Journal of Enterprise Information Management

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Received 2 April 2015
Revised 17 June 2015
19 October 2015
Accepted 19 October 2015

Abstract

Purpose – The purpose of this paper is to contribute to a growing body of research on the applicability of resource-based theory (RBT) to the information systems (IS) area. In particular, the paper provides an understanding of the IS value creation process, and strategies for managing it by demonstrating the application of cross-impact analysis.

Design/methodology/approach – RBT and systems theory are adopted as a theoretical framework in this study. Cross-impact analysis is used as a method for investigating interactions among elements of an IS value creation system. These elements were identified through 22 semi-structured interviews with organisational stakeholders, and assessed in terms of direction and strength of their interactions, and depicted in a coordinate system.

Findings – The result of the analysis is a meaningful classification of elements in an IS value creation system as: levers, indicators, identities, buffers or trends, based on their position in the system. The results provide additional clarity and insights into the relationships between IS and organisational resources and their effect on IS value.

Research limitations/implications – The research findings have important implications for researchers and managers in terms of understanding the impact of interactions among IS and organisational resources on formulating successful strategies for managing the IS value creation system.

Originality/value – This study explores interactions among IS/information technology resources and organisational resources by using cross-impact analysis. It shows that interactions among the identified resources do have a major influence on the overall IS value creation system.

Keywords IT business value, Systems theory, Interactions, Cross-impact analysis, IS/IT resources, Resource-based theory (RBT)

Paper type Research paper

1. Introduction

The resource-based view or, more recently, resource-based theory (RBT) (Kozlenkova *et al.*, 2014) suggests organisations have resources that lead to superior performance and competitive advantage. The link between organisational resources and performance has been empirically confirmed (e.g. Wernerfelt, 1995; Hitt *et al.*, 2001). However, RBT cannot identify the mechanism through which resources create business value (Nevo and Wade, 2010; Gruber *et al.*, 2010; Wade and Hulland, 2004; Galbreath, 2005; Priem and Butler, 2001). This is especially relevant in the information systems (IS) field where IS (this term is used interchangeably with information technology (IT)), is considered to be a strategic necessity (Clemons and Row 1991), and there is a lack of clarity on how IT value is created (Kohli and Grover, 2008; Melville *et al.*, 2004). RBT research in the IT literature posits that IT contributes to IT business value through interacting and supporting other organisational resources (Liang *et al.*, 2010; Jeffers *et al.*, 2008). Business value of IT can be defined as the "organizational performance impacts of information technology at both

Journal of Enterprise Information Management
Vol. 29 No. 4, 2016
pp. 589-611

1741-0398
DOI 10.1108/JEIM-04-2015-0027

the intermediate process level and the organization-wide level, comprising both efficiency and competitive impacts" (Melville *et al.*, 2004, p. 287).

IT potential for creating business value emerges from its interactions with other organisational resources, according to the RBT (Kraaijenbrink *et al.*, 2010; Wade and Hulland, 2004). Although RBT identifies the characteristics that resources must have to affect organisational performance, there is limited research into the link between resources and value creation (Gruber *et al.*, 2010). RBT is silent on how IT capabilities are developed, how IT resources create IT value, or how to manage IT interactions with other organisational resources to create value for the company (Kraaijenbrink *et al.*, 2010). This is the reason for conducting this research. Cross-impact analysis was used in this paper to investigate the interactions between IT and organisational resources and the effects this has for IT value. This method can be used to overcome the shortcomings of the RBT that are limiting further insights into the IT value creation process, and thus contribute to its further development.

2. Literature review

2.1 The RBT

The RBT is a prominent framework used in many management and marketing disciplines, including in the IT literature (e.g. Mata *et al.*, 1995; Bharadwaj, 2000; Wade and Hulland, 2004). It originates from the field of strategic management (Barney, 1991; Wernerfelt, 1984) were it was developed as an alternative to environmental models that emphasised industry conditions and trends as creating competitive advantage (e.g. five forces model; Porter, 2008). RBT takes on an internal organisational perspective and posits that the source of competitive advantage is strategic organisational resources (Barney, 1991).

In order to be strategic, a resource needs to be: valuable in terms of improving organisational effectiveness and efficiency; rare among current and potential competitors; non-imitable and non-substitutable by any other strategically equivalent resource (Barney, 1991). If one of the four conditions is not applicable, a resource is not strategic, and will not lead to competitive advantage. The identified conditions for strategic resources also imply that organisations need to built their strategic resources, as these cannot be bought (Teece *et al.*, 1997). Identifying resources that are valuable and inimitable is methodologically challenging for researchers as resources that comply with these two criteria are often intangible and hard to observe (Armstrong and Shimizu, 2007). RBT provides a generic classification of resources as organisational, human and physical capital resources (Barney, 1991). Such categorisation includes virtually all resources without distinguishing between them which make the practical application of RBT in management practice lacking relevance (Galbreath, 2005).

It is important to note that simply having resources does not influence competitive advantage. The actual value of a resource emerges when the resource is applied in a specific use context (Penrose, 1959). Barney (1991) identified an organisation's organisational structure, control systems and compensation policies as means through which resources can be productively engaged. On the other hand, use of resources is constrained by the configuration of the resources in the organisation (Newbert, 2007), management capability (Penrose, 1959) and path dependency (Teece *et al.*, 1997). Managers have an active role in RBT in combining, utilising and managing resources in a way that produces the greatest value for the organisation. Their experience with using resources affects their knowledge and perception of opportunities for growth and innovation in a way that is specific to the organisation (Penrose, 1959). Thus, managers affect conversion of organisational resources into value.

RBT posits that resources develop their traits necessary for attaining competitive advantage through relationships with one another (Black and Boal, 1994). That is, resources affect each other, both positively and negatively. Resources are typically used together in achieving organisational goals, and hence their combination and synergy is particularly important for business value creation. However, the RBT does not specify the configuration or relationships between resources that lead to competitive advantage (Black and Boal, 1994) and the mechanism through which resources create business value (Gruber *et al.*, 2010; Priem and Butler, 2001). Configuration of resources is an important aspect of RBT in explaining the sources of competitive advantage, but it has been insufficiently explored in the existing literature.

2.2 The RBT of IT

For the last two decades RBT has been widely used in IT research investigating the relationship between IT resources and organisational performance (Wade and Hulland, 2004). For instance, Bhatt and Grover (2005) found that IT business experience and relationship infrastructure have a positive relationship with competitive advantage and that organisational learning enhances all three IT capabilities (IT infrastructure, IT business experience and relationship infrastructure). Mata *et al.* (1995) concluded that technical IT skills are essential for using IT and can be a source of temporary competitive advantage.

