Human Knowledge Resources and Interorganizational Systems

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ABSTRACT AND KEYWORDS	
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Free Keywords	Interorganizational systems, resource-based view, IOS capabilities, Strategic benefits, Human Knowledge
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Abstract: This paper analyses how human knowledge resources affect capabilities and subsequently attainment of operational and strategic benefits. We test a conceptual model using data from two qualitative case studies and a quantitative field study. The findings indicate that human knowledge positively influences IOS capabilities related to cross-organizational business processes and transfer of knowledge. The data show that strategic benefits are the consequence of knowledge transfer, when the transfer supports business processes resulting in operational benefits.

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1. INTRODUCTION

Organizations use various types of interorganizational systems (IOSs) to facilitate their interorganizational relationships (IORs). The benefits of using such systems include operational benefits such as the efficiency of automating manual processes and strategic benefits such as creating new business opportunities [32]. Human individuals, in their roles as boundary spanners, play an important role in interorganizational communications. Interpersonal contacts are essential for supervising technological change; setting requirements, and determining the IOS configurations [10, 13, 24, 48]. Recently increased attention is devoted to the influences of knowledge resources. Nooteboom [38] and O'Callaghan et al. [39] assert that organizations develop relationships to improve their business processes, knowledge and learning capabilities. Organizations cautiously select business partners that possess the required resource profiles and learn by intensifying their relationships with them [30]. However, little is known regarding the influences of human knowledge resources on the development of IOS capabilities within business relationships. The objective of this paper is to increase the understanding in this area by investigating the influences of human knowledge resources on the use of the IOS and the consequent influences on performance. More specifically, the paper examines the influences of relationship-specificity of human-knowledge resources on the use of IOS and attained benefits. The resource-based view (RBV) is used to provide a conceptual foundation for the focus on human knowledge and its influences on the development of IOS capabilities in various contexts. The theoretical contribution encompasses the development of a conceptual model that builds on multiple literature streams including literature on IOS, RBV, transaction cost economics (TCE) and knowledge management. Combining concepts from these various streams facilitates a more comprehensive analysis of influences of human knowledge within different IOS configurations. The conceptual model is validated using a research design combining two qualitative case studies and a quantitative field study within the logistics sector. The case studies facilitate in-depth analysis of the influences of human knowledge and the field study facilitates rigorous testing of the hypotheses.

The paper is organized as follows. Section two briefly discusses the literature on IOSs and resource-based view. Section three discusses the development of the hypotheses. Section four describes the qualitative and quantitative data and examines their support for the hypotheses.

Section five discusses the implications of the empirical findings and finally, section six concludes the paper.

2. LITERATURE REVIEW

This section presents a brief literature review by first discussing the literature on IOS and their utilization within business relationships. Then the literature on resource-based view is discussed

Interorganizational systems

To qualify as an interorganizational system, it is necessary and sufficient for a system to be used by two or more organizations [7]. Diverse types of IOSs are distinguished ranging from extranets and commonly shared databases to electronic data interchanges and proprietary electronic-support supply chain management systems [8]. The use of IOSs can yield significant transactional advantages such as communication efficiency, enhanced storage and processing capabilities [2, 16, 33]. Previous studies have highlighted the benefits of IOS in supporting organizational boundary spanning business processes. The information exchange and intensive coordination enable customized make-to-order processes [46], just-in-time deliveries [14], interorganizational-process modularity [45] and other pursuits. Various studies emphasize the important influences of interlinking processes across organizational boundaries on improving performance within IORs [36, 46]. Recently increased emphasis is placed on the role of IOS to support the interorganizational information sharing and knowledge transfer [30, 32]. Organizations select particular business partners that possess specific resource profiles in order to have access to the needed information and knowledge. Organizations learn from each other by intensifying their relationships [30]. The IOS can facilitate exchange of rich and broad ranges of information and hence the knowledge of the business partner becomes easily accessible. The inhabituation consequently facilitates the absorption of knowledge and decreases the knowledge differences between organizations. Accordingly, the business partners can utilize a larger pool of knowledge to gain competitive advantage. Besides, the dynamic competitive business environment requires organizations to exchange information in a timely and effective adequate manner. At the same time, the signals received from the environment are usually vague and

inconsistent. The IOS can support organizations in detecting changes within the environment and improve the quality of the communications [15]. This will enhance the decision-making process.

Within the IT field, scholars have used various theoretical frameworks to analyze IOSs. This study combines Transaction Cost Economics (TCE) with the resource-based view (RBV). Scholars have intensively drawn from Transaction Cost Economics to explain the role of IOSs in cross-organizational activities and reducing transaction costs [17, 27, 49]. A key concept in TCE is the specificity of assets. Relationship-specific assets are assets tailored to a particular business partner and thus have an idiosyncratic nature [23]. These assets can be important sources of value creation and they cannot be easily redeployed outside the relationship [25]. Reviews of TCE within IOS literature can be found in Elgarah et al. [19] and Chatterjee et al. [11].

