Business-IT Alignment in PSS Value Networks: A Capability-Based Framework

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Abstract. Advanced information technology (IT) is regarded as a foundation for the operation of product-service system (PSS) value networks. This requires alignment between IT and PSS business strategy. Business-IT alignment (BIA) in a value network can raise the ability of partners to collaborate effectively and improve network performance. However, the theory of traditional firm-level BIA is not tailored to the specific situations of PSS value networks. In this paper we investigate the applicability of BIA concepts and definitions at a PSS value network level. Alignment in firm-level literature looked at fit between business and IT capabilities. To substantiate this at a PSS value network level, we identified and classified generic value network business capabilities on the one hand and IT capabilities on the other hand. By exploring and discussing the interrelations between the two types of capability, a conceptual framework for understanding BIA in a PSS value network is derived.

Keywords: Product-service system, value network, business-IT alignment, business capabilities, IT capabilities, capability-based framework

1   Introduction

In the era of servitization, offering a product-service system (PSS) becomes a prominent business strategy in the pursuit of value co-creation with customers and other partners in a PSS value network, for any firm that struggles to differentiate itself from competitors. The service content must not be seen as 'only' a support service, or stand-alone after-sales offering, but as an integrated part of the total offering [1]. Such integrated solutions imply a shift in focus from product functionality to the actual outcomes of products and services for customers' operations and processes [1]. In line with current literature on PSS, this study refers the PSS as an ongoing relational process, in which a provider aims to jointly solve the customer problem by reciprocal interaction and long-term collaboration with customers and other value network partners to deliver a bundle of goods and services to fulfill customer demands. We use terms PSS and an integrated solution interchangeably.

Increased emphasis on integrated solutions among scholars and practitioners highlights the role of IT as the essential technological foundation for operation of the PSS value networks. IT makes joint activities, integration and communication among

partners possible; therefor it needs to be aligned with a business strategy. Business-IT alignment (BIA), in a context of PSS value networks, enhances the ability of all actors to collaborate more effectively. In this paper we take the position that the status of BIA at a strategic level can be determined on the basis of alignment between business and IT capabilities. In the case of PSS, that requires firms to go beyond their organizational boundaries and to utilize the resources and capabilities of all PSS value network partners to co-create value, implies looking at business capabilities and IT capabilities that are specific for the PSS and studying the fit required between them. Both business and IT capabilities are identified through a literature review. This is followed by a classification of the findings. As a result, seven Business capabilities and six IT capabilities (ITCs) have been identified. Subsequently we developed hypotheses to examine the possible relationship between ITCs and business capabilities and to propose the research framework.

Summarizing, this study aims to answer the following research questions:
1. What are the key business and IT capabilities in a PSS value network?
2. What are the possible relationships between such business and IT capabilities?

Our study contributes to the emerging literature on BIA research in a context of PSS value network in twofold. Firstly, we identify and classify the key PSS business and IT capabilities. Secondly, we operationalize the notion of BIA in this context by investigating the link between IT and business capabilities in a conceptual framework.

The outline of the paper is as follows. Section 2 gives some definitions of BIA and an overview of current works. Then the research approach is described. The research results regarding business and IT capabilities are given in section 4. In section 5 the research framework is proposed. Finally, conclusions and future work are presented.

2   Current Works

After the seminal work on alignment between business and IT strategy by Henderson & Venkatraman [2], a vast body of literature on this topic has emerged over the past three decades. BIA discusses the best possible use of IT resources to meet enterprise objectives [3]. It refers the extent to which the IT strategy supports, and is supported by, the business strategy [4]. So far, the focus in literature has been on the notion of BIA with an internal perspective on a single firm, fall short with respect to the dynamic collaborative business network environments [5, 6]. The question is: how can this notion are extended to PSS value networks? Santana Tapia et al. [6] developed a maturity model to assess BIA in collaborative networks. They proposed four domains need to be addressed by collaborative networks in BIA process. Derzsi and Gordijn [7] studied the issue of inter-firm alignment in networks and tried to operationalize the value-based alignment process. The research of Pijpers et al. [8], based on multiple views on interactions between firms in a network addressed a process of creating inter-organizational BIA which is concerned with the coherence between the actors. Grefen and Lüftenegger [9]developed the framework in a PSS business network that can be seen as a service-oriented operationalization of BIA model. It consists of three pyramids; business, applications, and IT platforms. Each business layer (i.e. business strategy, business model, service composition, business

service) is supported by corresponding layers in the applications pyramid, then, mapped to the IT infrastructure pyramid.