Many IT studies have focused on exploring a direct relationship between IT resources and organisational performance, while ignoring the RBT emphasis on building and enhancing strategic resources (Teece *et al.*, 1997), and the effect that resources have on one another. That is, RBT postulates that resources are used together and that this bundle of resources impacts on organisational performance. For example, IT utilisation requires the use of organisational complementary resources. In addition, resources affect one another. The way these resources are combined has important implications for creation of IT value. However, there seems to be inadequate focus on exploration of the resource building process in the IT literature. This is the reason for conducting this research. Further insights into how IT resources are combined and how they interact together in an organisational context could make RBT more applicable in the IT area. Without understanding the interactions between the IT and organisational resources, the impact of individual IT resources on organisational performance reported in the earlier IT literature may be misleading.

Studies that used RBT as a theoretical framework have each conceptualised IT resources differently, as presented in Table AI. This reflects different foci as well as different findings in regard to the relationship between IT resources and organisational performance. Table AI illustrates that the IT literature has been focused on IS/IT resources that are commonly intangible and developed by the organisation internally over a period of time, rather than on IT assets.

For the purposes of this paper, IT resources are defined as IT assets and IT capabilities that can help organisations avoid threats and take advantage of market opportunities (Aral and Weill, 2007; Wade and Hulland, 2004). IT resources can be tangible or intangible (Wade and Hulland, 2004; Helfat and Peteraf, 2003). Often, IT assets are off-the-shelf and widely available IT applications, used to process, store and disseminate information (Aral and Weill, 2007; Wade and Hulland, 2004). IT capabilities refer to organisational skills, processes and ability to use IT and combine it with other organisational resources in order to achieve business objectives (Wade and Hulland, 2004; Bharadwaj, 2000).

IT capabilities are an important component of IT value. Several studies found that organisations with superior IT capabilities indeed, do achieve superior performance (e.g. Bharadwaj, 2000). For instance, Doherty and Terry (2009) found that an organisation's ability to effectively apply an appropriate portfolio of IS capabilities determines if IS will lead to competitive advantage or not. Apart from IS capabilities organisations also need to have additional complementary resources, such as organisational culture, and its outside-in and spanning capabilities (Doherty and Terry, 2009).

IT resources complement and influence organisational resources. Powell and Dent-Micallef (1997) found that IT assets contribute to sustainable performance advantage in the retail industry only when used to leverage intangible and complementary human and business resources. Aral and Weill (2007) found that IT assets complement organisational IT capabilities and thus, lead to different performance benefits. They established that organisations with strong IT capabilities demand more IT, and IT capabilities strengthen and broaden the performance effects of IT investments (Aral and Weill, 2007). Bharadwaj (2000) confirmed that organisations with high IT capabilities have outperformed organisations from control group.

IT resources can produce four IT effects on organisational performance (Gregor *et al.*, 2004). These are: informational (information sharing within an organisation, improved business intelligence through better understanding of customer needs and wants, and improved information for managing the organisation); strategic (creation of competitive advantage, new products or services, improved relationships with customers); transactional (improved business efficiency, labour productivity); and transformational IT effects (organisational change, expanded capabilities). These four IT effects capture different ways in which IT can affect organisational performance and competitive advantage. The combination of the four IT effects is considered as an appropriate operationalisation of the IT value construct in this paper. Gregor *et al.* (2004) found that IT effects have a different impact on organisational performance. Informational IT effects have the largest, while transactional IT effects have the least influence on organisational performances, regardless of organisational size.

The combination of IT and organisational resources is essential for creating IT value. Liang *et al.* (2010) found that organisational capabilities are in fact mediators between IS resources and organisational performance. When organisational capabilities are not taken into account, results of the relationship between IT and organisational performance are inconclusive. This means that the relationship between IT resources and business performance is not necessarily a direct one, as suggested by Bharadwaj (2000). Liang *et al.* (2010) concluded that IS resources can enhance internal and external organisational capabilities, which in turn, affect organisational performance. In addition, Wade and Hulland (2004) explain that impact of IS resources on organisational performance is mediated by organisational and environmental factors. Organisational factors mentioned by Wade and Hulland are top management commitment to IS, organisational structure and organisational culture, while environmental factors are turbulence, munificence and complexity. Related to this, Rivard *et al.* (2006) confirmed that a "strategic fit", that is, the alignment of external and internal business and IT resources is required in order to increase organisational performance.

In other words, it is the synergy between IS and organisational resources that enhances organisational performance. Synergy determines the strategic potential value

of IT resources in terms of value, rarity and inimitability (Nevo and Wade, 2011). Such strategic IT resources in turn have a positive impact on organisational performance. Realisation of synergy depends on compatibility and integration among IT assets and organisational resources. Compatibility is defined as "the ability of an organizational resource to apply an IT asset in its regular activities and routines" (Nevo and Wade, 2010, p. 170). That is, IT assets need to fit and be aligned with organisational resources, in order to produce relevant benefits.

IT business value can be created when IT is integrated with organisational routines, context and other complementary resources and capabilities (Wade and Hulland, 2004). Integration between IT assets and organisational resources occurs as a result of "activities taken by the organization's management to support, guide, and assist the implementation of the IT asset within the organizational resource" (Nevo and Wade, 2010, p. 173). It is the role of managers to integrate and use IT in a way that creates value for the organisation. That is, they have an active role in RBT (Lockett *et al.*, 2009) as they make decisions on the employment of IT that impact on the organisational outcomes. Moreover, Jeffers *et al.* (2008) emphasise managers' IT knowledge and understanding of the IT potential to enhance organisational activities in creating IT value.

Synergy is achieved when resources positively affect one another. However, relationship between resources is not always complementary, but can be suppressing, as found by Jeffers *et al.* (2008). Resources affect one another through interacting with one another (Wade and Hulland, 2004). Thus, the net effect of an IT resource depends on the nature and strength of the interactions it has with other organisational resources (Jeffers *et al.*, 2008). To understand IT value all interactions between IT and organisational resources should be considered.

Based on the discussion above, several RBT assumptions can be identified on how IT value is created. First, value of IT resources emerges from their combination with other organisational resources. It is not the IT application *per se* that contributes to organisational competitive advantage, but other resources that enable effective application and exploitation of the IT application (Doherty and Terry, 2009; Mata *et al.*, 1995). Based on whether IT and other organisational resources are complementary or not, resources can enhance or inhibit one another. The second RBT assumption is that organisational ability to use IT resources is necessary for creation of IT value. IT value depends on organisational competency to harness IT value through its use and combination with other organisational competencies (Dhillon, 2008). However, RBT research mainly focuses on the characteristics of resources, while ignoring the link between resources and value creation (Gruber *et al.*, 2010). As this missing link is critical for understanding how IT value is created, the focus of this study is on analysis of interactions between IT and organisational resources in a manufacturing organisation.