Resource-based view

From the resource-based view (RBV) each organization is perceived as a bundle of resources emphasizing the heterogeneity between organizations originating from different resources and different mechanisms of combining resources [50]. The theory is based on economic theories of monopolistic and imperfect competition [9, 44]. Robinson [44] emphasizes the importance of diversity between organizations and existence of imperfect competition to enable organizations to attain above normal returns. Penrose [40] extends these theories by arguing that the organization "is basically a collection of resources" and that the diversity between organizations results from different combinations of various resources. She argues that organizational growth is dependent on the speed of accumulation and assimilation of resources and on avoiding the underutilization of resources. Wernerfelt [50] argues that resource position barriers, i.e. imitation barriers, can produce above normal returns influencing the strength or weakness of the organization. Later studies focus on various resource characteristics that lead to competitive advantage [1, 18].

The resource-based theory is further advanced when Barney presented a concrete theory to identify the required characteristics of resources to create sustainable competitive advantage. Such resources are argued to be valuable in the sense that they exploit opportunities or neutralize threats in an organization's environment, rare among an organization's current and potential competitors, inimitable, and non-substitutable [3]. Other researchers (Grant 1991; Collis et. al

1995; Powell et. al 1997; Venkatraman 1997) adopt and expand Barney's theory to include other resource characteristics such as resource durability, non-tradability, and idiosyncratic nature of resources. Grant [26] distinguishes between resources and capabilities. Resources are basically inputs into the production process and capabilities are organization-specific information-based processes that are developed through interactions among resources. Teece et al. [47] argue that the competitive advantage of organizations is influenced by the distinctive processes of coordinating and combining resources including difficult to trade knowledge assets and complementary resources. They emphasize path dependence contending that previous investments and activities constrain current and future behavior and opportunities for learning.

Within the information systems field, the resource-based perspective is utilized to distinguish different types of IT resources and capabilities. Bharadwaj [5] presents a classification scheme that distinguishes three types of IT-based resources. The first type comprises tangible resources including the physical infrastructure. The second type comprises human IT resources including technical and managerial IT skills. The third type comprises intangible IT-enabled resources including knowledge assets and synergies enabled by IT. He demonstrates that organizations with high IT capabilities are likely to outperform on a variety of profit and cost-based performance measures. Whereas the importance of tangible IT resources has been questioned [6], the importance of human-based resources has been highlighted various studies. Mata et al. [34] and Powell et al [41] argue that top management commitment and the organization of IT are valuable organization-specific resources. These resources can produce a competitive advantage for the organization when they are complemented with suitable human resources such as IT skills and organizational culture encouraging change and experimentation. Ritter et al [43] distinguish between management qualifications and management tasks. The management tasks need to be performed in order to supervise an organization's network and related information exchange. The management qualifications include skills and knowledge that are needed to perform these tasks. They argue that these tasks and qualifications improve the network competence and degree of technological interweavement of an organization.

3. THE EFFECTS OF HUMAN KNOWLEDGE RESOURCES

Grant [26] and Bharadwaj [5] argue that when an organization combines various resources, it can develop capabilities that are information-based and specific to the organization. Prosser et al. [42] and Subramani [46] assert that relationship-specific investments can lead to important strategic relationships. By applying the logic of the RBV to IORs, we argue that human knowledge resources support the development and existence of IOS capabilities. Human knowledge resources comprise the IT and business knowledge that is possessed by humans and utilized to communicate with the business partner. Relationship-specific human knowledge resources are argued to positively influence existence of IOS capabilities at the IOR level. IOS capabilities are the abilities and competencies developed within the relationship through the use of the IOS. A distinction is made between process-based and knowledge-based IOS capabilities. The first type --process-based IOS capabilities-- encompasses the interlinkage of business processes across organizational boundaries. The human knowledge is important for ensuring successful interlinkage of processes. The knowledge determines the ability to act and exploit possibilities in the environment. The humans sense changes in the market and utilize their business-partner knowledge to determine potential improvements in interorganizational business processes. This is exemplified in just-in-time delivery settings where human supervision is essential for execution and improvement of processes.

The second type --knowledge-based IOS capabilities-- encompasses abilities to transfer and share knowledge across organizations. The human knowledge is argued to positively influence the use of IOS for knowledge transfer and sharing. Humans use the IOS to deliver a wide range of information to the business partner [12]. IOS can be used to coordinate internal organizational developments in real time and to communicate latest market trends. Hence, humans can rely on IOS for communication that in the current hypercompetitive business environments. Furthermore, in case of tacit knowledge, the IOS can facilitate access to knowledge by locating individuals with appropriate expertise and it can improve between those individuals [37]. Hence,

> Hypothesis 1a. Human knowledge resources that have a high degree of relationship-specificity positively affect process-based IOS capabilities.
>
> Hypothesis 1b. *Human knowledge* resources that have a high degree of relationship-specificity positively affect *knowledge-based* IOS capabilities.

