi:10.1109/SCC.2007.96

Henkel, M., Johannesson, P., Perjons, E., & Zdravkovic, J. (2007). Value and Goal Driven Design of E-Services. *Proceeding of IEEE Conference on e-Business Engineering*. doi:10.1109/ICEBE.2007.42

Johnson, J. L., Sohi, R. S., & Grewal, R. (2004). The role of relational knowledge stores in interfirm partnering. *Journal of Marketing*, *68*(3), 21–36. doi:10.1509/jmkg.68.3.21.34765

Kingman-Brundage, J., & William, R. (1995). "Service logic": Achieving service system integration. *International Journal of Service Industry Management*, *6*(4), 20–39. doi:10.1108/09564239510096885

Le Dinh, T., & Fillion, G. (2008). Acquiring Domain Knowledge of Information Systems: The Information System Upon Information Systems Approach. *Academy of Information and Management Sciences Journal*, *10*(2), 57–77.

Le Dinh, T., & Le Tang, H. (2007). Towards an approach for modelling interoperability of information systems. *Proceeding of the RIVF'07*, Ha-Noi, Vietnam.

Le Dinh, T., & Léonard, M. (2004). Towards coordination-ready information systems: the Information System Component approach.*Proceeding of the International Conference on Advances in Intelligent Systems - Theory and Applications (AISTA'04)*, Luxembourg.

Le Dinh, T., & Pham Thi, T. T. (2012). Information-Driven Framework for Collaborative Business Service Modelling. *International Journal of Service Science, Management, Engineering, and Technology*, *3*(1), 1–18. doi:10.4018/jssmet.2012010101

Le Dinh, T., & Rickenberg, T. Fill, Hans-Georg, & Breitner H. M. (2015). Enterprise Content Management Systems as a Knowledge Infrastructure: The Knowledge-Based Content Management Framework. International journal of e-collaboration, 11(3).

Le Dinh, T., Rinfret, L., Raymond, L., & Dong Thi, B. T. (2013). Towards the reconciliation of knowledge management and e-collaboration systems. *Interactive Technology and Smart Education*, *10*(2), 95–115. doi:10.1108/ITSE-09-2012-0022

Li, L. (2002). Information Sharing in a Supply Chain with Horizontal Competition. *Management Science*, *48*(9), 1196–1212. doi:10.1287/mnsc.48.9.1196.177

Lusch, R. F., Vargo, S. L., & Wessels, G. (2008). Towards a conceptual foundation for service science: Contributions from service-dominant logic. *IBM Systems Journal*, *47*(1), 5–14. doi:10.1147/sj.471.0005

Ma, C., Wang, Z., & Xu, X. (2010). Preliminary Discussions on Several Characteristics of Service Value. [IJSSMET]. *International Journal of Service Science, Management, Engineering, and Technology*, *1*(3), 50–62. doi:10.4018/jssmet.2010070103

Maglio, P. P., Spohrer, J., Seidman, D. I., & Ritsko, J. J. (2008). Preface. *IBM Systems Journal*, *47*(1), 3–4. doi:10.1147/sj.471.0003

McFarlane D., & Cutgbert R. (2012). Modelling information requirements in complex engineering services. *Journal of Computers in Industry*, 63, 349-360.

Miles, I. (2005). Knowledge intensive business services: Prospects and policies, *Foresight*. *Emerald Group Publishing Limited*, *7*(6), 39–63. doi:10.1108/14636680510630939

Miles, I., Kastrinon, N., Flanagan, K., Bilderbeek, R., den Hertog, P., Huntink, W., & Bouman, M. (1995). *Knowledge-intensive business services: Their roles as users, carriers and sources of Innovation*. The University of Manchester.

Mylopoulos, J., Chung, L., & Yu, E. (1999). From object-oriented to goal-oriented requirements analysis. *Communications of the ACM*, *42*(1), 31–37. doi:10.1145/291469.293165

OCDE. (2007). *Innovation and knowledge-intensive services activities*. Paris: OECD Publishing.

Paris, S. G., Cross, D. R., & Lipson, M. Y. (1984). Informed Strategies for Learning: A program to improve children's reading awareness and comprehension. *Journal of Educational Psychology*, *76*(6), 1239–1252. doi:10.1037/0022-0663.76.6.1239

Patricio, L., Raymond, P. F., & Cunha, J. F. (2008). Designing Multi-Interface Service Experiences. *Journal of Service Research*, *10*(4), 318–334. doi:10.1177/1094670508314264

Peterson, J. L. (1977). Petri Nets. *ACM Computing Surveys*, *9*(3), 223–252. doi:10.1145/356698.356702

Pham Thi, T. T., & Helfert, M. (2007). Modelling information manufacturing systems.[InderScience Publisher.]. *International Journal of Information Quality*, *1*(1), 5–21. doi:10.1504/IJIQ.2007.013373

Piccinelli, G., Emmerich, W., Zirpins, C., & Schutt, K. (2002). Web service interfaces for inter-organisational business processes an infrastructure for automated reconciliation. *Proceedings of theEnterprise Distributed Object Computing Conference*. doi:10.1109/EDOC.2002.1137717

Piccoli, G., Spalding, B. R., & Ives, B. (2001). The customer-service life cycle: A framework for improving customer service through information technology. *The Cornell Hotel and Restaurant Administration Quarterly*, *42*(3), 38–45.