2.3 Systems theory and IT value

Systems theory views every phenomenon as a system, defined as a collection of interrelated and interdependent parts that work together in performing certain functions in order to achieve the system's objective (Von Bertalanffy, 1972). Interactions are the central focus of systems theory and they are critical for maintaining the integrity of the system (Von Bertalanffy, 1972) and for determining its behaviour (Ackoff, 1971). Thus, systems theory encourages study of interactions between elements of a system "as a distinct and legitimate form of inquiry" (Trochim

et al., 2006, p. 540). In other words, a system is not the sum of the independent parts, but a product of their interactions (Ackoff and Gharajedaghi, 1996).

The focus on interactions among a system's elements makes systems theory an appropriate complementary framework to RBT. That is, RBT focuses on resources but it does not investigate the level below resources – IT assets (Nevo and Wade, 2010, 2011). Due to its focus on interactions, systems theory can complement RBT and shed further light into interactions among IT and organisational resources, and creation of IT value. These two theories are similar in terms of their views on organisations, and the concepts they use are idiosyncratic (Nevo and Wade, 2010). RBT sees organisations as bundles of resources, and systems theory sees them as systems that are composed of subsystems. Organisational resources and competencies can be considered as systems composed of other resources and assets, as done in a study by Nevo and Wade (2010). They conceptualised IT-enabled resource as a system that emerges from a relationship between IT assets and organisational resources.

Changing a resource (element) in the resource bundle (system), or its interactions with other resources changes the overall IT value, and features of the resource bundle. When IT interacts with other organisational resources, a new entity is created: an IT value creation system with emergent properties not contained in any of its parts (Nevo and Wade, 2010). For the purposes of this paper, an IT value creation system is defined as a collection of IT applications, users, and organisational and environmental contexts. In other words, IT/IS resources such as those identified in Table AI can be considered as elements of such a system. In addition, the external environment is considered as part of the IT value creation process following systems theory's understanding that organisations are open systems as they interact with their external environments. RBT also identifies that the strategic potential of resources depends on the external environment (Nevo and Wade, 2011; Priem and Butler, 2001).

Relationships among IT and organisational IT resources are interactive, that is, "the effect of one resource depends on the level of other resources" (Jeffers *et al.*, 2008, p. 705). Relationships can be synergistic/enhancing, suppressive or compensatory (Black and Boal, 1994). In an enhancing relationship a resource magnifies the impact of another resource, while in a suppressing relationship one resource diminishes the impact of another. In a compensatory relationship, a change in the level of one resource is offset by a change in the level of another resource. As a result of the three potential types of relationships between resources, IT value can be positive, negative or neutral, intended and emergent. In order to understand the value creation process, both IT and organisational resources should be considered, and the nature of their relationships needs to be taken into consideration. This is the focus of cross-impact analysis which is discussed next.

3. Methodology

Cross-impact analysis is used in this paper as a systems theory method for analysing interactions between IT and organisational resources, that is, a system's elements. By analysing these interactions, cross-impact analysis classifies factors based on their role and behaviour in the system. Cross-impact analysis was developed by Helmer (1972) and Gordon and Hayward (1968), and several extensions have been developed (e.g. Advanced Impact Analysis method, Linss and Fried, 2010; Matrice d'Impacts Croisés Multiplication Appliquée à un Classement method, Godet, 1994). Cross-impact analysis has been adapted and successfully applied in different areas to evaluate key factors for explaining and improving a variety of systems. For example, Fried (2010) used cross-impact analysis to

investigate the mutual dependency of strategic learning and a performance measurement system in a case of software development. Cross-impact analysis has also been used as a scenario method, as it allows for more consistent and accurate forecasts by considering interactions between trends and events (Asan *et al.*, 2004).

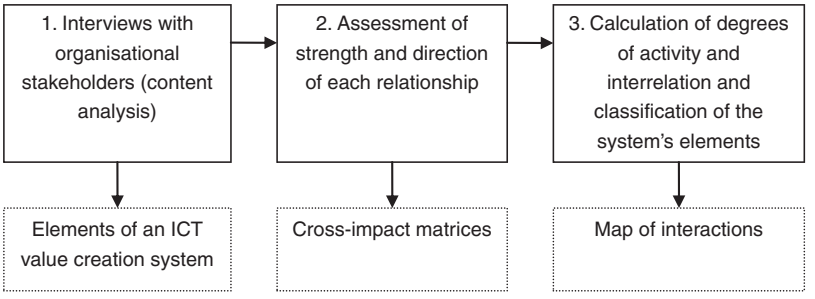
Cross-impact analysis provides a systematic description of relationships by using a cross-impact matrix (Asan *et al.*, 2004). Relationships are assessed by organisational experts using a linguistic fuzzy approach. Cross-impact matrix is information rich as it capture experts' practical knowledge and experience in the form of the direction and strength of each relationship among the set of factors (Asan *et al.*, 2004). As experts find it difficult to assign numbers in expressing their beliefs on the strength of a relationship, linguistic variables weak < moderate < strong are a preferred option (Kardaras and Karakostas, 1999). A cross-impact matrix is based on the same methodology as fuzzy cognitive mapping (FCM) and it contains the same information on concepts and their relationships.

Cross-impact analysis goes a step further in comparison to FCM. After gathering information on strength and direction of relationships among the identified set of factors, it further analyses these interactions by using simple mathematical procedures of adding, subtracting, multiplying and dividing developed by Dubois and Prade (1979) (detailed in Section 4 of this paper). The result is a classification of factors based on their functional role in the system.

Figure 1 illustrates the methodology approach taken in this study, and the three steps of cross-impact analysis: first, identification of factors that define a system based on content analysis of interviews with key stakeholders; second, evaluation of interactions among the set of factors in terms of strength and direction of each relationship; and third, analysis and visual representation of the interactions in the system named 'the map of interactions' and classification of the system's elements (Asan *et al.*, 2004; Messerli, 2000). Each of these steps is discussed further after introducing the research setting.

3.1 Research setting

This research was conducted in a medium-size manufacturing company in Croatia, referred to as Engineering and Production (E&P) organisation. Its reliance on IT applications and their extensive use in designing products, organising production and aligning the production schedule with customers' timetables made it an appropriate



Notes: Boxes with full lines represent the three steps of the cross-impact analysis. Boxes with dotted lines represent the outcomes/tools used in the cross-impact analysis

Figure 1.
Research design diagram

context for researching an IT value creation system. IT in this particular case is an information system that integrates production processes with all other business processes in the organisation, including the interactions with customers and suppliers. Such integration is the cornerstone of the IT potential to create IT value and to enhance the organisation's competitive advantage.

