

UNDERSTANDING THE CREATION OF ICT-VALUE IN THE BUILDING AND CONSTRUCTION INDUSTRY

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ICT (Information and communication technology) creation of business value has become - for few reasons- a topic in need of closer scrutiny. Numerous governmental initiatives originate from a belief that digitization would improve the performance of the building and construction industry. But, there are evidences that expectations of positive effects of use of new ICT, for example BIM, may be too optimistic. In Information Systems research (IS), ICT creation of business value presents one of the main concerns. Accordingly, by drawing on the literature on ICT value creation and characteristics of the building and construction industry, the aim of the paper is to outline a conceptual understanding of ICT value creation in the building and construction industry. The analysis will take the point of departure in three perspectives on ICT-value creation: the resource-based, the process and capability building, and the multiple-firms perspectives. When ICT-value creation is analysed, a paradox is uncovered. In the industry, customer value is co-created due to the need for a wide array of competencies and resources. But, at the same time there are very weak incentives for firms to co-create ICT-value due to existing governance systems and institutionalized role systems. Research is needed in order to uncover facilitators for building more long term relations among firms that in turn creates conditions for processes of building capabilities for creation of ICT-value.

Keywords: ICT-value, co-creation, capabilities, resources.

INTRODUCTION

In countries like Great Britain and Sweden, governmental initiatives are taken to increase the digitization of the building and construction industry. This is often expressed by promoting an increased use of BIM (Building Information Modelling) that is believed to improve the efficiency of the industry. Also in the literature, BIM is claimed to be one of the most promising developments in the industry that is expected to introduce significant changes for all stages of the construction process (see e.g. Eastman *et al.*, 2011). However, despite the optimistic predictions on BIM's positive effects on the industry, a number of challenges are identified. Demian and Waters (2014), and Linderoth (2010) argue that the temporary nature of construction projects create challenges when BIM use diffuses to consecutive projects. Fox (2014) claims that expectations of BIM benefits may be too optimistic, Kang *et al.*, (2013) question whether claimed benefits of BIM have been fully achieved, Vass and Gustafsson (2014) state that BIM professional do not see any business value from BIM today, but it might appear in the future, and Becerik-Gerber and Rice (2010) claim that benefits of BIM use are difficult to evaluate with quantitative measures because claimed benefits are often intangible.

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However, the creation of ICT (Information and communication technology) value is not a unique concern for the building and construction industry. ICT creation of business value presents one of the main concerns in IS (Information Systems) research. There is a longstanding stream of research examining ICT business value, however, mostly focuses on studying the relationship between ICT investments and organizational outcomes of performance and productivity. Recently, this stream has been expanded to include other facets of value and recognized that ICT business value occur in varying degrees (Luo *et al.*, 2012). The repertoire of ICT business value has been hence expanded to include not only productivity enhancement, profitability improvement but also cost reduction, competitive advantage, inventory reduction, new organizational capability among other factors. Research showed that for ICT to create business value, it has to influence a firm's dynamic capabilities and strategic processes as these have been identified as important components that shape the firm's ability to perform value creating activities (Sambamurthy *et al.*, 2003).

The extent and dimension of the created value are dependent upon internal and external factors, including complementary organizational resources of the firm and its trading partners, as well as the competitive and the macro environment (Melville *et al.*, 2004). This view departs from the singular firm perspective on ICT value creation, where more contemporary research suggests a multiple-firm perspective of ICT value creation. The latter recognizes the fast moving market conditions that organizations currently face and the organizational needs to collaborate to acquire and utilize resources (Grover and Kohli, 2012). It also recognizes that firm's resources might span firm boundaries, and may even lie in its relationships with other firms (Dyer and Singh, 1998). This co-creation of ICT value has been recently highlighted as a critical theme for future IS research and IS researchers are strongly encouraged to understand how multiple partners in multi-organizational relationships co-create and share ICT-based value (Grover and Kohli, 2012; Kohli and Grover, 2008).