The variety of BIA approaches and definitions indicates that there is no consensus on a comprehensive definition of the concept of BIA in the context of a PSS. In fact, BIA is a multidimensional concept encompassing strategic, structural, operational, and social dimensions [5, 10]. In this study we will focus on the strategic dimension. We define strategic business-IT alignment in a context of a PSS value network as the degree to which the IT strategy enables the PSS business strategy. But even with this focus we see that research on strategic BIA typically focuses on notions such as a fit between IT planning and business strategic planning [4, 10, 11]. These concepts are highly abstract, and become even more complex at a network level due to issues such that relationships, a delivery of an integrated offering, information representation, user customized interfaces, dynamically adjusted to assist different actors, and services provision supported on cloud computing [12, 13]. To elaborate the notion of BIA, an operationalization is required. Addressing BIA using a capability lens can be an appropriate approach, due to the fact that creating strategic value as the ultimate goal of BIA lies in the usage and alignment of business and IT capabilities. A discussion on capabilities is rooted in a resource-based view (RBV) a well-known theory within the strategic management literature. Under RBV the term capability is defined as special resources that are unique and valuable, encompassing a firm's capacity to coordinate and deploy resources to affect a desired end [14, 15]. Within IT research, the notion of IT capability is also grounded in RBV theory. ITCs are those capabilities necessary to ensure that organizations can exploit changing technology to achieve business value through IT over time [16]. IT capability is a firm's ability to mobilize and deploy IT-based resources in combination with other resources and capabilities [17]. It is not a specific set of sophisticated technological functionality but rather than the organizational capabilities to leverage technology to differentiate firms from competitors [2]. In previous works BIA has already been studied from a capability point of view. Peppard and Ward [18] addressed ITCs in a BIA model and argued how well ITCs in relation to different aspects of the BIA model can improve a firm performance. McLaren et al. [19] developed a multilevel strategic fit measurement model to measure alignment between a firm's competitive strategies and its IT capabilities. Similar work in a PSS context has not been found. We feel that in a case of an integrated solution, which is inherently based on resources and capabilities of autonomous and geographically distributed network partners, increases the need of alignment between IT and business capabilities to facilitate the interaction and collaboration among partners in fulfilling common business values. Here, alignment represents the extent to which the ITCs meet the requirements of key business capabilities and enable them to achieve desired goal of PSS value networks. The 'key' refers to the fact that we will focus only on those capabilities that enable the PSS as a whole and are in particular required to function in a value network. Similarly, our investigation of key IT capabilities focusses at those that are specific for a PSS environment. In response to the gap in literature, this study aims to define the key business and IT capabilities and to identify potential relationships between such capabilities resulting in the conceptual framework.

3   Research Approach

To support the elaboration of BIA in a PSS value network from a capability perspective we need to identify and define business and IT capabilities that are relevant in such a context. In the first step of the study a structured literature search has been executed to identify these key capabilities. Several search strategies were used. First a generic search was used to identify a number of well-known and well referenced authors of papers on BIA, business capability, and IT capabilities. Based on these, a number of keywords including a number of synonyms were identified and used in the search. Finally, relevant papers were used in a backward (i.e. looking at papers cited) and forward (i.e. looking at papers citing the paper) snowball process. The search processes resulted in collecting 10 and 12 relevant papers on PSS business and IT capabilities respectively. Since the results are mixed and there is no consensus on specific sets of key capabilities, we executed a structured classification process to obtain well-founded sets of key business and of key IT capabilities. For this the Metaplan approach was selected. The Metaplan method is a card sorting technique based on a group discussion [20]. The researchers of this paper felt they had sufficient knowledge to carry out the classification, especially since the group discussion aspect of the approach tends to cancel out individual bias. Each classification was carried out in an iterative process whereby classes were identified in one iteration and then refined in two following meetings. Finally the resulting groups of capabilities received group-named and definitions, closely following information from the literature used. The process leads to the construction of seven PSS value network business capabilities (table 1) and six ITCs (table 2) which are described in the following section. Based on these two sets of capabilities, again in a group discussion, in three iterations a number of research hypotheses were formulated that can be used to investigate the extent to which IT capabilities enable PSS value network business capabilities. The results are shown in a research framework (fig.1). The hypotheses which are theoretically supported by literature show relationships between IT and business capabilities. Further validation of them will be done in the future empirical works.