As the knowledge-based IOS capabilities involve the transfer and sharing of knowledge with the partner, they are expected to lead to the detection of novel knowledge possessed by the partner [38]. The detection of novel knowledge and its subsequent application can have two imperative influences within the relationship. On the one hand, the knowledge can improve current business processes. Novel knowledge within the relationship can originate from internal R&D projects or best practices discovered from other organizations. The transfer and sharing of such knowledge between the organizations will improve the effectiveness and efficiency of cross-organizational processes. On the other hand, successful sharing of knowledge may positively influence the attainment of strategic benefits. Organizations that utilize their partners' knowledge have an increased understanding of the environment, have access to a broader range of opportunities and are able to conduct enhanced decision-making. They share market information and combine their skills to develop new products and services that provide a competitive advantage [32, 35].

Hypothesis 2a. Knowledge-based IOS capabilities positively affect process-based IOS capabilities.

Hypothesis 2b. Knowledge-based IOS capabilities positively affect the attainment of strategic benefits.

The interorganizational relationship at the operational level can be perceived as one organization providing products or services to a business parent in exchange for compensation. Information sharing obstacles can lead to non-optimal behavior and building up of inventory [31]. The focus of numerous IOS initiatives has been the improvement of information flow between business partners to achieve operational benefits including cost reduction, data error elimination, rapid invoicing, customer responsiveness improvement, efficiency gains, product quality monitoring and automation of boundary-crossing processes (Cash & Konsysbsju 1985, Chatfield & Bjorn-Andersen 1997, Johnston & Vitale 1988, Subramani 2004). Organizations utilize electronic communication to increase the efficiency and effectiveness of business processes. When business partners use IOS to realize smooth information flow, they are able to react to latest changes, coordinate activities and achieve higher performance. Hence,

Hypothesis 3. Process-based IOS capabilities positively affect the attainment of operational benefits.

Accumulation of various operational benefits leads to the attainment of strategic benefits. Operational benefits can be realized in various aspects such as the reduction in costs, improved processing of orders or more efficient stock management. The accumulation of these aspects and their convergence is expected to lead to attainment of more strategic benefits such as better understanding of customer needs and increased competitive advantage for the business partners.

Hypothesis 4. The attainment of operational benefits positively affects the attainment of strategic benefits.

Insert figure 1 About Here

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4. THE EMPIRICAL STUDY

This study adopts the triangulation principle (Webb et al. 1966). The objective is to use two types of triangulation: method triangulation and data triangulation. The methodological triangulation is realized by following a mixed method approach. The combination of multiple qualitative case studies and a quantitative field study enables more rigorous testing of the hypotheses. Attewell and Rule (1991) emphasize the complementarities between case studies and field studies stating that 'each is incomplete without the other'. Quantitative evidence can save the researcher from being influenced by vivid, but incorrect, notions in qualitative data. Qualitative evidence is valuable for discovering the rationale triggering the relationships revealed by the quantitative data. Data triangulation is realized by gathering data through a variety of data sources within the case studies. The data sources include semi-structured interviews, organizational documents and publicly published information.

The unit of analysis of both methods is the dyadic business relationship between two organizations. The organizations are separate, legally independent organizations and they can take decisions autonomously regarding their relationship with their environment.

Case studies

Case studies are useful for in-depth investigation of contemporary events and phenomena within their natural settings [4, 51]. Besides testing the hypotheses, the aim of case studies is to acquire more insights on the proposed causal links. In this study, multiple case-study approach (Yin 2003) is adopted and the replication logic is theoretical replication, i.e. predicting contrasting results but for predictable reasons. Accordingly two case studies are selected: case A is characterized with low relationship-specificity of human knowledge resources and case B is characterized with high relationship-specificity of human knowledge resources. We conducted initial interviews with a number of organizations to assess their suitability. The objective was to determine for each organization whether it was engaging in a specific business relationship that is appropriate for our study.

Case A. The relationship between Global Automation Companion and Trundac Logistics.

Global Automation Companion (GAC) is a globally operating industrial automation company based in the US. GAC supplies a broad product portfolio consisting of industrial automation products, systems and services that aid their customers in controlling and improving manufacturing processes. Its sales exceed $ 3.5 billion. Product sales occur through a blend of direct sales, sales through distributors and system integrators. The case study focuses on the relationship between GAC and Trundac Logistics. Trundac manages the storage process of products designated for Europe, Middle East and Africa (EMEA). Trundac is a subsidiary of a Dutch logistics group of companies. The services of Trundac mainly include the integration of different types of carriage and logistics and value chain services. Trundac has a dedicated warehouse for storing GAC's products. The activities it provides for GAC are mainly warehousing activities.

Communications between GAC and Trundac are conducted through multiple EDI connections. Service orders of GAC EMEA are transferred to GAC US and then to Trundac. After performing the order, Trundac sends a confirmation to GAC US. The communications pass through the headquarters in the US because products stored in the warehouse are property of GAC US and stock modifications need to be processed by the financial systems due to the accounting regulations of Sarbanes-Oxley.

Humans at each organization have accumulated substantial knowledge regarding the business relationship. The setting of the relationship requires representatives of both organizations to have frequent intensive communications and acquire information and knowledge regarding the business partner. This is to ensure correct execution of the different types of orders under the various conditions depicted by the market. This is exemplified in the cross-dock project that GAC initiated aiming at decreasing the minimum stocking period of products after arrival from the US from 48 to 24 hours. As all changes in the inventory needed to be updated in both the GAC system based in the US and the IS of Trundac, the project required the collaboration of logistic executives and IT experts on both sides. Hence, both GAC and Trundac employ human knowledge resources that have a high degree of relationship-specificity.