Thus, it can be argued that the building and construction industry meet some of the requirements for (co)creating ICT-value. Basically, the building and construction process can be seen as a process of co-creating value, because in order to accomplish a building or construction, several firms with a wide array of competencies co-create the final product. But at the same time, firms in the industry have been using ICT more for controlling and monitoring their own processes, instead of using ICT for creating value with regard to what is best for the project (see e.g. Jacobsson and Linderoth, 2010).

Against this background, the aim of the paper is to outline a conceptual understanding of ICT-value creation in the building and construction industry. This will be achieved by reviewing the literature on ICT value creation and presenting a few models of how ICT-value creation can be understood. The central concepts in the models will be discussed with regard to conditions in the building and construction industry in order to identify constraints and facilitators for ICT-value creation in the industry.

ICT VALUE CREATION

In management literature, organizational value creation could be understood along three value disciplines: operational excellence, customer intimacy and product leadership (Treacy *et al.*, 1993). In the IS-literature, ICT value has been studied from at least three different perspectives with different theoretical approaches. Traditionally ICT value research focused on examining ICT's financial impact on productivity and firm performance. This stream of research applied economic theories to statistically examine and directly trace IT investment to firms' financial metrics of internal and external

performance or what Barua *et al.*, (1995) defined as first order effect on operational level variables and higher level variables such as market share and profit. This stream of research has produced mixed results that invited research to consider mediating factors. Research increasingly find that the relationship between ICT investment and firm performance is mediated by many factors. Devaraj and Kohli (2003) also found that actual usage is the missing link between ICT investment and its impact on organizational performance and showed that the driver of ICT impact is not the investment in the technology, but the actual usage of the technology (*ibid.*).

A second stream of research applies theories from strategic management literature, mainly the resource-based view of the firm to understand the ICT impact on firms' competitiveness. It explores how ICT resources change business operations and create value. ICT resources has been described in terms of a firm's ICT infrastructure, human ICT resources comprised of technical and managerial ICT skills, and ICT-enabled intangibles such as knowledge assets, customer orientation, and synergy (Bharadwaj 2000). However, in a recent study this direct link could not be established and further research was called for to study the role of a firm's resources and dynamic capabilities as mediators between ICT resources/capability and firm performance (Chae, *et al.*, 2014).

Based on theories of capability and dynamic capability, a third stream of research focuses on the role of ICT in developing firm's capability and dynamic capability. Wang *et al.*, (2012) suggest that in stable environments, creation mechanism for ICT value is primarily resource structuring while the primarily mechanism in dynamic environments is capability building. Tallon and Pinsonneault (2011) uncover a positive link between ICT alignment with business strategy and firm's agility, and between agility and firm performance. In this context agility is the ability to detect and seize market opportunities with speed and surprise, and is considered to be an imperative for business success (Brown and Eisenhardt 1997; D'Aveni 1994). Tallon and Pinsonneault (2011) also showed that agility has a greater impact on firm performance in more volatile markets.

Recently, studies on value creation recognized the multifaceted, subjective and intangible nature of value creation. Kohli and Grover (2008) highlight the need to consider and assess the intangible value and rather subjective nature of value as they state: "businesses and customers are the final arbitrators of value creation, and by over emphasizing pure financial post hoc metrics or even ex ante market value, we underreport the true benefits of ICT to these stakeholders (Kohli and Grover, 2008:33). Researchers have tried to inquire into the dynamic and multi facet context of ICT value creation. It is recognised that IT "does not create value in isolation" (Kohli and Grover 2008). It is part of a business value creating network that involves complementary IT and organisational processes (Melville *et al.*, 2004; Wade and Hulland 2004). IT and organizational processes include management, policies, routines, structure, culture, organizational knowledge and learning processes play important role in IT value creation. In this regard, understanding the business value creation network would be of particular importance in understanding how ICT creates value and in assessing the value of a particular system.