E&P has 314 employees. It uses the latest IT applications and is competitive in the European Union (EU) market. The company's vision is to further increase its competitiveness in the EU market, building on a solid foundation of investing in technology, people and processes. The organisational strategies of E&P are based on the production of high quality products, reduction of operational costs and enhancement of customer satisfaction through on-time delivery and quality products. The role of IT in achieving the organisation's strategies is clear: raising productivity and decreasing overall costs. IT is regarded as a strategic necessity and it enables the organisation to survive in the turbulent market caused by the global financial crisis.

3.2 Identifying elements of IT value creation system in E&P

The focus of the first step of the cross-impact analysis is on identifying a set of factors that describe the system of interest, that is, its elements (Asan *et al.*, 2004). To this end, a series of semi-structured interviews were conducted with organisational stakeholders at different levels of the organisational hierarchy (employees (12), IT employees (2), IT manager (1) and senior and top managers (7)). Interviewees were selected using a snowballing strategy which ensured the selection of respondents who had knowledge of their organisation's IT practices. Triangulation of interviewees' responses was enabled by the fact that employees from different departments and levels of the organisational hierarchy participated in the interviews. In addition, all interviews were conducted in person to improve the accuracy of responses. These strategies were employed with the purpose of ensuring reliability of the findings. Validity on the other hand was ensured by designing interview questions based on a review of the IT literature. The questions focused on aspects of IT that interviewees found relevant for achieving organisational goals, user related factors that enabled or inhibited IT use, aspects of the organisational context that affected IT use and value creation, as well as the impacts of the external environment forces on the process of IT value creation.

Interviews lasted for approximately one hour. They were recorded, transcribed and analysed using content analysis. A total of 23 factors were identified as elements of an IT value creation system in E&P. They are listed in Tables AII and AIII. The system's elements thus identified are related to IT characteristics, organisational context, users, external environment and four components of IT value. Such an holistic and comprehensive conceptualisation of a system helps to obtain useful insights into the process of IT value creation.

3.3 Establishing direction and strength of interactions among the system's elements

In the second step of the cross-impact analysis, interactions among the identified set of a system's elements are assessed in terms of the strength and direction of the relationship between each element and all others. Strength of a relationship is the degree to which one factor influences the other (Fried, 2010). The influence can be strong (2), medium (1), weak (0.5) or none (0). Direction of a relationship between two factors indicates whether an increase in factor "X" results in an increase or decrease in

factor "Y" (Kardaras and Karakostas, 1999). Interactions are recorded in cross-impact matrices, one for positive and one for negative interactions. Hence, where there are n factors there are two $n \times n$ cross-impact matrices (see Tables AII and AIII). This provides a clearer understanding of the dynamics in the system. Use of cross-impact matrices also enables a systematic evaluation of all interactions in the system.

Cross-impact matrices are typically filled out by experts, that is, organisational stakeholders who are knowledgeable in the process being investigated (Kardaras and Karakostas, 1999). In the demonstration analysis, two IT employees were identified as experts due to their comprehensive IT and business knowledge gained over more than two decades of experience with E&P's IT systems. They were responsible for the implementation and adaptation of IS to the organisation's specific business processes, and had frequent interactions with both users and business managers. Thus, they were well aware of how IS is being used, for which purposes and the organisational context that affected its employment. They were approached to evaluate the interactions among the system's elements in E&P, which they agreed to. An additional meeting was organised where both IT employees and the principal researcher were present to ensure accuracy of the responses and reliability of findings. The researcher acted as a facilitator, making sure that each interaction was being evaluated, and that the experts reached a consensus in cases where they had different views on any specific interaction. Their rich tacit knowledge of the interactions among the system's elements was captured in two cross-impact matrices presented in Tables AII and AIII.

3.4 Identifying functional position of elements in the system

In the third step of cross-impact analysis, interactions among the system's elements captured in cross-impact matrices are further analysed. Four indicators are calculated through application of simple mathematical operations (Dubois and Prade, 1979):

(1) Active sum (AS) was calculated by adding values in each row of the matrix. AS provides information on the total effect a cause factor (X) has on all effect variables ($Y_{\Sigma i}$).

(2) Passive sum (PS) was calculated by adding values in each column of the matrix. It provides information on the total effect an effect variable (Y) receives from all cause variables ($X_{\Sigma i}$).

(3) Degree of interrelation (AS × PS) was calculated by multiplying AS and PS for each factor. The higher the degree of interrelation, the more the element is integrated with the system and the more relationships it has with other elements. Elements with the highest degree of interrelation are the most influential elements in the system.

(4) Degree of activity (AS/PS) was calculated by dividing AS by PS for each factor. The higher the degree of activity, the greater the overall influence the element exerts on other elements. That is, elements with the highest degree of activity are the most active elements, and elements with the lowest degree of activity are passive elements.

Degrees of interrelation and activity reflect each factor's individual role in relation to the overall system and thus, are used as a starting point for identification of the functional position of system's elements. In the coordinate system, named the map of interactions, the vertical axis of the map represents the degree of interrelation, while the

horizontal axis represents the degree of activity (see Figure 2). In order to present the complementary information from each cross-impact matrix, each factor is represented by two points on the map. One point (a circle) is based on coordinates (i.e. degree of activity and degree of interrelation) from a positive interactions matrix and the other point (a triangle) is based on the coordinates from the negative interactions matrix. Each pair of circle and triangle is connected by a line to visually link coordinates belonging to one factor (see Figure 3).

