

## **Chapter 20: Interdependencies between people and information systems in organizations**

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### **Introduction**

Organizations are multilevel systems composed of interconnected and interdependent elements that must work together to be effective (Kozlowski and Klein 2000). Two essential and increasingly important elements are people and information systems (ISs), both forms of intangible capital: resources that organizations invest in with expectations of returns. Despite the interconnectedness of these human and technological assets there has been very little research on the nature of their interdependencies and how these dependencies affect their functioning and complementarity (Wade and Hulland 2004). In this chapter we discuss how a better understanding of the dynamics of interdependencies between people and information systems can help researchers study organizations and help organizations improve the interoperation of their human and technological assets, thus returns on investments in them.

We begin by reviewing the concept of capital and its application to people—human capital—and information systems—information systems capital. Next we survey past literature on interdependencies and recent literature relating to interdependencies between people and information systems. Based on our analysis we propose an agenda for future research aiming to conceptualize interdependencies between people and information systems in a richer fashion. We conclude with an analysis of the implications for research and practice.

## **Applying the notion of capital to people and information systems (ISs)**

To apply the notion of capital to people and information systems (ISs), we need to understand the nature of each entity and the extent to which each one exhibits features of capital. The lay person's understanding of the nature of people is sufficient for our discussion at this stage, but the lay person's understanding of the nature of ISs may vary. As a result, we briefly clarify the nature of ISs before we examine the extent to which people and ISs can be called capital.

In the IS academic discipline, there is no single agreed-upon definition of an IS (Orlikowski and Iacono 2001). One approach is to think of the IS as a standalone tool, such as a sales system that can be used to produce sales reports. Another approach is to think of the IS as a combination of technology and people, for example, (a) infrastructure (hardware, networks, and operating systems) , (b) applications that use infrastructure (such as sales reporting systems), (c) technical skills (involved in programming or maintaining systems), and (d) managerial skills (involved in managing projects to develop systems) (Melville et al. 2004). A third perspective, which we adopt in this paper, pays particular attention to what makes ISs unique as a resource. According to this view, the primary characteristic of an IS is that it serves to represent some other system in the world. Weber (2004, p. viii) writes:

“... representation [is] the essence of all information systems. The *raison d'être* for information systems [is] that they track states of and state changes in other systems. By observing the behavior of an information system, we obviate the need to observe the behavior of the system it represents.... For example, with an order-entry information system, we track states of and state changes in customers,

which means that we do not have to consult with each customer individually to determine the goods or services they wish to purchase.”

According to this view, businesses invest in ISs because having computerized representations is useful. It is useful because it can *informate* the business, enabling workers to make better decisions, and because it allows a business to *automate* tasks involving representations, enabling tasks to be done more quickly (Zuboff, 1988). Drawing on this research, therefore, we adopt the view that (1) an IS is an artifact that provides representations of some domains in the world, and (2) the development and use of an IS depends on both technologies (infrastructure and applications) and people (developers, suppliers, managers, support staff and users) (Melville et al. 2004).

Given this view of ISs, what ‘capital like’ features do people and ISs share and in what respects do they differ as forms of capital? Answers to these questions should help us to understand essential similarities and differences between human and IS capital and provide a context and rationale for discussing their interdependencies. Key features of capital described in past research relate to investment, structure, time, depletion, knowledge, labour, ownership, social processes, complementarity, fungibility, returns, and measurability. In Table 1, we briefly review the extent to which each of these features is present in human capital and IS capital.

Overall, our analysis in Table 1 suggests that people and ISs exhibit many features of capital. This is intuitive because people and ISs have often been referred to in past research as types of capital. The notion of human capital, for example, has been studied by economists for many years (Schultz 1961, Mincer 1958, Becker 1962, Laroche et al. 1999). This and subsequent research led to the identification of many important aspects of human capital such as the value of

firm-specific skills (Becker 1962), rare and unique skills (Burton-Jones 1999, Lepak and Snell 1999), and high-level generic skills (Drucker 1966, Reich 1991). ISs are also often considered a type of capital. One common view is that ISs are a type of ‘intellectual capital.’ Intellectual capital is typically classified into human capital, social capital, and structural or organizational capital, with ISs being a type of structural or organizational capital (Brooking 1996, Sveiby 1997).

Table 1 does highlight, however, that human and IS capital have characteristics that distinguish them from other types of capital. In particular, the value of both depends heavily on personal knowledge. Consequently, ownership and fungibility cannot be achieved fully, returns are difficult to measure, and value can amplify rather than deteriorate with use over time. Moreover, the value of human capital and IS capital are clearly interdependent. To perform their work, most people in organizations have to use ISs. Likewise, ISs cannot be created and used without skilled people. As a result, attempts to study, measure, or manage human capital in isolation from ISs is unlikely to succeed, just as attempts to study, measure, or manage IS capital in isolation from IS designers and users is unlikely to succeed. Accounting for the interdependencies between IS capital and human capital thus appears to require a holistic approach. How to design such an approach is the challenge we seek to address in this chapter.