The electronic communications between GAC and Trundac support various objectives. This case study focuses on two specific objectives: interlinkage of business processes and transfer of information and knowledge. The interlinkage of processes is essential for conducting daily operations. All of GAC's activities that require spare parts or small products can only be performed when Trundac executes certain actions in a predetermined sequence agreed upon by both parties. For example, when the agent of GAC confirms a sales order with a customer, GAC issues a pick order to Trundac to prepare the product for shipping. As Trundac prepares the product, GAC arranges for the product to be shipped by issuing a transport order to another organization; most products should be ready for shipping within four hours after confirming the sales order to the customer. As there are more than 1000 orders daily, interruptions can have significant influences. In case of interruptions, employees of Trundac immediately discuss all details with GAC, including what items are being picked up, quantities and exact time. These discussions allow both parties to manage end-customers' orders and adjust the shipping schedule when needed. This intense collaboration is possible due to the tight coordination between internal processes of both partners. Accordingly, it is argued that GAC and Trundac have developed process-based IOS capabilities within the IOR.

The exchange of information and knowledge between the two organizations is conducted in order to realize two main objectives. The market GAC is serving is volatile and has seasonal

characteristics. Therefore, the IOS is used to exchange extensive information regarding past market trends and future forecasts. The IOS is also used to perform various types of market analyses and to communicate the results of these analyses between the partners. GAC can be limited in some of its activities by the capacity of Trundac. Accordingly GAC needs to have detailed information regarding Trundac's abilities and how it is planning to cope with the market changes. The exchange of market information is also beneficial for Trundac as it obtains future forecasts from its customer. The second aim of exchanging information is the improvement of the relationship. As the activities are tightly coupled across the organizations, realization of improvements is reliant on the cooperation of both organizations. To be able to design and plan any modifications, each organization needs to have in-depth knowledge about the activities conducted by the partner and the underlying reasons for performing these activities. The cross-dock project discussed earlier is an example of the need of having detailed information of both business and IT-related issues in order to realize modifications.

The relationship offers operational and strategic benefits for both GAC and Trundac. The intensive information exchange leads to lower transaction costs. This offers operational benefits including being able to meet the progressive cost targets and accurate forecasts. The better forecasts also improve employee productivity by enhancing the planning of working hours and ensuring the availability of capable employees. On a strategic level, GAC is able to offer more reliable and faster delivery of products to its customers in the EMEA region. The reliability of services and products is of essential importance in GAC's market. GAC is perceived as a successful player because it can realize high-quality performance consistently. For Trundac, the satisfaction of its customer has strategic importance. These benefits have eventually led to the extension of the contract and prolongation of the relationship.

Case B. **The relationship of Fretadia with Phoselot.**

Phoselot is a large US-based organization that operates several types of large merchandise stores in North America. The merchandise stores mainly consist of discount stores and department stores. The products include everyday essentials and fashionable merchandise. The yearly revenue exceeds $ 40 billion. The large diversity of merchandise results in a large number of suppliers. Phoselot demands from vendors to comply with rules and audits prescribed by the authorities as well as additional rules and audits to ensure compliance to standards that Phoselot

sets for itself. The case study focuses on the relationship between Phoselot and Fretadia. Fretadia has been a supplier of Phoselot for the past four years. Fretadia is specialized in designing and manufacturing stylish home and bathroom accessories. It is based in the Netherlands and has production facilities in Hong Kong. Fretadia's yearly revenues exceed one million euros and its customers consist mainly of retailers specialized in upscale stylish products.

Communications are conducted through an extranet that Phoselot has developed to facilitate interactions with its numerous suppliers. The system is linked with Phoselot's ERP system and provides plentiful up-to-date information and performance metrics such as previous and current stock levels, percentage of damaged products and future predictions. Phoselot also uses the system to perform reverse auctions whereby it initially permits only reliable suppliers to participate and subsequently displays its future procurement contracts for commodity products. The suppliers competitively bid for supplying the product. As Phoselot determines most of the contract terms in advance, the main selection criterion is price.

The human knowledge has a general and non relationship-specific nature. Managers of Phoselot offer Fretadia similar contract terms as the numerous other suppliers of Phoselot and the nature of products does not require specific domain knowledge. Managers of Fretadia rely mainly on general market information to maintain the relationship with Phoselot. They collect information regarding prices of raw materials and manufacturing costs from the market to be able to place competitive bids at the reverse auctions. Even after signing contracts, there is no need for frequent meetings between representatives of both organizations. There is also no need to have particular experience or training to conduct communications. The extranet transfers explicit codified information and such information is transferred without loss of integrity. The system is easy to use and Phoselot provides support in case of technical problems. Accordingly, the human knowledge resources are characterized with low relationship-specificity.