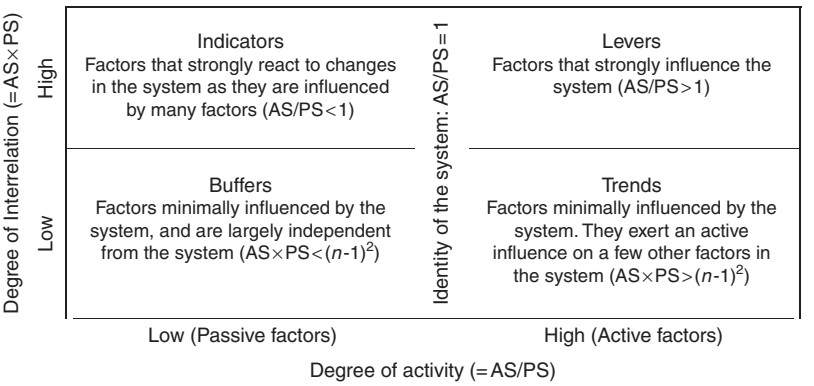


Figure 2.
Identification of functional roles of system's elements in the map of interactions

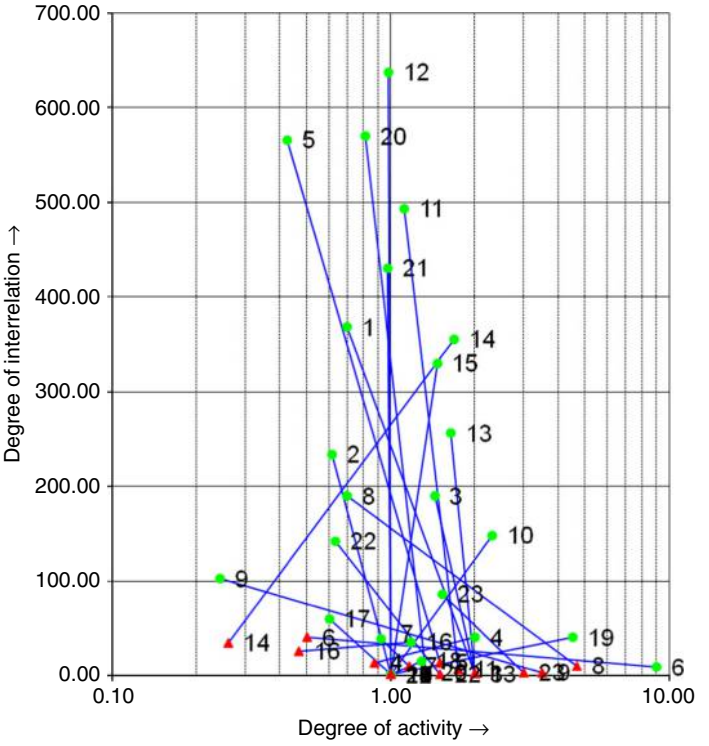


Figure 3.
E&P's map of interactions

As a result, the map of interactions displays the whole system and indicates the functional position of each element within the system. The position of each element in the map reflects its impact on the system. Understanding the functional position of a system's elements is critical for developing effective strategies for managing the system. The system's elements can be classified as levers, indicators, identity, buffers or trends based on their position in the map of interactions, as presented in Figure 2.

Every element has a position in the map of interactions denoting its characteristic behaviour in relation to all other variables. Indicators of the system are passive and highly interrelated elements that quickly react to changes in the system. As they are controlled by the system, indicators can be used to monitor change in the system, and as indicators of success of intervening actions. Levers are active and interrelated factors that exert more influence on the system than they receive, and because they are highly interrelated, their influence quickly spreads to other factors. They drive and control the system, but can be a source of instability. A driving factor is also an excellent basis for intervention activities to improve the performance of the system.

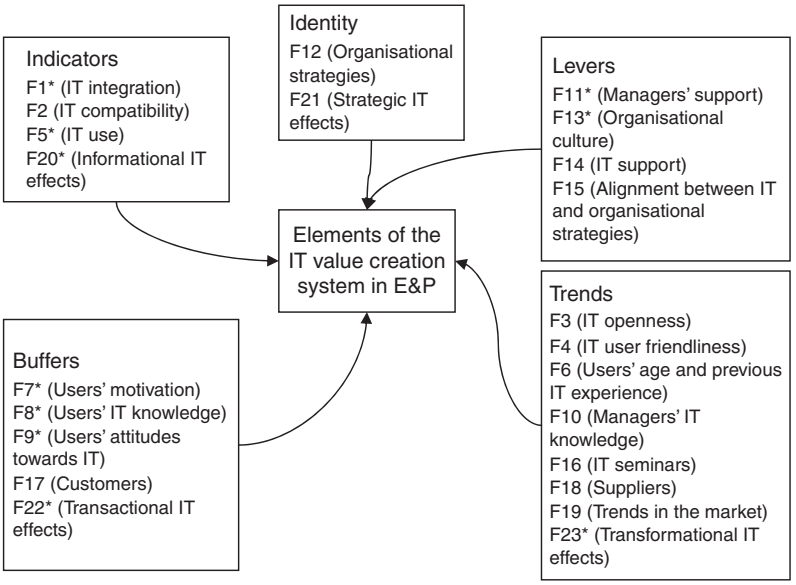
Elements that determine the essential identity of each system are positioned on the central vertical line in the map. They are neutral factors as the forces in the system balance out any influence these elements exert or receive from other elements in the system. Thus, they cannot be used as either levers or indicators (Linss and Fried, 2010). Trends are active elements but exert a weak influence on the system due to a low degree of interrelation and their effect might only be observed over time. Buffers of the system are passive and not well interrelated factors. They have a minimal influence within the system, but are shaped by the system.

The presented classification is useful in understanding the system. However, a word of caution seems appropriate. It is important to be aware of both the positive and negative component of each factor. Some elements may have their positive component (circle) in one area of the map and the negative component (triangle) in another. If the negative component has a degree of activity larger than one (AS/PS > 1), such elements will have an inhibiting effect on the system. For example, managers' support (F11) and organisational culture (F13) are classified as levers based on their active component (circle) (see Figure 3). However, these two elements also have their inhibiting component (triangle) on the right hand side of the map of interactions (AS/PS > 1). This means that their inhibiting components are active and influence other elements in the system. Hence, growth of these elements will lead to growth of other elements in the system, but it will also inhibit a few other elements in the system. For this reason, factors that have inhibiting component with the degree of activity larger than one must be observed closely. In contrast, IT support (F14) is a lever with an inhibiting component that has a degree of activity less than 1 (AS/PS < 1) shown by a triangle to the lower left of Figure 3. This can be interpreted in a way that the inhibiting component absorbs the influences exerted from other elements in the system, but it does not pass it on to the other elements.

4. Discussion of E&P's IT value creation system

Cross-impact analysis, as applied in this study, results in the map of interactions depicting the E&P's IT value creation system (see Figure 3). Elements of the E&P's IT value creation system are further classified as indicators, levers, identity, trends or buffers, as indicated in Figure 4.

Figure 4 summarises the results of the cross-impact analysis in terms of the functional role or the system's elements. The fact that all these elements interact



Note: Symbol '*' is used to denote elements with active inhibiting components

Figure 4.
Classification of elements in E&P's IT value creation system

with one another indicates that the system is a dynamic one and it responds to internal and external pressures. As the organisation has less control over its external environment, related environmental elements are the source of the system's emergent development. The same applies to the elements with inhibiting potential that are identified in Figure 4.