**[Insert Table 1 about here]**

### **The nature of interdependencies**

To understand how the interdependencies between human capital and IS capital might be conceptualized and studied it is useful to review the nature of interdependencies in general.

Three types of interdependencies are particularly relevant for our analysis: interdependencies among *people*, among *tasks*, and among *resources*, see Figure 1.

**[Insert Figure 1 about here]**

Of these three types of interdependence, *interdependencies among people* have received the greatest attention in the literature. Early research on interdependencies among people was conducted by Deutsch (1949) and Thibaut and Kelley (1959) when they extended Lewin's (1951) work on field theory. Their research showed that the way that people think, feel, and act at any given time is affected greatly by the manner in which those people depend on others (such as colleagues, competitors, friends, and partners). These ideas have had an ongoing impact in social psychology (Rusbult and Van Lange 2008), education (Johnson 2003), and organizational studies (Tjosvold 1986). In organizational studies, for instance, researchers have often focused on interdependencies among employees and their work units (Victor and Blackburn 1987). Because of the work-oriented nature of organizations, however, a recurring theme in organizational studies has been that interdependencies among people often also involve interdependencies among *tasks* and *resources* (Pennings 1973; Victor and Blackburn 1987).

The most well known typology of *interdependencies among tasks* (and the dominant framework of interdependencies in organizational science) was provided by Thompson (1967). He identified three types of interdependency reflected in tasks involving people. In order of increasing levels of interdependency, these are: pooled, sequential, and reciprocal. In pooled interdependence, an organization depends on the performance of multiple tasks but each task may occur independently, such as in sales firms that depend on multiple salespeople who operate quite independently. In a sequential interdependence, tasks occur in sequence with the output of one

serving as input to another, such as in manufacturing production lines. In reciprocal interdependence, tasks are reciprocally and dynamically dependent on each other, such as in the tasks performed by a medical team in an emergency room.

Thompson's ideas have been extended by many researchers. Nonetheless, an enduring idea in his work is that when interdependencies exist among tasks, an organization will need coordination mechanisms to deal with them. Furthermore, each type of interdependence requires a different coordination mechanism: pooled interdependence requires standardization and rule conformance, sequential interdependence requires planning and scheduling, and reciprocal dependence requires mutual adjustment and feedback.

Subsequent research on coordination led to the realization that interdependence among tasks often also involves *interdependence among resources* (Malone and Crowston 1994; Victor and Blackburn 1987). For example, Crowston (1997) proposed that organizational processes often involve three types of dependencies: (1) task-task (when tasks share an input or output, or when the output of one task is the input of another), (2) task-resource (when a task requires a resource), and (3) resource-resource (when one resource requires another resource). Likewise, Malone et al. (1999) suggested that three types of dependencies often arise in organizations due to the way that resources relate to tasks: (1) flow (when a task produces a resource used by another task), (2) sharing (when multiple tasks require one resource), and (3) fit (when multiple tasks must be performed to produce a resource). While often useful in practice to distinguish people from other resources, as shown in Figure 1, resources may also be referred to generically; Malone and Crowston (1994, p92) for example note that a resource can include "money, storage space or an actor's time".

These typologies are useful for our analysis because ISs can be studied in terms of tasks (the tasks involved in developing, maintaining, and using them) or in terms of a resource (the resource provided by the IS). As a result, these typologies enable us to describe the possible types of interdependencies that can exist among people, tasks, and systems. Specifically, interdependencies can exist among people (people-people), tasks (tasks-tasks), systems (system-system), and among any combination (people-task, people-system, task-system, or people-task-system). Given the focus of our chapter on interdependencies among people and systems, we are especially interested in interdependencies within and among people and systems. Such interdependencies will often occur, of course, in the performance of tasks.

### **A review of recent research on interdependencies between HC and ISC**

To examine how interdependencies have been examined recently, we developed a model to describe the ways in which such interdependencies may be realized. Figure 2 distinguishes between two types of resources—people and systems—and two types of activities and associated tasks: functional support activities and primary activities. Functional support activities refer to all the tasks performed to procure, develop, and maintain resources. We use the term ‘functional’ because the groups in organizations that perform these support activities are typically located in discrete organizational functions such as HR departments for human resources and IS departments for IS resources. Work tasks are the primary value activities (Porter 1985) *for which* people and systems are procured, developed, and maintained, such as buying and selling products and services and executing an organization’s strategy. Outputs from these work tasks, by reducing costs or increasing margins, add to organizational value - the pool of rents available for reinvestment or distribution to stakeholders. Organizational effectiveness derives from the organizational value or rents that are appropriated by the organization and used

to improve capabilities, performance and returns to shareholders (see Coff, chapter 14 this volume). Figure 2 also depicts four types of dependency involving resources and functions: IS - people; people - IS support; IS - people support; people support - IS support.