4   Research Result Regarding Business and IT Capabilities

4.1 Business Capabilities

In the following the key business capabilities of PSS value networks that resulted from the literature search and the classification process are presented.

Customer understanding capability: The ability of a value network to understand customer requirements to offer high-value customized solutions that address individual customer's operational process and business needs [21–23]. It assists to get customers' ideas and identifying customers' value to enhance the PSS offerings.

Partnership capability: The ability of a value network to develop collaboration and partnership among actors including customers in order to access complementary capabilities [14, 22, 24, 25]. In value networks a focus of value creation moves from

the internal firm processes to interaction processes among partners. Active dialogue and social interaction instead of one-way communication, are therefore prominent and of critical importance in value co-creation [24, 25].

Trust-based interaction capability: The ability of a value network to have a non-opportunistic behavior and establish long-lasting relationship among actors [21, 22, 25]. Offering PSS is actually an ongoing interaction that is built on mutual trust and commitment. Trust is one of the factors that differentiates collaborative relationships from transaction and includes both economical (i.e. risk-based trust) and social (i.e. goodwill trust) perspective of trust [26].

Engagement capability: The ability of a value network to involve all partners to contribute in integrated solutions [22, 27, 28]. In this context, firms inextricably depend on other parties to provide a PSS due to specialization, knowledge intensiveness and technological complexity of such integrated solutions [24]. The ability to engage partners in the value co-creation lead to deliver a PSS that can differentiate network from competitors.

PSS design and delivery capability: The ability of a value network to design and deliver combinations of products and services to individual customers by using the capabilities of all partners [15, 21, 23]. In this sense, the service elements of a PSS range from traditional product-related services to services supporting customer operational processes [21].

Process management capability: The ability of a value network to coordinate and integrate collaborative processes within a network, to maintain efficiency of PSS design and delivery[15, 22, 23, 29].

Knowledge management (KM) capability: The ability of a value network to capture, transfer, share, and utilize knowledge resources across the network to deliver integrated solutions [23, 29]. In line with the well-defined framework of [30] we consider the KM capability as a multidimensional construct encompassing infrastructure (technical, cultural, structural) and process (acquisition, conversion, application and protection) capabilities. KM capability implies the focus on symmetric knowledge sharing among actors and learning from each other. Firms share their own expertise and knowledge resources for the enhancement of their co-creation partners' skills [22].

Table1. Key business capabilities of a PSS value network

Business Capability	References
Customer Understanding	[21–23]
Partnership	[14, 22, 24, 25]
Trust-based interaction	[21, 22, 25]
Engagement	[22, 27, 28]
PSS design & delivery	[15, 21, 23]
Process management	[15, 22, 23, 29]
Knowledge Management	[23, 29]

4.2   IT Capabilities

In the following the key IT capabilities resulting from the literature search and the classification process are discussed.

IT architecture capability: The ability of a value network to create a coherent blueprint of technology, data, application, and their relationships, that meet PSS business requirements[11, 16, 31, 32]. Recently the service-oriented architecture (SOA) has become a prominent IT paradigm. SOA is an IT architectural style in which discrete bundles of software functionality are componentized and delivered to other systems as "services," enabling different applications to use common parts [33].

IT development capability: The ability of a value network to recognize technology trends and developments within the IT sector and to make appropriate recommendations for adopting emerging technologies, or altering or adapting current ones to leverage technology to achieve desired ends [16, 18, 32].

Flexible IT infrastructure capability: The ability of a value network's IT infrastructure to develop, diffuse, and support various system components quickly to cope with constantly changing business requirement [29, 34, 35]. It depends on the degree to which the IT infrastructure is connective, compatible, modular, and can handle multiple business applications [34].

IT integration capability: The ability of a value network to interlink different applications distributed in a network, in order to communicate with each other and timely and idiosyncratic exchange data. It involves both application integration and data consistency[29, 36, 37].An inter-organizational information system (IOIS) is a combination of technologies, people and processes that a value network uses to manage information across a network. Part of IOIS would be a shared system among partners and part of it would be an individual organizational system that needs to link. In this sense, the ability to link and maintain this linkage and keep logical and ontological data interchange among divers applications is called IT integration.

IT management capability: The ability of a value network to manage IT functions such as IT planning, investment and monitoring, coordination, control, IT project management, and negotiations with vendors[31, 32, 34, 36]. A PSS value network with greater IT management capability is expected to achieve more efficient and cost-effective IT operations to deliver business value.