Powell, W. W. (1990). Neither market nor hierarchy: Network forms of organization. *Research in Organizational Behavior*, (12): 295–336.

Provan, K. G., & Kenis, P. N. (2008). Modes of network governance: Structure, management, and effectiveness. *Journal of Public Administration: Research and Theory*, *18*(2), 229–252. doi:10.1093/jopart/mum015

Quartel, D. A. C., Steen, M. W. A., Pokraev, S., & Sinderen, M. V. (2007). COSMO: A conceptual framework for service modelling and refinement. *Information Systems Frontiers*, *9*(2-3), 225–244. doi:10.1007/s10796-007-9034-7

Räisänen, V. (2006). *Service Modelling: Principles and Applications*. Wiley. doi:10.1002/0470028653

Roland, C., & Souveyet, C. (2010). An intentional approach to service engineering. *IEEE Transactions on Services Computing*, *3*(4), 292–305. doi:10.1109/TSC.2010.26

Roodt, S., de Villiers, C., & Joubert, P. (2012). Collaborative Learning for the Net Generation: Using Social Networks in an Undergraduate Course. *International Journal of Innovation in the Digital Economy*, *3*(3), 10–24. doi:10.4018/jide.2012070102

Rumbaugh, J., Jacobson, I., & Booch, G. (1999). *The Unified Modeling Language Reference Manual*. Addison Wesley Longman.

Shearmur, R., & Doloreux, D. (2008). Urban hierarchy or local buzz? High-order producer service and (or) knowledge-intensive business service location in Canada, 1991-2001. *The Professional Geographer*, *60*(3), 333–355. doi:10.1080/00330120801985661

Shostack, L. G. (1982). How to Design a Service. *European Journal of Marketing*, *16*(1), 49–63. doi:10.1108/EUM0000000004799

Shostack, L. G. (1984). Design Services that Deliver. *Harvard Business Review*, *62*(1), 133–139.

Spohrer, J., Maglio, P.P., Bailey, J., & Gruhl, D. (2007). Steps Towards a Science of Service Systems. *IEEE Computer*, 40(1), 71-77.

Steinmueller, W. E. (2002). Knowledge-based economies and information and communication technologies. *International Social Science Journal*, *54*(171), 141–153. doi:10.1111/1468-2451.00365

Terai, K., Izumi, N., & Yamaguchi, T. (2003). Coordinating Web Services based on business models. *Proceedings of of the 5th international conference on Electronic commerce*. New York, NY, USA: ACM. doi:10.1145/948005.948066

Tien, J. M., & Berg, D. (2003). A case for service systems engineering. *Journal of Systems Science and Systems Engineering*, *12*(1), 13–38. doi:10.1007/s11518-006-0118-6

Tung, W.-F., & Yuan, S.-T. (2010). iDesign: An intelligent design framework for service innovation. *International Journal of Services Sciences*, *1*, 315–332. doi:10.1504/IJSSCI.2008.021768

Vargo, S. L., & Lusch, R. F. (2004). Evolving to a New Dominant Logic for Marketing. *Journal of Marketing*, *68*(1), 1–17. doi:10.1509/jmkg.68.1.1.24036

Williamson, O. E. (1975). *Markets and Hierarchies: Analysis and Antitrust Implications*. New York: Free Press.

Womack, J. P., & Jones, D. J. (2005). Lean Consumption. *Harvard Business Review*, 83(3), 93–103. PMID:15768676

Yan, J., Ye, K., Wang, H., & Hua, Z. (2010). Ontology of collaborative manufacturing: Alignment of service-oriented framework with service-dominant logic. *International Journal of Expert Systems with Applications, No.*, *37*(3), 2222–2231. doi:10.1016/j.eswa.2009.07.051

Yao, J., Chen, S., Wang, C., Levy, D., & Zic, J. (2011). Modelling collaborative services for business and QoS compliance.*Proceedings of IEEE International Conference on Web Services*. doi:10.1109/ICWS.2011.44

Zhang, H. (2002). Vertical information exchange in a supply chain with duopoly retailers. *Production and Operations Management*, *11*(4), 531–546. doi:10.1111/j.1937-5956.2002.tb00476.x

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