Among the more obvious dependencies that can be deduced from this framework are that people and ISs depend on each other because people depend on ISs to perform tasks and ISs require people to use them. Similarly people depend on IS support; if only because they require training by IS support to use systems. ISs in turn depend on people support because people must be hired that have the requisite skills to use the ISs. Dependencies between people support and IS support include the need to maintain fit between support practices involving people and IS procurement, development and maintenance, in order that people can use the IS and the IS can be effectively used by people. Overall, the figure illustrates many examples of the types of dependencies that we noted above among people, systems, and different types of tasks, including functional support tasks and work tasks.

**[Insert Figure 2 about here]**

To understand the extent to which researchers have studied interdependencies like those in Figure 2, we hired a graduate student with a M.Sc. in information systems and coursework in organizational studies to review all research articles published in 2008 in two organizational science journals and two IS journals. In both cases, one journal was chosen to reflect the leading research in that field (*Academy of Management Journal* and *MIS Quarterly*) and another major journal was included that specializes in more European, interpretive research (*Organizational Studies* and *Information Systems Journal*) because such research is sometimes underrepresented

in leading North American journals. The coder was asked to read each article in the sample and identify those that examined interdependencies between people and systems, whether in the context of work tasks or functional support tasks (HR or IS support) (per Figure 2). To provide additional assurance that articles were not missed, the coder also searched electronically across all articles in the sample for terms related to interdependencies.

Table 2 summarizes the results. As the table shows, few articles were found in the IS journals and no articles were found in the organizational science journals. We therefore added one more year of organizational science journals (2007), but only one new article was found. The lack of examination of interdependencies among people and systems in organizational science was surprising to us given the importance of this issue in practice but it confirms Orlikowski and Scott's (2008) recent observation that organizational scientists rarely examine IS-related issues.

**[Insert Table 2 about here]**

After identifying the 10 articles in Table 2, the coder then read each article and classified the way in which interdependencies were studied according to a coding scheme we created. The coding scheme required the coder to first identify terms used to study interdependencies whether the term 'interdependency' was used in an article or not. Second, the coder classified the nature of interdependencies studied according to the types identified in past research (by Crowston, Malone, and Thompson, referred to above). Third, drawing on Figure 2, the coder specified whether the article examined interdependencies among IS support functions and work tasks, HR and IS support functions, or all three (IS support activities, HR support activities, and work tasks). Fourth, the coder distinguished between simple and composite interdependencies where

simple interdependencies are *between* elements (such as between ISs and tasks) and complex interdependencies are *both within and between* elements (such as within different elements of ISs or tasks *and* between ISs and tasks). Finally, the coder classified the level of analysis at which the interdependency was studied (individual, group, or organization).

Table 3 summarizes the results of the coding. To some extent, the table suggests that interdependencies have been viewed in a wide variety of ways because researchers have used many concepts to study interdependencies and have examined interdependencies at various levels of analysis (individual, group, and organizational levels). However, the table also indicates that researchers have conceptualized interdependencies in fairly simple ways that do not account for the full range of interdependencies in organizations. Specifically, they have generally conceptualized interdependencies in terms of how multiple people rely on an IS to perform their tasks (i.e., task-resource, sharing, pooled, IS-tasks, simple/composite). Although our analysis is limited to just four journals and a limited time period, it illustrates how rarely and simply researchers have studied interdependencies between people and ISs in organizations.

**[Insert Table 3 about here]**

Table 3 indicates that researchers could study interdependencies between people and systems in many more ways than they have studied them in the past. Given the importance of interdependencies in organizations, this would seem to be a significant opportunity for future research. Our review indicates that research is particularly needed that examines (1) interdependencies among resources, (2) interdependencies that involve temporal elements such as flow, (3) sequential and reciprocal interdependencies, (4) interdependencies among IS and HR

functions, and (5) composite interdependencies. In the next section, we provide an illustration of how some of these opportunities might be tackled.

### **Enhancing our perspective of people - IS interdependencies: Illustrations**

Researchers could take an inductive or deductive approach to research on interdependencies. In this section, we illustrate how researchers could carry out such studies by providing an example of each approach: an inductive examination of interdependencies among resources and a deductive analysis of interdependencies among support functions, resources, and work tasks as they contribute towards organizational outcomes.

#### Example A. Inductive Approach

An inductive approach begins with data rather than theory. The aim is to use data to discover phenomena rather than to prove or disprove a particular theory. In this case, we draw upon an empirical study conducted in a large inner city hotel. The aim of the study was to measure the influence of three resources on hotel performance: the hotel workforce (people), hotel information systems and processes (IS), and the hotel brand standard. The hotel workforce comprised all management and staff working for the hotel including full time employees, part time and temporary staff and contractors. The hotel IS comprised the computer hardware, software and communications infrastructure and applications used by the hotel workforce. The brand standard comprised the set of standard operating procedures and methods prescribed for use by the workforce by the hotel's head office.