The first category of elements is indicators. IT compatibility (F2) has been high in E&P and this is a result of the influences from other elements in the system. Three other indicators identified in Figure 4, namely, IT integration (F1), IT use (F5) and informational IT effects (F20), change in reaction to other changes in the system. However, their growth inhibits IT seminars as indicated in the negative cross-impact matrix. In addition, IT use (F5) also inhibits IT user friendliness, managers' support and IT seminars. In other words, IT is being used to a satisfactory level and hence there is no perceived need for managers' support or IT seminars. However, IT use inhibits IT user friendliness as new screens and functions that are being developed make IT cumbersome to use. Employees in E&P organisation emphasised in the interviews that due to too many adjustments, IT was becoming complex to use. IT employees clearly need to find a right balance between adjusting the IT functions to employees' requests and future IT user friendliness.

The second category of elements in E&P's system is levers. IT support (F14) and alignment between IT and organisational strategies (F15) are the only elements that do not have an inhibiting component. Hence, these elements strengthen the system and have a critical role in driving the system and shaping the process of IT value creation. In contrast, other levers, managers' support (F11) and organisational culture (F13), have inhibiting potential and can be seen as a source of instability in the system. That is, their strong influence encourages growth of other elements, but it also inhibits some elements. The negative cross-impact matrix identifies that managers' support (F11) inhibits users' age and previous experience (F6), and IT seminars (F16). Organisational

culture (F13) inhibits users' motivation (F7). For example, organisation A has a low turnover of employees, who are loyal and well aware of organisational strategies and culture. However, this also means that the organisation has a significant group of employees who are in their late 50s who, due to age and lack of experience with IT, are struggling with utilising and learning to use IT functions. This may inhibit the system's future development as they require significant IT support, putting pressure on IT employees' time.

The third category of elements is named identity. In E&P two elements represent the identity of the system, organisational strategies (F12) and strategic IT effects (F21). These are well interrelated elements; however their degree of activity is one. They are neither active nor passive factors. They are the glue of the system and have a critical role in integrating the whole system. This can be observed in the cross-impact matrix (Table AII) that indicates that these two elements influence and are influenced by the majority of elements in the system. If these two elements would change, the whole system would change dramatically as a result. It is because of the central role of the identity elements and their synergy with all the other elements that the system in E&P operates successfully.

Trends are the fourth group of elements discussed in this paper. They are active but not well interrelated elements. Hence, the influence of trends: F3, F4, F6, F10, F16, F18, F19 and F23 on the system may be observed in the future. Cross-impact matrix (Table AII) identifies that identified trends affect IT integration (F1), IT use (F5), users' attitudes towards IT (F9) and informational IT effects (F20), among others. In addition, transformational IT effects (F23), due to its active inhibiting component ($AS/PS > 1$), may inhibit IT support (F14) in the future. E&P constantly updates IT and adapts it to its business processes and users' needs, which requires further IT support. Such incremental IT adaptations ensure alignment between business needs and processes, work tasks and IT functions, and consequently, determine the long-term compatibility of IT and business processes. Any transformational IT changes need to be carefully managed having a long-term vision of the system's purpose in mind as well as the organisational environment that the system needs to adapt to.

The fifth and the last group of elements presented in Figure 4 is buffers. Elements classified as buffers are shaped and determined by the system, although, they take a long time to respond to change. They can be seen as the products of the interactions among the system's elements or the aim of the system. They are relatively inert and unresponsive to changes in the system, and hence are quite difficult to change. The time lags that come from changing buffers can be a source of stability or an issue for the system. Buffers in E&P's system are users' motivation (F7), users' IT knowledge (F8), users' attitude towards IT (F9) as well as relationships the organisation has with its customers (F17) and transactional IT effects (F22). The identified buffers work well in E&P, thus testifying to the successful development of the IT value creation system in the organisation good and efficient management is critical for making this happen. It took years to develop each of these elements, but they are now stable, and will take a long time to change as a result of changes in the system. This can provide the organisation with additional room for manoeuvre and to allow for temporary independence between the changes in the system and the buffers. However, some of the identified buffers, F7, F8, F9 and F22 have inhibiting effect on several other elements, as presented in the negative cross-impact matrix (Table AIII). F7 and F8 inhibit users' age and previous experience. In other words, employees in E&P are motivated and have a sufficient level of IT knowledge to offset the effect of their age and lack of

previous IT experience. F8 and F9 inhibit IT support. That is, users require less IT support as a result of their IT knowledge and positive IT attitude. Lastly, users' IT knowledge (F8) and realisation of transactional IT effects (F22) reduces the need for additional IT seminars.

4.1 Implications for managers

RBT states that resources are the source of organisational success. However, due to the generic definition of resources, RBT does not seem practical for managers and IS/IT practitioners. Next, RBT posits that resources create value only when they are employed. To understand the importance and value of utilising IS/IT resources, it is critical to understand their relationships with other organisational resources. So far, RBT was not able to investigate and capture these interactions. Use of cross-impact analysis, as demonstrated in this paper, helps with analysing interactions between IT and other organisational resources. In addition, it enables classification of resources based on their actual role and impact on the system as indicators, levers, identity, trends or buffers. Such a classification of a system's elements or organisational resources, together with knowledge of their enhancing and suppressing interactions, has important implications for managers and IS/IT practitioners.

First, indicators have a low degree of activity which means they react to changes in the system, but do not have an impact on the system as they do not pass on the given energy. Hence indicators should not be considered as part of the solution, as focusing on them will not bring any changes to the system. Indicators simply reflect changes in the system. Understanding this may be beneficial for practitioners in terms of saving energy and resources for more effective solutions. Second, the most important group of resources that are critical in shaping IT value are levers. These resources should be given priority in developing plans and actions for influencing, optimising and managing the system. Levers have a strong influence on the rest of the system. Any change in these resources will affect the entire system. Third, resources classified as identities are critical for the functioning of the system as they integrate and keep all the resources together as a system. They are neutral factors integrating and guiding the system towards a common cause. If managers want to maintain the stability of the system, these factors need to be strengthened, but if the system needs to be changed, then these factors may need to be weakened. Hence, they are important in change management. Due to their high interactivity with other resources in the system they affect many other resources. Strengthening them will increase the synergy of the system. Fourth, trends are active although less interrelated resources. They should be considered in terms of the future development of the IT value creation system. Monitoring is suggested, and managers can consider implementing additional activities in order to improve their long-term impact on the system. Fifth, buffers have low degree of activity and interrelation. They can be used to understand the real purpose of the system and its design.