Three perspectives on creation of ICT-value

Melville *et al.*, (2004) draw on resource-based theory and propose that creation of ICT business value can be understood through three layers: 1) The focal firm; 2) Competitive environment; 3) Macro environment. In the focal firm the deployment of technology- and human ICT-resources, and complementary organizational resources in a business process generates ICT business value and improves organizational performance. But the generation of ICT business value influence by the competitive environment. Industry

characteristics shape the way in which ICT is applied in the focal firm, at the same time as trading partners' resources and business processes has an increased impact on generation of ICT business value for the focal firm. Finally, resources in the macro environment, for example the level of development of basic infrastructure, education, research and development investments, culture etc. has an impact on the opportunities of ICT value creation.

This view connects the macro and micro of value creation at different levels of analysis. It is therefore useful for strategic thinking in terms of policy making, industry analysis and market evaluation.

In the second perspective, Sambamurthy *et al.*, (2003) focus on the focal firm and consider ICT value creation in terms of competitiveness and financial performance from a capability and processes perspective. They argue that firm performance is influenced by a nomological network of three significant organizational capabilities and three strategic processes. The three organizational capabilities are: agility, digital options and entrepreneurial alertness. Agility is the ability to detect opportunities for innovation and seize those competitive market opportunities by assembling requisite assets, knowledge and relationships with speed and surprise. Digital options are described as a set of IT-enabled capabilities in the form of digitized enterprise work processes and knowledge systems. Entrepreneurial alertness, is the capability of a firm to explore its marketplace, detect areas of marketplace ignorance and determine opportunities for action. Two specific capabilities describe entrepreneurial alertness: strategic foresight and systemic insight

The three strategic processes are: capability building, entrepreneurial action and co-evolutionary adaptation. The capability building process integrate ICT and business resources into organizational capabilities. The capabilities are built by a firm's strategic decisions to invest in ICT and the blending of ICT with organizational processes and knowledge (Barua and Mukhopadhyay, 2000). The entrepreneurial action process is consistent with the logic of opportunism and underlies the creative combinations of agility and entrepreneurial alertness for the launch of competitive actions. The co-evolutionary adaptation process refers to the fact that firms learn over time and through experience as they develop digital options and agility and launch a variety of competitive actions.

The third perspective is built on recent research that has recognized that value is increasingly co-created among multiple partners in multi-organizational relationships (see e.g. Kohli and Grover, 2008; Sarker *et al.*, 2012). As markets and digital infrastructures are changing, it became more difficult for the single firm to create business value in isolation and value is increasingly co-created in networks of organizations. Accordingly, ICT co-creation of value has been articulated as a critical theme for future IS research (Kohli and Grover, 2008). By drawing on a relational view, proposing that a firm's resources might span firm boundaries, and even may lie in its relationships with other firms (Dyer and Singh, 1998), Grover and Kohli (2012) outline four layers in the co-creation of ICT value namely; the asset layer, complimentary capability layer, knowledge sharing, and governance layer.

Value creation in the *asset layer* can only be achieved when partners' resources, for example manufacturing technologies or other physical assets, are combined, and network facilities create new value in form digital or physical products and services. In the *complimentary capabilities* layer, the focus is identification and exploitation of resources/capabilities among the partners in order to identify sources of value that that a

partner not can build on its own. This could be an IT-based resource or a skill provided by a network partner that leverages other partners' resources. In the *knowledge sharing* layer the focus is on the sharing of information and expertise that can inform decision making for co-creating new and better products (Dyer and Hatch, 2006).

In this layer IT-infrastructure and processes for sharing knowledge are means these can enhance absorptive capacity, or abilities to recognize, assimilate and exploit external partners' information (Cohen and Levinthal, 1990). However, it is important to note that right incentives must be in place if firms should share their knowledge for a collective good (Grover and Kohli, 2012). Finally, *the governance* layer can be viewed as the layer integrating assets, complimentary capabilities and knowledge exchange layers, by setting up a control structure that reduce transaction costs and incentivizes new value co-creation. This is typically done through contracts, but social and informal controls (trust) can play a major role and be less costly in facilitating co-creation of value (ibid.). Moreover, it is assumed that the governance layer has an even greater significance when several firms are engaged in a loosely coupled network with the intention to co-create products and services when conditions are conducive (Dhanaraj and Parkhe, 2006).