IT Personnel capability: The ability of the IT staff in the value network. It encompasses technical (hardware and software system), behavioral (interpersonal) and managerial skills of IT personnel [17, 31, 32, 34, 38]. These ranges of skills and knowledge are essential for IT personnel to be able to design, develop and deploy reliable IT solutions in order to meet both technical and business requirements of PSS and also to be able to communicate well with partners in a value network.

Besides the aforementioned ITCs, IT-business integration and partnership are also mentioned in the current literature as ITCs [32, 38, 39]. The former refers to the management ability to envision how IT supports business strategy while the latter refers to relationship, communication and coordination between IT and business for active engagement in related issues. We omit these capabilities in our discussion because both business and IT communities are responsible to share their experiences and knowledge, to understand each other, to integrate their functionalities, and to facilitate dialogue and interaction to work together. These capabilities are more

relevant to the social and perhaps cultural dimensions of BIA, while we in this paper focus on its strategic dimension.

Table2. Key IT capabilities of a PSS value network

IT capability	References
IT Architecture	[11, 16, 31, 32]
IT Development	[16, 18, 32]
Flexible IT infrastructure	[29, 34, 35]
IT Integration	[29, 36, 37]
IT management	[31, 32, 34, 36]
IT Personnel	[17, 31, 32, 34, 38]

5 Framework Development

In this section a framework for capability based BIA in a PSS value network context is developed. First, the internal relationships between IT capabilities are discussed. Since these relationships are supported well in literature, this part of the framework can be used as a basis for the further discussion. Then, a number of hypotheses are developed to show the relationship between IT and business capabilities as potential areas of capability alignment. The research framework is presented in figure1.

IT management and IT personnel capabilities can serve as the supportive capabilities which feed into the other IT capabilities to leverage them and enhance their performance. Previous studies show that firms with competent IT management and IT personnel skills are better at transforming IT resource into business value than their competitors [31, 34, 36].

Relationship a) *IT management and IT personnel capabilities enable other IT capabilities.*

As technology develops, the IT architecture is changed. IT architecture is a blueprint to place a new enabling IT technology in a context of value network. Evolution of internet-based technology like cloud-computing that enables convenient on-demand network access to a shared pool of computing resources requires a new architectural style for realizing cloud-computing in a PSS value network environment. Here cloud-based architectures need to be designed for network access [40, 41].

Relationship b) *IT development capability enables IT architecture capability.*

A flexible IT infrastructure is supported by network-wide architecture. SOA as a new architectural approach aims at increasing the flexibility of the IT infrastructure [33, 42]. It facilitates the realization of the modularity and connectivity by applying services as loose coupling of software functionalities. Also SOA promises to simplify the application integration by providing universal connectivity to existing systems and a consistent view of the data in terms of both semantic and syntactic integration [29]. Instead of point-to-point individual applications connections, SOA contributes to the many-to-many integration [33, 43] .

Relationships c,d) *IT architecture capability enables flexible IT infrastructure and IT integration capability.*

A flexible IT infrastructure able to support the design, rapid development, reconfiguration, and implementation of heterogeneity of applications [34, 44, 45].Within a service-oriented environment, the integration and implementation of service-based applications rely on the flexible IT infrastructure. These services are reusable components that represent repeatable business activities and should be accessible through a shared IT infrastructure that enables intra- and inter organizational value networks [46, 47].

Relationship e) *Flexible IT infrastructure capability enables IT integration capability.*

According to fig.1, by following the proposed relationships between the IT capabilities, this points to the IT integration capability as a final resulting IT capability. In the following section we will discuss possible relationships between this IT capability and the previously identified business capabilities.