Understanding functional roles of resources in the organisation and their ensuing classification can provide further insights into the functioning of the IT value creation system. It can also encourage managers to consider additional ideas for employing IS/IT resources in a way that will increase the overall value of the organisation. Cross-impact analysis equips managers and practitioners with precise information on the interactions among resources, which can be used as a basis for informed decision on how to combine and recombine resources and create value for the organisation. Most importantly, the application of cross-impact analysis

in this paper demonstrates the functionality and value of IT/IS resources that depend on their combination and integration with other organisational resources. This is central to development of IT/IS capabilities and creation of IT value, and it surpasses merely investing in IT/IS (Bharadwaj, 2000).

4.2 Implications for theory

This paper contributes to furthering our understanding of the IT value creation process. This is a dynamic process characterised by constant interactions among IT and organisational resources where some resources enhance and others inhibit IT value. Classifying resources based on their impact on the process of IT value creation is an important contribution to the RBT. It also enhances applicability of RBT for practitioners, and provides an additional area for future research.

Most of the empirical studies that have investigated the relationship between resources and organisational performance typically consider a single resource, or rarely a group of resources (Newbert, 2007). Use of systems theory and cross-impact analysis in this study enabled capturing a group of IT and organisational resources represented by 23 elements in the IT value creation system (Tables AII and AIII). Next, use of cross-impact analysis is a relevant contribution to RBT as it enables capturing, visually presenting and analysing interactions among assets and resources (Figure 3). It has been reported that RBT does not explore assets and their interactions but focuses on resources (Nevo and Wade, 2010). Further understanding of the interactions among IT assets and organisational resources can lead to better understanding of how capabilities are developed, what impacts them and how.

Creation of IT value depends on the interactions between IT, human and organisational resources. Understanding interactions among these resources is a key for developing organisational ability to use IT resources. As IT value creation rests on managers' knowledge and ability to integrate and use IT with other resources, information provided by the cross-impact analysis may assist managers in understanding the IT value creation process, its better management and hence development of the organisational IT capability.

5. Conclusion

RBT is a widely adopted theory that has important contributions for IT researchers. It emphasises that resources provide value when they are used in combination with one another. Inadequate focus on the combination and interactions between IT and organisational resources is identified as a gap in the IT literature. This study attempted to fill this gap by conceptualising the IT value creation process as a system in which IT and organisational resources interact with one another. This system can be considered as an IT capability that is a result of interactions among IT and organisational resources. In other words, it is the interactions among resources that build IT capability.

The aim of this paper was to further explore the black box, that is, the interactions among IT and organisational resources as the essential mechanism through which IT value is being created. Use of the cross-impact analysis demonstrated that IT value creation system is a network of 23 elements that affects each other positively and negatively and in different degrees, as well as the system as a whole. Each element has a specific role in creating IT value. That is, IT value is affected by the interactions among a number of resources, and their synergy, instead of a single IT resource. This is an important contribution to the IT literature and the RBT, as they missed to investigate how IT resources are combined, how they affect one another and what the outcome of

this for the organisation is. The example of using cross-impact analysis presented in this study can be extended to provide further insights into the missing link.

Apart from capturing interactions among IT and organisational resources by using cross-impact analysis, this paper contributes to RBT in terms of classification of resources based on their actual role in the system. Resulting identification of the factors that build and factors that inhibit IT value is an additional contribution of this paper. By complementing RBT with cross-impact analysis it has been demonstrated that RBT is applicable to IS practitioners and researchers in terms of understanding the process of IT value creation and the actual role of specific resources in this process. It has been shown that not all resources have the same role or importance in this process. In fact, some resources inhibit the process, some are affected by the process, and others actively influence the entire system. Only by understanding such interactive roles of IT resources within overall system can IT value creation be managed effectively.

While research in paper contributes to furthering developments of RBT, it has some limitations. The main limitation of this study is in relation to generalisation of the findings. The research was conducted in a Croatian SME, and due to specific nature of Croatian developing economy, the results may not be applicable to developed countries. Next, results are based on application of cross-impact analysis to a single organisation. Findings based on a single case cannot be generalised to other cases. Thus, there is need for future research on applying cross-impact method to several organisations in developing as well as developed countries, in order to generate more insights into the role of resources in creating IT value. This will increase the generalisation of the findings.

The findings presented in this paper have important implications for IT as it proposes new areas of research. An extensive research is needed to better understand the resources that influence the IT value creation, and in particular each group of IT effects. A comprehensive and in-depth systematic evaluation of internal and external forces influencing IT value creation should be initiated through both qualitative and quantitative studies. This should include collection of data from IT managers, as well as other senior managers and employees. Another aspect of this topic that demands investigation is the examination of effectiveness of past and current IT value creation strategies used by organisations.

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(The Appendix follows overleaf.)

Appendix

Author(s)	IT/IS resources and capabilities	Factors
Mata *et al.* (1995)	IT resource	Access to capital for IT investments
		Proprietary technology
		Technical IT skills needed to build and use IT
		Managerial IT skills
Powell and Dent-Micallef (1997)	Human resources	Open organisation, open communications, consensus, CEO commitment, flexibility, IT-strategy integration
	Business resources	
	Technology resources	Supplier relationships, supplier-driven IT, IT training, process redesign, teams, benchmarking, IT planning
		Hardware and software
Bharadwaj (2000)	Tangible IT resources	IT infrastructure
		Technical IT skills
	Human IT resources	Managerial IT skills
	IT-enabled intangibles	Knowledge assets
		Customer orientation
		Synergy
Wade and Hulland (2004)	Inside-out resources	External relationship management
	Outside-in resources	Market responsiveness
	Spanning resources	IS business partnerships
	IT assets	IS planning and change management
		IS infrastructure
		IS technical skills
		IS development
		Cost effective IS operations
		Hardware and software
Bhatt and Grover (2005)	IT capabilities	IT infrastructure
	Competitive IT capabilities	IT business experience
		Relationship infrastructure
	Dynamic capabilities	Organisational learning
Aral and Weill (2007)	IT assets	Infrastructure
	Human resource competency	Transactional (e.g. process automation)
		Informational (e.g. information for management activities)
	Management competency	Strategic assets (entry into a new market, new product/ service)
		Technical and business skills of IT staff
	Organisational practices	IT skills of business users
		Relative ability of firms to satisfy their demand for highly skilled IT labour
		Senior management commitment to IT projects
		Business unit involvement in IT decisions
		IT use intensity for communication
		Digital transaction intensity
		Internet architecture
Jeffers *et al.* (2008)	IT resources	Generic IT applications
	Non-IT resources	Shared knowledge (IT manager's knowledge and the line-managerial IT knowledge)
		Human resources (openness of communication)
		Business work practices