The deliveries of stylish home and bathroom accessories by Fretadia to Phoselot occur on a regular basis. The orders are issued every week and products are typically manufactured within two weeks and delivered to Phoselot's agent in Hong Kong. Subsequently, the products are shipped to the US and arrive approximately four weeks later. The long time span between

ordering and delivery implies that short-term market fluctuations have to be absorbed by maintaining a buffer stock. The existence of both the long time span and the buffer stock indicates that functioning of the processes is reliant mainly on other internal processes within each organization. The business processes are weakly interlinked with processes of the business partner. Therefore, we can argue that no process-based IOS capabilities exist within the relationship. Furthermore, the stylish home and bathroom accessories have commodity characteristics and usually no significant changes occur to the products after contracts have been fixed. Phoselot and Fretadia have no need to exchange information regarding the latest market trends. They utilize the IOS to communicate large amounts of transaction and coordination information. The large amount of information exchange does not improve knowledge exchange because the information is not utilized for long-term purposes. Most communicated information consists of information concerning the inventory levels, historical data and forecasts. The information is collected by ERP of Phoselot and is offered to Fretadia, but there is no enduring objective. The business partners do not conduct further analysis to extract knowledge from that information. Therefore, it is argued that no knowledge-based IOS capabilities exist within the relationship.

The benefits obtained from the relationship through the use of the IOS are only operational. IOS is used to facilitate exchange of large amount of operational information to improve stock management and increase the speed of ordering and processing. However, the automated communication of ample information does not result in the attainment of strategic benefits such as enhancing the IOR or better understanding of end-customer preferences. Further analysis of the information provided by the IOS may provide important insights and these can lead to strategic benefits. However, Fretadia does not conduct the analysis and no strategic benefits are obtained from information exchange.

The findings of both case studies are summarized in table 1.

Insert table 1 About Here

Field study

The data of the field study are collected through a web survey. The sample frame of the survey contains Internet shops that are based in the Netherlands and sell computer related products. The questionnaire focuses on their relationships with their transportation companies. For an Internet shop, the relationship with its transportation company is important because products need to be delivered to customers in a timely and proficient manner. Some products require last minute modifications according to customer needs or on-site installation at the customer's location. These relationships are attractive for this study due to the extensive need for timely and reliable information and reliance on ICT. The Dutch transportation industry provides additional opportunity for this study due to the geographical location of the Netherlands in facilitating transportation and distribution to the European mainland, and due to the increased reliance on ICT to achieve timely communications across long distances. To ensure content validity Lawshe's (1975) quantitative approach is employed by asking a panel including ten experts in the transportation industry to indicate whether or not a measurement item in a set of other measurement items is "essential" to the operationalization of each theoretical construct. Subsequently, a pretest is conducted on 20 companies to observe the reactions of respondents to the questionnaire under realistic conditions. To increase response rate, companies are offered to fill out a separate form to obtain a summary of the findings and to receive a benchmark of their answers with those from the entire sample. The number of valid responses is 137 (5 percent response rate). Our sample mainly consists of small companies: 85.4% have less than 10 employees. For the most part, they sell PCs/laptops (65.7%), PC spare parts/components (67.9%), Software (60.6%) and PDA's & Handhelds (54.0%). The transport is mainly conducted by road (97.8%), and the mean duration of the relation with the transportation company is 3.9 years. We do not pretend to have a representative sample of all Internet shops in the Netherlands (such a population is both ill-defined and very volatile) but there is no reason to assume that our respondents deviate from the majority of Internet shops.

Structural equation modeling (SEM) is used for the data analysis as it enables validating the model in a single, systematic and comprehensive analysis by modeling the relationships among multiple related equations simultaneously [21]. LISREL is used as a SEM technique and it consists of two parts: the measurement model and the structural equation model. The

measurement model identifies the relations between the observed measures, i.e. indicators, and their underlying latent constructs. The structural equation model identifies the causal relations between the constructs as put forward by the underlying theory. LISREL provides the opportunity to calculate the maximum likelihood estimates for both models, the measurement model and the structural equation model, simultaneously. However, it is recommended that the measurement model is calculated and fixed before the structural model is estimated [20, 22]. Our study follows this two-stage approach.

The aim of the first step is to establish the convergent and discriminant validity of the constructs. This is done using LISREL confirmatory factor analysis (CFA). The CFA shows acceptable model fit. The χ^2 of 140.80 with 94 degrees of freedom is a χ^2 to df ratio of less than the recommended 1:3. The AGFI at 0.83, the CFI at 0.95, the RMR at 0.047, and the RMSEA at 0.061 are all within acceptable limits for CFA; the GFI at 0.89 and the NFI at 0.89 are slightly below the 0.9 thresholds. Next, all of the hypothesized propositions are simultaneously tested by means of examining the structural model. The fit measures are acceptable: χ^2 to degrees of freedom ratio of 1:1.36 (χ^2_{109} = 148.61), The AGFI at 0.85, the CFI at 0.96, the RMR at 0.067, and the RMSEA at 0.052 are within acceptable limits; the GFI at 0.88 and NFI at 0.89 are slightly below the recommended thresholds. Figure 2 shows the standardized LISREL path coefficients.