The ability to quickly gather and transfer information through integrated applications allows a better response to customer requests [48, 49]. In this respect, new types of IOIS have been developed based on social media technology called as a social customer relationship management to facilitate real-time, interactive two-way communication, and dialogue with customers to understand customer values [50]. IT integration aids a PSS value network to get a coherent picture and real time monitoring of customer requirements.
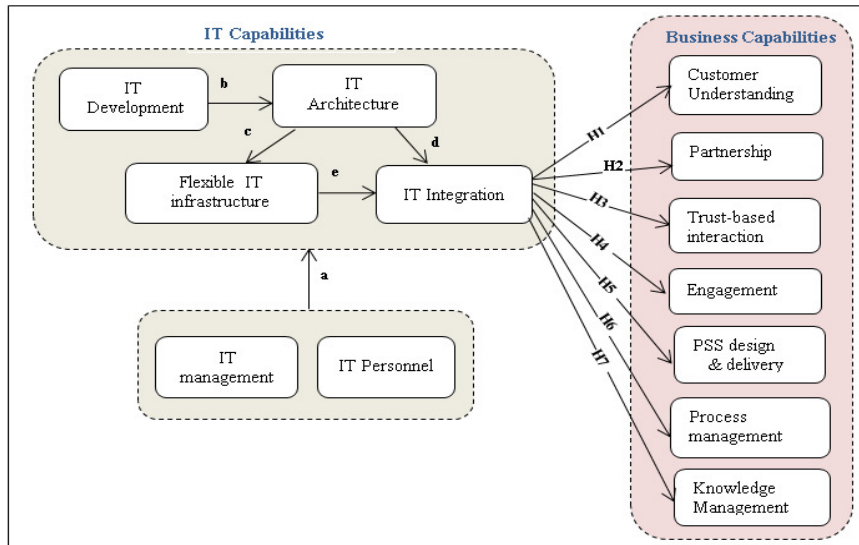

Fig1. Research framework, business- IT capabilities alignment in PSS value networks

Hypothesis 1: *IT integration capability supports customer understanding capability.* The ability to couple various applications and data sources within a PSS value

network enhances information flow and therefore enables interactive relationship among partners, while they are encouraged to co-create value. Web-based IOIS have been identified in prior studies as a key component to support the inter-organizational efforts and to strengthen partnerships [48, 49, 51].

Hypothesis 2: *IT integration capability supports partnership capability.*

IT integration based on web technology facilitates interaction and two-way communication with partners which are necessary in building trust. Commitment and trust can be enhanced and solidified by allowing partners access to real-time data and providing information transparency which is enabled by IT integration [51, 52].

Hypothesis 3: *IT integration capability supports trust-based interaction capability.*

Partners' engagement in collaborative activities can be realized via applications and data sources integration as means to share their resources and capabilities. It helps firms to access to complementary capabilities of their partners to discover opportunities and to respond to the market with customer-driven offerings [35]. A geographical scattering of partners implies any involvement in the co-creation value has to occur via an IOIS that aims to improve involvement in a service provision [53].

Hypothesis 4: *IT integration capability supports engagement capability.*

IT integration facilitates gathering and processing more reliable information from partners which in turn enables value networks to check the availability of resources, to select the best options, and to combine products and services in more rapid and cost-effective ways to enhance and widen offerings. Design and delivery of PSS with more extensive services to meet divers customer demands could not have been possible without a well-functioning IT integration [35, 54].

Hypothesis 5: *IT integration capability supports PSS design and delivery capability.*

Integrated solutions rely on interconnected and interdependent activities undertaken by partners. With advanced IOIS a value network ability to integrate inter-firm business processes at lower costs has become more feasible. IT integration aids a successful operation and coordination of collaborative processes and increases the effectiveness and efficiency of inter-firm processes [29, 48, 49].

Hypothesis 6: *IT integration capability supports process management capability.*

In value networks different firms involve in a co-creation value, they share not only explicit knowledge but also tacit knowledge, information is a key factor to create value and promote integrated solutions especially in complex offerings. IT integration helps a value network to timely acquire information of market spaces and customer requirements. It also enhances knowledge sharing among partners through common standards and protocols [29, 48, 49, 53].

Hypothesis 7: *IT integration capability supports knowledge management capability.*

6 Conclusion

This study presents a further step towards elaboration of the business-IT alignment at a network level. A PSS value network with more emphasis on establishing closer relationships with partners, operational linkages, enhanced information sharing, and cooperation among partners, requires additional insights of BIA. We examine the

notion of BIA in a more operationalized way in the light of a capability approach. We identify two sets of business and IT capabilities from literature on a PSS value network and subsequently redefine and classify under new labels. We define seven business and six IT capabilities. In the next step, by developing hypotheses comprising a conceptual framework we investigate the relationship between IT and business capabilities defined as the business-IT capability alignment. The proposed framework suggests that the IT integration capability is the core essential ITCs that supports business capabilities. IT integration is a solid foundation of a PSS value network; it promotes information flow, collaboration and partnership, trust-based relationship, and coordination among partners. In future work we aim to validate these hypotheses by doing case studies and survey research. The framework can aid PSS value networks to leverage their both IT and business capabilities to gain competitive advantage over time. We will investigate whether this notion of business-IT capability alignment does indeed improve the performance of a PSS value network.

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