Table AI.
Conceptualisation of IT resources in the IT literature

(*continued*)

Author(s)	IT/IS resources and capabilities	Factors
Dhillon (2008)	Strategic competence (strategic use of IT)	Customer needs, management vision and support, organisation's understanding of technological and business aspects
	Exploitation competence	Competence to exploit an opportunity is influenced by the prevailing management culture, experience, and employee satisfaction, organisational infrastructure capable of developing and moving innovations to market quickly, management outlook and attitude, a unique combination of the firm's resources
	Supply competence	Interaction between environmental conditions and internal competencies
Doherty and Terry (2009)	Inside-out	IS development contribution
	Spanning Outside-in	IS infrastructure contribution
		IS technical skills contribution
		Cost effective IS operations
		IS planning contribution
		IS business partnerships
		External relationships
		Market response contribution
Liang *et al.* (2010)	Technological resources	IT infrastructure, assets, software applications and IT investment
	Organisational resources	IT knowledge assets, IT labour skills, human resource, staff expenses, labour training, financial resources
	Internal capabilities	System integration, information sharing, IT/IS capability,
	External capabilities	IS planning experience, IS productivity, IS maturity, IS flexibility, process impact
		Customer capability, relationship management, supplier responsiveness, customer responsiveness, online performance
Nevo and Wade (2011)	IT assets	IT applications with processing and storage features
	Organisational resource	Customer service department
	IT-enabled resources	Synergy between IT assets and organisational resources

Table AI.

Table AII.
Organisation A: positive cross-impact matrix

Cause factors		Effect factors 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Active sum AS	Ratio $Q = AS/PS$	Product $R = AS \times PS$
ICT integration	1	1			0.5	2				1			2	0.5		0.5		1	0.5		2	2	2	1	16	0.70	368.00
ICT compatibility	2	2	1		0.5	2				0.5			2	0.5				1			1	1	0.5		12	0.62	234.00
ICT openness	3	2	2	1		2				0.5			1		2	1					2	1	1	1	16.5	1.43	189.75
ICT user friendliness	4	1			1	2		0.5	0.5	2			0.5	0.5							1				9	2.00	40.50
ICT utilisation	5					1		2	1	0.5	0.5		2	1	1			1	0.5		2	1	1	1	15.5	0.42	565.75
Users' age and previous ICT experience	6						1		2	2	1		0.5		2		0.5								9	9.00	9.00
Motivation	7					1		1	1	1	0.5		1										0.5		6	0.92	39.00
Users' ICT knowledge	8				0.5	2		1	1	2			0.5	0.5							2	0.5	1	0.5	11.5	0.70	189.75
Users' attitudes towards ICT	9					1		1	2	1															5	0.24	102.50
Managers' ICT knowledge	10	1	1	2		2		1	1	1	1	2	1	0.5		1				1	2	1			18.5	2.31	148.00
Managers' support	11	2	2	2		2				1		1	2	1	2	2		0.5			2	2	1	1	23.5	1.12	493.50
Organisational strategies	12	2	2	2	0.5	2			0.5	0.5	0.5	2	1	1	2	2	1	1			2	2	1		25	0.98	637.50
Organisational culture	13	2	2			2			1	1	1	2		1	2	2	1	0.5			2	0.5	0.5		20.5	1.64	256.25
IT support	14	2	2	0.5		2			2	2	1	2	1	1	1	2	1			2	2	1			24.5	1.69	355.25
Alignment between ICT and organisational strategies	15	2	2	2		2				0.5	1	2	2		2	1					2	2	1	0.5	22	1.47	330.00
ICT seminars	16	0.5			0.5	2				1		1	1				1								6.5	1.18	35.75
Customers	17	1	1			1		0.5		0.5	1	1					0.5	1	1	0.5					6	0.60	60.00
Suppliers	18					0.5						1	1					1	1						4.5	1.29	15.75
Trends in the market	19					2			0.5	0.5	0.5	2	1	2	0.5	0.5	1	1		1			0.5	0.5	13.5	4.50	40.50
Informational ICT effects	20	2	2		1	2			1	0.5		2	2	2				1	1		1	2	1	1	21.5	0.81	569.75
Strategic ICT effects	21	2	2	2		2			1		1	2	2			2		1	0.5		1	1	1		20.5	0.98	430.50
Transactional ICT effects	22					2			0.5	1		1	1			1					1	1	1		9.5	0.63	142.50
Transformational ICT effects	23	0.5	0.5			1			0.5			1	1	1	2						2	2	1	1	11.5	1.53	86.25
Passive sum	PS:	23	19.5	11.5	4.5	36.5	1.0	6.5	16.5	20.5	8	21	25.5	12.5	14.5	15	5.5	10	3.5	3	26.5	21	15	7.5	329		

Cause factors		Effect factors 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Active sum AS	Ratio $Q = AS/PS$	Quotient $R = AS \times PS$
ICT integration	1	1															1								2	2	2
ICT compatibility	2		1																						1	1	1
ICT openness	3			1	1																				2	2	2
ICT user friendliness	4				1		0.5								2										3.5	0.88	14
ICT utilisation	5				1	1	0.5					1					1								4.5	1.50	13.50
Users' age and previous ICT experience	6					2	1	1													0.5				4.5	0.50	40.50
Motivation	7						2	1							0.5										3.5	1.17	10.50
Users' ICT knowledge	8						2		1						2		2								7	4.67	10.50
Users' attitudes towards ICT	9						0.5			1		1			2										3.5	3.50	3.50
Managers' ICT knowledge	10										1														1	1	1
Managers' support	11						1		0.5			1					1								3.5	1.75	7
Organisational strategies	12												1												1	1	1
Organisational culture	13							1						1											2	2	2
IT support	14				1		1								1										3	0.26	34.50
Alignment between ICT and organisational strategies	15															1									1	1	1
ICT seminars	16						0.5								2		1								3.5	0.47	26.25
Customers	17																	1							1	1	1
Suppliers	18																		1						1	1	1
Trends in the market	19																			1					1	1	1
Informational ICT effects	20																1				1				2	1.33	3
Strategic ICT effects	21																					1			1	1	1
Transactional ICT effects	22																0.5						1		1.5	1.50	1.50
Transformational ICT effects	23														2									1	3	3	3
Passive sum	PS:	1	1	1	4	3	9	3	1.5	1	1	2	1	1	11.5	1	7.5	1	1	1	1.5	1	1	1	58		

Table AIII.
Organisation A: negative cross-impact matrix