Insert figure 2 About Here

Insert table 2 about Here

Results

The empirical data show support for both hypotheses 1a and 1b. In both case studies and the field study, high relationship-specificity of human knowledge resources supports the existence of

process-based and knowledge-based IOS capabilities. Specific human knowledge of abilities and activities of the business partner facilitates successful execution of orders and successful transfer of information. The empirical data also show support for hypothesis 2a. The existence of knowledge-based IOS capabilities supports the existence of process-based IOS capabilities. The sharing of information and knowledge is thus found to support the successful interlinkage of business processes. However, the empirical data do not show undisputed support for hypotheses 2b, 3 and 4. The findings of the case studies show that knowledge-based IOS capabilities positively affect the attainment of strategic benefits, but the data of the field study reveal that even though the support is positive, it is not significant. The case study on the relationship between GAC and Trundac logistics and the field study provide support for hypotheses 3 and 4. The successful interlinkage of business processes is found to support the attainment of operational benefits and subsequently the operational benefits coincide with the existence of strategic benefits. However, the data of the case study on the relationship between Fretadia and Phoselot show that even though process-based IOS capabilities do not exist, operational benefits can be obtained within the IOR. It can be argued that in that particular case, the operational benefits are obtained from other activities. Moreover, the operational benefits in that particular relationship do not lead to the attainment of strategic benefits. These findings are summarized in table 3.

Insert table 3 About Here

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5. DISCUSSION

This study uses the resource-based view to establish a conceptual model that describes the influences of human knowledge resources on the existence of IOS capabilities and subsequently the attainment of benefits. The findings indicate that human knowledge improves IOS capabilities and leads to strategic benefits through the attainment of operational benefits. Relationship-specific human knowledge is important for process-based IOS capabilities. The interlinkage of processes across organizations can be sensitive to environmental changes. Human individuals are able to sense these changes and share their experiences with their colleagues. Based on their knowledge and experience, humans choose the best course of action to use the

IOS to manage cross-organizational business processes. The findings also indicate that human knowledge is important for the cross-organizational transfer of knowledge. In case of tacit knowledge, humans use IOSs to locate their colleagues and counterparts and in case of explicit knowledge, the IOS is used to communicate the explicit information. The findings do not support the argument that knowledge-based IOS capabilities have direct positive influence on strategic benefits. This contradicts recent studies arguing that knowledge creation and transfer produce strategic benefits. The findings suggest that knowledge-based IOS capabilities can only produce strategic benefits when they positively support process-based IOS capabilities and lead to operational benefits. The sharing of information can produce current and up-to-date information regarding the environment, understanding market developments and creating new business opportunities. In addition, the sharing of information increases the knowledge within each organization regarding the abilities of the business partner and how it intends to deal with environmental changes. The results indicate that when organizations use information transfer to improve execution of cross-organizational processes, they can attain significant operational benefits. The accumulation of the various operational benefits subsequently leads to the attainment of strategic benefits.

The conceptual model presented in this study aims at combining the theoretical concepts of TCE, RBV and knowledge management to improve the understanding of the use of IOSs. The focus is on human knowledge resources and our claim is that relationship-specific human-knowledge resources are key to improved performance in multiple ways. Following TCE, it is argued that relationship-specific character of these resources enable the creation of additional value within the relationship. The relationship-specific character also emphasizes heterogeneity and diversity between IORs. This coincides with the arguments of Penrose [40] and Wernerfelt [50] and extends the application of their arguments to an interorganizational context, i.e. that different collections of resources influence performance and the relationship specificity –perceived as imitation barrier– is key to the attainment of above normal returns. Furthermore, the attainment of strategic benefits through the attainment of operational benefits confirms the path-dependence characteristic highlighted in previous RBV studies.

6. CONCLUSION

Human cognitive and social skills are essential for the success of IORs. The objective of this study is to increase the understanding of how human knowledge influences the use of IOSs and the consequent influences of IOS on performance. This paper presents a conceptual model arguing that relationship-specific human knowledge have positive influences on two particular cross-organizational activities --the interlinkage of business-processes and transfer of knowledge-- and subsequently these activities have positive influences on the attainment of operational and strategic benefits. The conceptual model supports the notion of complementarities between TCE and RBV. The empirical findings provide strong undisputed support for most of the hypotheses of the conceptual model; however some hypotheses do not obtain undisputed empirical support.

This paper makes theoretical contributions to the literature on IOS and strategic management. The paper applies concepts from the RBV within an interorganizational context. This enables the focus on human knowledge without the loss of generality, i.e. the conceptual model can be applied to different types of IOSs. The findings complement previous studies within the IOS literature and provide additional complementary insights. For instance, Subramani [46] and Malhotra [32] emphasize the importance of IT infrastructures that enabled rich information and knowledge sharing. This paper complements this by arguing that human coordination and management are essential supplements for the knowledge transfer. Human thinking and knowledge are important in discovering and capitalizing the opportunities within the constantly changing environment. Furthermore, the literature on strategic alliance management focuses on the strategic long-term cooperative arrangements between organizations [29], and particular studies within that stream focus on the sharing of resources [28]. Here it is argued that the management of the relationship and more specifically the relationship-specific knowledge play an important role in the achievement of strategic benefits. This study also focuses on how strategic benefits are achieved. The examination of the causal relationship between IOS capabilities and strategic benefits complements earlier studies and provides a conceptualization relying on the dynamic compliance with requirements of the environment through information exchange. The distinction between operational and strategic benefits enables the distinction between different levels of influences. Mukhopadhyay et al. [36] examine the influences of electronic integration on the operational and strategic level. This study provides a more detailed analysis by focusing on the relationship-specificity of human knowledge.