To determine the extent to which each of these resources influenced performance and depended on each other, data was collected and analyzed using the method of causal mapping. Both qualitative and quantitative causal maps were created using concepts and techniques proven in prior studies and described in the relevant literature (Eden and et al 1992; Clarkson and Hodgkinson 2005; Abernathy et al 2005).

Expert consultative panels comprising the managers of the major hotel functions were established to oversee the causal mapping process. Overall, 25 elements were identified that influenced hotel performance. Causal relationships were then identified among these elements and collectively on hotel performance and the causal influence in each case was quantified in percentage terms. Elements were divided into three major groups: external environmental elements, internal elements and outcome elements:

1. *External environmental elements* comprised elements largely outside the hotel's sphere of influence, e.g., physical location, competitors, and head office policies.
2. *Internal elements* comprised elements largely within the hotel's sphere of influence.

These elements were further subdivided into two types:

- *Hotel resources*, comprised of intellectual resources (hotel workforce, IS and hotel brand standard), and physical and financial resources (property and amenities and purchasing power)
  - *Management activities*, comprised management of hotel operations, hotel infrastructure, hotel supply chain, and hotel pricing.
3. *Outcome elements* comprised key performance indicators such as guest volume, guest yield, costs, revenues, market share, gross profit contribution, guest satisfaction, guest loyalty, and employee turnover.

Detailed causal maps were created to reflect the contributions of each of these elements to hotel performance (for full details, see Burton-Jones 2007). The causal maps showed that although many of these elements contributed to hotel performance, few did so in isolation. Most elements depended on other elements for their effects. The investigation was therefore expanded to investigate the nature of the interdependencies involved. In order to keep the exercise manageable it was decided to focus solely on identifying and measuring interdependencies between the hotel's major intellectual resources: the hotel workforce, the hotel ISs, and the hotel brand standard. No attempt was made in this study to identify or measure interdependencies between resources and support functions.

To identify the extent to which patterns of interdependencies varied, six contexts were identified, each context representing an important hotel function or outcome element in which the hotel workforce, hotel IS, and hotel brand standard were all considered by senior management to play an important role: (1) operations management, (2) infrastructure management, (3) supply chain management, (4) pricing, (5) guest satisfaction, and (6) guest volume.

A semi-structured questionnaire was used to identify and measure the extent of interdependencies between workforce (people), IS, and brand standard in each of these contexts. Interdependencies were quantified by asking informants to estimate the extent in percentage terms to which the hotel workforce, IS, and the brand standard were distinguished from each other in their individual effects on performance. Each of the six members of the expert management panel was interviewed separately to obtain their individual impressions of interdependencies and the results correlated and averaged.

Table 4 below shows the results averaged across all six causal contexts, the figure in each cell representing the percentage dependency of one element on another in their effects.

Interdependencies between IS and the brand standard were not assessed as they were outside the scope of the study. Net dependency refers to the balance of dependency in each case e.g. the figure in Column C is the difference between columns A and B.

**[Insert Table 4 about here]**

As Table 4 shows, interdependencies between the workforce and IS and the workforce and the brand standard in their influence on hotel performance were both high. In the case of workforce-IS dependencies, the dependency was also quite symmetric. The higher estimates of workforce-IS dependencies may have been due to IS use being more readily observable than use of the brand standard, as IS use typically involved a greater range of stylized activities and use of artifacts (hardware and software) whereas the latter frequently involved only mental reference to a set of policies or procedures. Alternatively, it may simply reflect the high level of reliance on IT systems experienced in the hotel.

#### Findings from Example

Whereas previous studies have tended to focus on task-resource or task-task interdependencies (as shown in Table 3), this inductive analysis demonstrates the existence of strong resource-resource interdependencies. Moreover, rather than just studying one-way dependencies by people and systems (as in the case of people who use systems), this study explored and measured the strength of dependencies in both directions. The study also identified and measured interdependencies in a range of operational contexts and included an analysis of three resources that are each typically the domain of a different academic discipline (people studied in Organizational Science, systems studied in Information Systems, and brand standards studied in Marketing). In addition to adding to the literature on resource-resource interdependencies, therefore, this inductive study suggests that discipline-centric theoretical models that posit an independent effect of people, brands, or systems on organizational effectiveness may be

incomplete and possibly misleading.

### Example B. Deductive Approach

Deductive approaches begin with theory. In this example, we use existing theories to develop a model to explain how functional support tasks affect the provision of resources that are used to perform work tasks that influence organizational effectiveness. In the context of this model, we then explain the interdependencies that exist among the different elements along the causal chain to organizational effectiveness. Figure 3 shows the theoretical model.