The proposed framework expands value creation from the focal firm to value creation in network of firms. They highlight one condition for value co-creation which is that firms need to be willing to form cooperative bonds and to co-create value by using ICT in a thoughtful way (Grover and Kohli, 2012).

ICT value creation in the building and construction industry

Taking the point of departure in the focal firm perspective (Melville *et al.*, 2004) and the perspective of processes and capabilities in the focal firm (Sambamurthy *et al.*, 2003), constraints and facilitators for ICT-value creation can be identified in the building and construction industry. With regard to technological ICT resources, larger building and construction companies has for almost a decade used ICT in order to coordinate and manage information flows at the same level as companies in other industries (see e.g. Molnar *et al.*, 2007). With regard to human ICT resources is the situation more mixed? Larger building and construction companies have their own IT-functions with IT-staff, but the IT-function has traditionally been a branch of the accounting and finance department, that may be one explanation for that ICT mostly has been used for calculation and control purposes (see Jacobsson and Linderoth, 2010).

Thus, it is foremost the financial dimension that has been in focus for ICT-value creation. However, a major constraint for creating ICT-value is probably the complimentary organizational resources. Successful application of ICT is often supported by significant organizational changes, including workplace practice, organizational structure, rules and policies, and organizational culture (Brynjolfson and Hitt, 2000; Melville *et al.*, 2004). The need for significant organizational changes has been prevented by industry characteristics, for example identity (see e.g. Löwstedt and Räisänen, 2014) and trading partners, foremost the clients (see e.g. Linderoth *et al.*, 2011). However, in a long term perspective resources in the macro environment, e.g. education and culture, may facilitate the creation of ICT-value in the industry. The major argument is that new generations habits to use ICT in their daily life, but also the fact that different forms of ICT, like BIM, is becoming a more significant component in the education of the industry's future workforce.

When analysing conditions for creating ICT-value from the perspective of processes and capabilities in the focal firm, both obstacles and facilitators can be identified. In one

sense it can be argued that agility is a characteristic of the industry that originates from a need for local adjustments at site. This adjustment is a consequence of three uncertainty factors: lack of complete specifications, lack of uniformity and an unpredictable environment (Dubois and Gadde, 2002). It can be argued that these uncertainties have facilitated a capability of solving problems, or to innovate. Due to a combination of time pressure and lack of complete specifications a capability of finding immediate solutions to a problem has developed among actors in the industry. This can be one reason for the fact that managers on all levels describe themselves as doers (see Löwstedt and Räisänen, 2014). However, this kind of agility, or innovative behaviour, being more a doer more than a thinker (*ibid.*) does effectively prevent other essential capabilities to be built and strategic processes to be developed. In the process of capability building, ICT- and business resources are integrated into organizational capabilities (Sambamurthy *et al.*, 2003). Thus, in a context where people identify themselves more as doers than thinkers, and the focus is on solving problems here and now, it would be difficult to imagine the need for significant organizational changes in order to achieve a successful application of ICT. Instead, digital options, described as a set of IT-enabled capabilities in the form of digitized enterprise work processes and knowledge systems (*ibid.*), will be exploited in manner that immediately makes sense for managers. This is, off site managers exploit digital options when there is a potential for increasing control over projects, and site managers exploit digital options when there is potential of facilitating the keeping budget and deadlines (see also Jacobsson and Linderoth, 2010). Thus, in the entrepreneurial action process, that underlies the creative combinations of agility and entrepreneurial alertness for the launch of competitive actions, actions are, explicitly or implicitly, directed at the financial side of ICT-value creation. This observation is consistent with Love *et al.*'s (1998:381) observation:

1. ...each discipline has become dedicated to the optimization of its own function, with little regard to, or understanding of, the construction process

Finally, it can be argued that the co-evolutionary adaptation process is constrained by the focus on single projects and the strong reliance on competitive tendering. In the co-evolutionary adaptation process the IT-competence and capability building process are reinforced when firms learn over time as they develop digital options and agility, and launch a variety of competitive actions. It can be argued that this process is continuously interrupted by a strong reliance on competitive tendering, which is supposed to promote efficiency (Cox and Thompson, 1977). A project consists of a constellation of actors who happened to have the lowest bid and in the next project there is another constellation of actors working together. Therefore, are there little incentives for creating ICT-value in the project network, because actors do not know who they will work with in the next project?