This study has several limitations that can serve as possible directions for future research. First, the findings are restricted by the research context, which focuses on dyadic IORs. Organizations participate in other types of IORs, such as networks, electronic markets, cartels, associations, and interlocking boards of directors. Within these contexts, human knowledge can have distinctive influences. The findings of our study therefore cannot be generalized to all types of IORs. Hence, future research can incorporate other types of relationships. Another limitation of this study is the focus on the influences of human knowledge resources only. Future research can include other types of resources including tangible IT resources and intangible IT-enabled resources [5]. Finally, the positive relationship between operational and strategic benefits is not supported by all empirical data in this study. Longitudinal research designs can enable the attainment of more accurate insights on the influences of IOS capabilities on operational and strategic benefits.

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APPENDIX A

Standardized Item Loadings

Item	Wording	All Items	After Dropping Items
	Relationship-specificity human knowledge resources		
HRE1	Our employees and managers require specific IT knowledge to be able to communicate with the business partner	0.87	0.86
HRE2	Our employees and managers require specific business knowledge to be able to communicate with the business partner	0.68	0.69
	Process-based IOS Capabilities		
PRC1	IT supports order processing, invoicing and settling accounts	0.46	Dropped
PRC2	IT supports exchange of shipment and delivery information	0.73	Dropped
PRC3	IT supports integration of order planning and forecasts	0.86	0.82
PRC4	IT supports coordinating responses in case of unexpected disruptions	0.83	0.88
	Knowledge-based IOS Capabilities		
KNC1	IT supports the improvement of organizational expertise	0.65	Dropped
KNC2	IT supports the creation of new business opportunities	0.82	0.84
KNC3	IT supports improving the understanding of market developments	0.83	0.83
KNC4	IT supports the integration of functions with the business partner	0.84	0.83
	Operational Benefits		
OPB1	Lowering transaction costs	0.80	0.80
OPB2	Improving cash flow	0.85	0.85
OPB3	More efficient stock management	0.82	0.82
OPB4	Higher productivity	0.85	0.85
OPB5	Faster processing of orders of your own customers / end customers	0.83	0.83
	Strategic Benefits		
STB1	Establishing and/or improving the competitive advantage of your organization	0.86	0.85
STB2	Improving your understanding of the customers' needs	0.84	0.84
STB3	Improving your relationship with your customers	0.85	0.87
STB4	Improving the information exchange with your business partner	0.84	0.85
STB5	Improving your products and services	0.68	Dropped

APPENDIX B

Correlation Tables

	HRE1	HRE2	PRC1	PRC2	PRC3	PRC4	KNC1	KNC2	KNC3	KNC4	OPB1	OPB2	OPB3	OPB4	OPB5
HRE1	1														
HRE2	0.5947	1													
PRC1	0.0976	0.0193	1												
PRC2	0.3058	0.2839	0.5484	1											
PRC3	0.2156	0.1874	0.3612	0.6393	1										
PRC4	0.2590	0.2146	0.3277	0.5484	0.7212	1									
KNC1	0.2275	0.3058	0.1999	0.3508	0.4891	0.4932	1								
KNC2	0.1008	-.0302	0.2303	0.3083	0.5051	0.5816	0.4911	1							
KNC3	0.2429	0.1510	0.1873	0.4346	0.4914	0.5490	0.5431	0.7011	1						
KNC4	0.1840	0.1378	0.1910	0.4379	0.5722	0.5435	0.5498	0.6972	0.6898	1					
OPB1	0.2342	0.1963	0.3086	0.3408	0.1901	0.2719	0.3904	0.2046	0.2056	0.2554	1				
OPB2	0.1024	0.1570	0.2687	0.2663	0.2421	0.2642	0.3876	0.1917	0.3002	0.2885	0.7133	1			
OPB3	0.2452	0.2211	0.3713	0.3558	0.1600	0.1842	0.2901	0.1859	0.1939	0.2321	0.6723	0.6990	1		
OPB4	0.2292	0.1646	0.3149	0.3805	0.2197	0.2395	0.3051	0.2199	0.2263	0.2797	0.6500	0.7041	0.7093	1	
OPB5	0.2320	0.1811	0.1941	0.3174	0.1410	0.1806	0.2547	0.0848	0.1078	0.1419	0.6261	0.6954	0.6708	0.7426	1
STB1	0.3155	0.1822	0.3026	0.3178	0.1573	0.2038	0.3299	0.1626	0.2301	0.1820	0.6301	0.5755	0.5082	0.5443	0.6064
STB2	0.1714	0.0926	0.2764	0.2612	0.1289	0.2306	0.3076	0.2486	0.3091	0.2563	0.4270	0.4498	0.3800	0.3972	0.4480
STB3	0.1870	0.0950	0.2684	0.2773	0.1325	0.1538	0.1717	0.1483	0.2706	0.1997	0.5044	0.5691	0.4667	0.5265	0.5705