**[Insert Figure 3 about here]**

The theoretical model draws on contingency theory (Donaldson 2001), knowledge based theory of the firm (Grant 1996, Spender 1996), and theories associated with human capital (Becker, 1964) and strategic human resource management (Lepak and Snell 1999, 2002). The underlying idea is that organizations must obtain resources (such as people and systems) that fit their strategy (needs), structure (such as their contracts), and processes (such as work practices). Organizations that are able to achieve greater degrees of fit are more likely to be able to generate value from resources (such as via employee contributions; Bandura 1977, 1986, Stajkovic and Luthans 1998) and appropriate value from these resources (Coff 1999; Blyler and Coff 2003, Coff, chapter 14 this volume) and, thereby, perform more effectively.

The model has four high-level constructs with each construct formed by its dimensions (Law et al. 1998). In the following subsections, we describe the dimensions of each construct and the dependencies that we expect between systems and people within each construct.

## 1. Resource procurement and organization capability

### 1.1 Dimensions

The model includes four dimensions that we propose drive the capability of an organization to procure the resources (whether people or systems) it needs. These four dimensions were selected based on previous research into the importance of IT-business alignment (Chan and Reich 2007), knowledge congruence (Grant 1996) and strategic flexibility (Sanchez 1995; Volberda 1998) to achieve strategic and operational fit.

Drawing on this prior work, we suggest that at any point in time, the ability of an organization to achieve fit depends on the constraints the organization faces. The model incorporates three dimensions to reflect such constraints:

- the organization's knowledge of the human and IS resources it needs to meet its strategic objectives
- the availability of required human and IS resources in internal or external markets, and
- the organization's knowledge of the strategic value of people and IS's and how best to contract for their supply.

Having fit at a point in time, however, is not enough. Maintaining fit of resources over time requires an additional dimension:

- resource supply flexibility, i.e., the ability of the organization to adapt its people and IS supply practices to new demands and the ability of the organization's people and ISs to adapt or be adapted to new demands.

As Figure 3 shows, we propose that these four factors collectively drive the level of fit that an organization can achieve and sustain.

## 1.2 Dependencies among people and systems

Each of the dimensions noted above involve dependencies among people and ISs. For example:

- Knowledge of resource requirements may depend on knowledge of what ISs are required and the IS knowledge people need to have.
- Availability of people and IS resources may depend on the availability of people with requisite IS knowledge.
- Knowledge of the strategic value of resources may depend on estimates of people's IS knowledge and estimates of ISs value to people.
- Human resource supply flexibility may depend on people's knowledge of IS. The extent to which people management practices can be reconfigured to adapt to new demands may depend on the flexibility of ISs.

## 2. Resource relationships with strategy, structure, and process

### 2.1 Dimensions

The model uses an alignment or 'fit' perspective (Wright and Snell 1998, Lepak and Snell 1999, Birkinshaw et al. 2002, Lepak et al chapter 13 this volume) that emphasizes the reduction of strategic knowledge and process gaps to improve organizational effectiveness (Zack 1999,

Rosemann and Chan 2000). Drawing on this literature, we propose that fit consists of three dimensions:

- IS-strategy and people-strategy fit: fit of people/human knowledge and ISs with organizations' strategic requirements (Zack 1999).
- IS-contract and people-contract fit: fit of people and ISs with the organization's supply contracts in terms of the match of contractual modes and relationships to the value of the human resources (Lepak and Snell 1999) and IS resources being supplied.
- HR support- and IS support-contract fit: fit of HR support activities (Lepak and Snell 1999) and IS support activities with the characteristics of organizations' people (Lepak and Snell 2002) and IS supply contracts.

## 2.2 Dependencies among people and systems

Each of these dimensions involves dependencies among people and ISs. For example:

- People-strategy fit may depend on people's knowledge of IS. For example, for ISs to fit the strategy, they must be used in a way that is consistent with it, which requires having the right people with the right knowledge to use the ISs.
- People-contract fit and IS-contract fit may overlap as well as influence each other. Poor contracts with internal or external IS suppliers (for example lacking appropriate financial incentives or quality controls) may lead to supply of poor ISs. Likewise, because people are needed to achieve and maintain IS-contract fit, if an organization lacks people-contract fit, this will constrain its ability to maximize IS-contract fit.
- HR support practices depend on IS support practices. Because HR support practices are supported by ISs, achieving HR support-contract fit depends on having IS support-

contract fit, because without the right contracts with the right IS suppliers, HR support practices cannot function appropriately.

### 3. Resource value generation and organization appropriation capability

#### 3.1 Dimensions

Because organizations have limited property rights over human knowledge, people's willingness to contribute what they know is critical to organizational value creation (Burton-Jones, 1999; Scarbrough 1999; Hislop 2003). Individuals' contribute what they know through their continuance, attendance, organizational citizenship behaviour, and task performance (Allen and Meyer, 1990; Tsui et al, 1997; Van Dyne et al. 1994; Kelloway and Barling 2000; Organ and Ryan, 2001). Organizations can generate and appropriate value from human knowledge by using it to create rent generating products and services or strategic assets that they can control (Amit and Schoemaker, 1993).

Organizations can generate and appropriate value from IS by designing or buying in ISs with the required capabilities and having the policies and procedures in place to enable them to appropriate value from both the ISs and the people involved in their supply and use.