Thus, this condition will have implications when analysing conditions for creating ICT-value from the multi firm perspective, or perspective of co-creating value. In this perspective four layers in the co-creation of ICT value were out-lined: The asset-, complimentary capability-, knowledge sharing-, and governance layer (Grover and Kohli, 2012). The asset layer and complimentary capability layer can be seen as cornerstones for creating customer value in the building and construction industry. In order to create value for customers' partners, resources, for example manufacturing technologies or other physical assets, need to be combined, as well as partners' complimentary capabilities. Thus, with regard to how operations are organized in the industry, the only way to create customer value, is by co-creation. By drawing on the resource based- and capability perspective it can be claimed that partners have capabilities of co-creating value. However, due to the interruptive nature of the production process, these capabilities are

built on quite standardized role systems associated with strong cultures and value orientation that should facilitate the interaction with other professional groups (see e.g. Björklöf, 1986; Kadefors, 1995).

It can be claimed that the institutionalized role system constrains the development of new capabilities, but also the will to share knowledge. Söderholm (2006) claims that a varying sets of principles, rules, knowledge domains, etc. in professional groups has implied difficulties in co-operating. What finally might hamper the co-creation of ICT-value in the industry is the governance layer. This layer would integrate assets, complimentary capabilities and knowledge exchange layers, by setting up a control structure that reduce transaction costs and incentivizes new value co-creation. However, the industry's governance layer has not promoted an integrative behaviour facilitating co-creation of ICT-value. Instead has the competitive tendering shaped market based, short term interactions between independents businesses (Gann, 1996).

CONCLUDING DISCUSSION

It can be concluded that basic resources and capabilities are present for the co-creation of ICT value in the building and construction industry. As stated is the co-creation of customer value a corner stone in the industry, because actors cannot create customer value on their own. Instead they have to create value by contributing with their unique assets and complimentary capabilities. At the first glance these conditions seem to be a promising ground for the co-creation of ICT-value. However, a basic condition for value co-creation is that firms need to be willing to form cooperative bonds and to co-create value by using ICT in a thoughtful way (Grover and Kohli, 2012). This condition is, however, more or less absent in the industry due to lacking incentives to co-create ICT-value.

As has been described, firms are more focused on optimising their own processes and when ICT is used for value creation, it is foremost in situations where the value is immediate and possible to link to financial outcomes. The reason behind this behaviour can at the first glance be found in the competitive environment and the industry characteristics if an explanation is sought from the resource based perspective (see Melville *et al.*, 2004). This is, the industry is characterized by being market based and have short-term interactions between independents firms (Gann, 1996). But the deeper underlying explanation can be found in the multi firm perspective's governance layer. A lowest price tender policy in combination with organizing operations by projects have reinforced the market based, short term interactions (Linderoth *et al.*, 2011). This condition has in turn constrained the creation of long term relations where informal controls (trust) can play a major role and be less costly in facilitating co-creation of value (Grover and Kohli, 2012).

Moreover, ICT value creation occurs in networks where the internal and external conditions and capabilities of each organisation need not only to be developed but also developing each other. In this context, boundary spanning becomes an important activity to support organisational learning and capability development internally and in relation to each other. More effort need to take place to enhance this boundary spanning activities and the role of public and private institutions that could support them. Enhancing the understanding of the co-creation of ICT value in the building and construction industry requires more research and empirical investigations. Further research is needed to uncover facilitators for building more long term relations among firms that in turn creates conditions for processes of building capabilities for creation of ICT-value.

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