STB4	0.2299	0.1335	0.2741	0.3590	0.2462	0.2089	0.2593	0.1755	0.2089	0.1432	0.5662	0.4863	0.5404	0.5512	0.6001
STB5	0.2655	0.2174	0.2369	0.4082	0.4030	0.4290	0.4750	0.3633	0.4248	0.5124	0.5316	0.4923	0.4431	0.5285	0.4399

	STB1	STB2	STB3	STB4	STB5
STB1	1				
STB2	0.7267	1			
STB3	0.6942	0.7686	1		
STB4	0.7153	0.6828	0.7445	1	
STB5	0.6028	0.5939	0.5092	0.5133	1

Table 1

Summary of case study findings

	Case A GAC and Trundac Logistics	**Case B** Fretadia and Phoselot
Relationship-specificity of human knowledge resources	High	Low
Process-based IOS capabilities	Existing	Non existing
Knowledge-based IOS capabilities	Existing	Non existing
Operational benefits	High	High
Strategic benefits	High	Low

Table 2

LISREL Standardized Correlation Matrix

	Human knowledge resources	Process-based IOS Capabilities	Knowledge-based IOS Capabilities	Operational Benefits	Strategic Benefits
Human knowledge resources	1.00				
Process-based IOS Capabilities	0.35	1.00			
Knowledge-based IOS Capabilities	0.22	0.77	1.00		
Operational Benefits	0.11	0.33	0.25	1.00	
Strategic Benefits	0.10	0.29	0.26	0.73	

Table 3

SUMMARY OF THE EMPIRICAL FINDINGS ON THE CONCEPTUAL MODEL

	Case A	Case B	Field study
Hypothesis 1a	Supported	Supported	Supported
Hypothesis 1b	Supported	Supported	Supported
Hypothesis 2a	Supported	Supported	Supported
Hypothesis 2b	Supported	Supported	Not supported
Hypothesis 3	Supported	Not supported	Supported
Hypothesis 4	Supported	Not supported	Supported

Figure 1

Conceptual Model

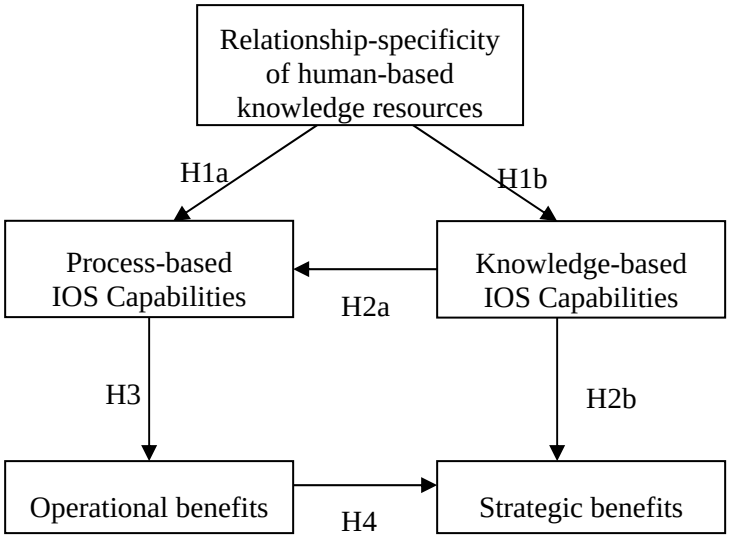
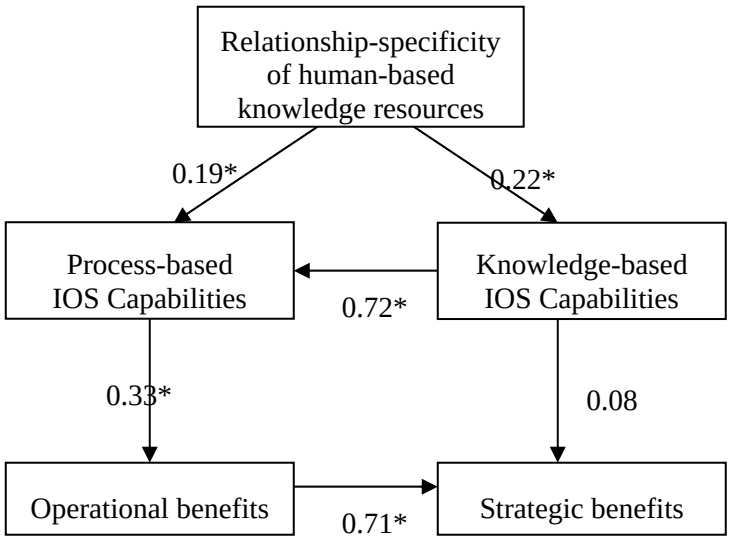


Figure 2

Standardized LISREL solution



* $p < 0.05$

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