To account for the effect of fit on organizational effectiveness, therefore, the model posits an intervening process involving two dimensions:

- IS and people's value contributions
- Organizations' ability to appropriate the benefits of IS and people's contributions.

#### 3.2 Dependencies among people and systems

Each of these dimensions involves dependencies among people and ISs. For example:

- People's contribution of what they know may depend in practice on their having access to appropriate ISs. For example, deficiencies in ISs can inhibit information sharing in organizations (Te'eni, 2001).
- IS suppliers' contribution of ISs may depend on knowing what to supply to meet organizational needs or access to people with that knowledge.
- Because all job functions require knowledge to perform them and most involve use of ISs, appropriating value from job performance must depend on appropriating value from knowledge applied in using ISs.

#### 4. Organizational Effectiveness

The final construct in the model is organizational effectiveness. As the model shows, organizational performance will increase if organizations can obtain greater contributions from their resources and if they can appropriate more of the benefits from these contributions. We have already showed that dependencies exist among ISs and people at each stage leading up to organizational effectiveness: the procurement of resources, the fit of resources, and the performance of work tasks with resources. As a result, organizational effectiveness will depend heavily on the way these interdependencies are managed.

### Findings from Example

The proposed model illustrates the richness and complexity of dependencies that can exist between people and IS resources and support functions in organizations; some degree of dependency being apparent at every stage and in all components of the model.

Patterns of interdependent relationships were observed both within and between stages in the model. For example, in the fit stage of the model, the ability to achieve HR support-contract fit depends on having IS support-contact fit, however the model also shows that both types of contract fit are dependent on the organization's prior ability, reflected in the first stage of the model, to procure the right people and the right ISs and to do so using the right contracts.

The model provides explicit examples of reciprocal dependencies. For example, people support activities depend on IS support activities and vice versa. Pooled interdependencies, while not explicitly represented are implied. For example, people need ISs to perform their tasks and ISs to be effective need people to use them. Sequential interdependencies are similarly implied. For example, people's use of IS to (say) search a database for suitable job candidates typically involves sequential human-IS interaction, in which the output of one step becomes the input for the next.

While the implications of the dependencies discussed here would need to be empirically tested, the findings from our theoretical analysis are consistent with prior research that highlights the importance of understanding the interplay between human, IS, and other forms of intellectual capital in organizations (Wade and Hulland 2004; Youndt et al. 2004).

## **Conclusion**

Organizations are systems composed of interconnected and interdependent elements of which two critical elements are people and information systems. People and ISs may also be regarded as forms of capital: resources that organizations invest in by way of procurement, use, and development and from which they expect returns through improved organizational capabilities and performance.

In this chapter we have sought to demonstrate how a better understanding of the nature and dynamics of interdependencies between people and IS can help organizations optimize their interconnections and thereby improve returns on investments in them.

At least three major implications flow from our findings:

*1. When human capital is studied (by researchers) or managed (by practitioners), they must account for the effects of IS capital because otherwise their attribution of cause-effect relationships on, for example, organizational performance or the development of organizational capabilities, may be spurious.*

Our empirical study, while limited in scope, suggests that there are strong interdependencies between people and IS in their effects on organizational performance. These findings and our theoretical model both imply that models that seek to show how to use human capital to improve organizational performance need to incorporate not only people but IS and to model not only resource fit but resource interdependency.

Development of organizational capabilities has been closely linked to workers' willingness to contribute their knowledge and organizations' ability to appropriate and retain the benefits of individuals' contributions (Liebeskind 1996; Spender 1996; Nahapiet and Goshal 1998). Prior research has shown that organizational policies and procedures are required for appropriation (Coff 2003, Coff chapter 14 this volume). Our analysis suggests that such appropriation mechanisms will also depend highly on an organization's IS, because the way that people acquire, use and transfer what they know is increasingly reliant on IS.

From an accounting perspective (see Kramar et al chapter 15 this volume) there has been a dearth of research into the links between human capital accounting and human capital management and between human capital accounting and organizational effectiveness. Our findings suggest that to attempt to account for the effects of people or IS on performance without explicitly including IS-people dependencies is likely to be at best suboptimal and at worst misleading.

*2. Because of the close interdependencies between human and IS capital, researchers and practitioners should attend to the management of these interdependencies. At present people/HR support and IS support are separate functions within organizations. Closer coordination of these functions may improve organizational returns on investments in people and IS.*

From a strategic perspective, closer coordination between IS support and people support functions would appear useful at each stage of the supply chain depicted in our theoretical model, from resource procurement through fit, to maximizing value and organizational effectiveness.

Thompson notes that where interdependence is reciprocal, coordination requires positioning the functions involved tangential to one another, in a common group (Thompson 1967). It is evident from our theoretical model that activities such as planning future workforce requirements and planning future IS requirements are activities that are likely to benefit from cross functional, team-based approaches. Similar benefits would appear likely to flow from closer coordination of HR and IS activities within and across all stages in our model. The evident need for greater coordination of HR and IS support activities suggest that organizations may need to develop strategies for overcoming structural, disciplinary and cultural barriers between the relevant functions.

As noted at the outset of this chapter, the core of the IS discipline and its main purpose in organizations is to provide representations of what is known so as to inform people and help automate task performance. The validity and relevance of such representations and how they are subsequently used is pivotal to the success of both IS and people investments. Research and development into creating better (i.e., more accurate and relevant representations) has been surprisingly limited to date and largely conducted by IS specialists as part of systems analysis and design (e.g., Weber 1997). Given that such representations depend fundamentally on knowledge elicitation and abstraction and much human knowledge is uncertain and tacit, an interdisciplinary approach involving IS and HR perspectives may be beneficial.

Research and development into ways to optimize IS usage has also been limited and largely conducted to date by IS researchers. The popular technology acceptance model (TAM) (Bagozzi et al. 1992) conceptualizes an individual's decision to use an IS as

cognition but his/her actual usage as behaviour. Recent advances in cognitive research indicate that this model and others like it are out of date and that IS usage should be studied as cognitive behaviour (Burton-Jones and Straub, 2006). These findings suggest a fusion of technological and humanistic perspectives would be beneficial.

*3. We have shown that people and IS are strongly interdependent within organizations. We have also shown that both may be dependent on other forms of intellectual capital. These findings suggest that researchers and practitioners should be cautious about taking a reductionist perspective in relation to capital in organizations and may obtain more value from seeing it in a systemic and dynamic fashion.*

As noted in the Introduction, human capital is essentially constituted in the knowledge and other attributes of the human knower (Becker 1962). The core of an IS, the representation that it provides of a domain, is a product of human knowledge (Brooks 1995). Given knowledge is essentially a human resource then human capital, IS capital, and other forms of intellectual capital are ultimately dependent on and reducible to the human knower. Thus, all forms of intellectual capital (human, social, and structural) are arguably human 'knowledge capital,' (see also Lewin Chapter 5 this volume). Even so, the human knower increasingly depends on the instruments of his knowing, in particular IS.

The preceding arguments indicate that investments in both human and IS capital may be viewed as investments in knowledge, which suggests the need for a unified approach to managing them. An obstacle to achieving such an approach is that organizations have suffered to date from having two divergent perspectives of knowledge: knowledge as an abstract, symbolic representation and knowledge as embodied in the human knower, the former supported by the IS function and the latter supported by the HR/people management function.

Functionally separating the management of knowledge representations from the management of human embodied knowledge clearly has some merits but also significant limitations, due to the strong interdependencies between these two types of knowledge capital. A unified approach to managing both forms of capital implies new strategies and structures as indicated earlier plus, importantly, a shift in beliefs, not just about what constitutes knowledge in organizations but more practically about the relationships between people, IS and knowledge in action. We endorse Blackler's (1995) call to focus on the process of knowing rather than the abstract concept of knowledge and for an activity-based approach to conceptualizing knowing in organizations. Organizations that can overcome the cultural and functional barriers involved should reap the benefits through improved returns on their human and IS capital.

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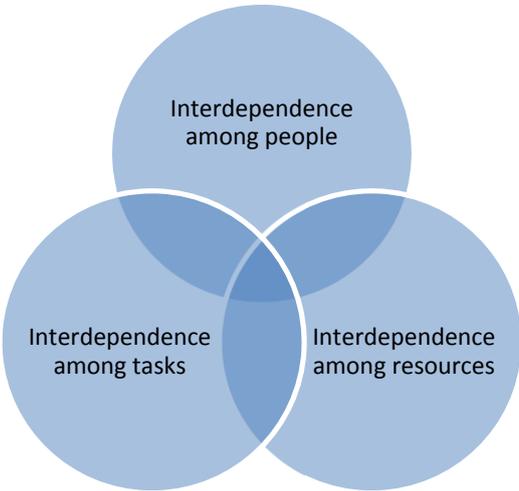
**Table 1: Mapping of features of capital to human capital and IS capital**

<b>Features of capital</b>	<b>Mapping to human capital</b>	<b>Mapping to IS capital</b>
Investment	People and organizations regularly invest in human capital via expenditures on education and health (Schultz 1961).	Surveys suggest that US businesses spend about 50% of their capital expenditure on IT (Gurbaxani et al. 2003, Meeker et al. 2007).
Structure	Organizations can choose different ways of structuring the way they obtain human capital, e.g., via insourcing or outsourcing.	Organizations often choose different ways of structuring the way they obtain IS capital, e.g., via insourcing or outsourcing.
Time	Investments in human capital often yield future returns and can even be made without opportunity costs, e.g., on-the-job learning (Ben-Porath 1967).	Investments in ISs are made over time and it takes time to generate returns from them (Barua et al. 1995, Weill, 1992, Soh and Markus 1995).
Depletion	Human capital deteriorates with ageing but usage can often amplify its value, e.g., through learning (Mincer 1958).	The physical aspects of ISs deteriorate with age, but the conceptual aspects can be used indefinitely and their value can amplify with use (Romer 1993).

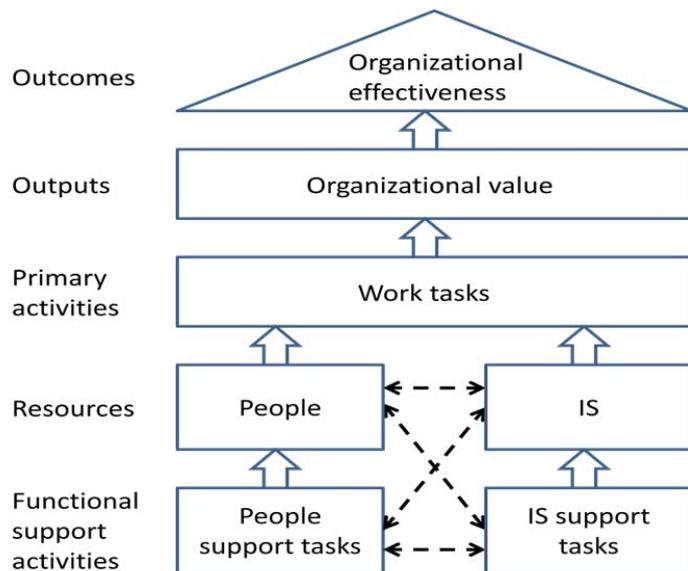
Knowledge	Human capital is essentially constituted in the knowledge and other attributes of the human knower (Becker 1962).	The core of an IS is the representation that it provides of a domain, a product of human knowledge (Brooks 1995).
Labour	Human capital depends on labour because it is embodied in people.	ISs cannot be created and used without labour.
Ownership	Human capital cannot be owned because people cannot be owned.	Some aspects of ISs can be owned (e.g., via licenses) but ownership of data is more challenging (Coombes et al. 2001).
Social processes	Social processes influence human capital because people construct their knowledge socially (Berger and Luckman 1967)	Social processes heavily influence the development and use of ISs (DeSanctis and Poole 1994, Orlikowski 2000).
Complementarity	Human capital is developed and its value amplified by its interaction with other forms of capital such as social and structural capital (Nahapiet, Chapter 2 , this volume)	Economic studies have shown that firms need to make complementary investments to get positive returns from ISs (Brynjolfsson 2003).
Fungibility	Human capital is not fungible because all human beings are unique.	Fungibility is a property of some aspects of an IS such as hardware and some software, but not data.

Returns	Human capital offers a stream of returns and employers and workers often vary in their ability to appropriate these returns (Becker 1962, Ben-Porath 1967).	ISs offer the potential for returns and businesses, their workers, and customers may vary in their ability to appropriate them (Orlikowski 1991, Hitt and Brynjolfsson 1996).
Measurability	Because human capital depends on human knowledge, it is transient and difficult to observe and measure, other than in action (Blackler 1995).	The value of hardware and some software are often measurable but measurability is a difficult challenge for firm-specific data and software.

**Figure 1: Interdependencies among people, tasks, and resources**



**Figure 2: Interdependencies among HR Support, Task Performance, and IS Support Activities**



↑ *Contributions*

← - - - → *Other interdependencies*

**Table 2: Recent Studies of Interdependencies in Organizational Science and Information Systems**

<b>Journal</b>	<b>Year</b>	<b>Number of Issues</b>	<b>Number of articles</b>	<b>Number of articles examining interdependencies</b>
MISQ	2008	4	32	5
ISJ	2008	6	26	4
AMJ	2008	6	55	0
	2007	6	58	0
OS	2008	12	50	0
	2007	12	65	1

**Key:** MISQ (MIS Quarterly), ISJ (Information Systems Journal), AMJ (Academy of

Management Journal), OS (Organization Studies). Interdependencies examined included those between IS activities and work tasks and/or between IS activities and HR support activities.

**Table 3: How Interdependencies were Studied in the Ten Articles<sup>1</sup>**

Concepts used to study interdependence	Nature of Interdependence Examined					
	Crowston <sup>2</sup>	Malone <sup>2</sup>	Thompson <sup>2</sup>	IS/HR/Tasks <sup>2</sup>	Simple/Composite	Level of analysis
Rely on, cause, enable, match, share, exhibit synchronicity/continuity	Task-Resource (10 articles), Task-Task (1 article)	Sharing (4 articles), Fit (1 article), NA (6 articles) <sup>3</sup>	Pooled (4 articles), Reciprocal (1 article), NA (6 articles) <sup>3</sup>	IS-Tasks (10 articles).	Simple (IS-Tasks) (8 articles), Composite (IS-Tasks) (2 articles)	Individual (4 articles), Group (1 article), Organization (5 articles)

<sup>1</sup>The ten articles are those in Table 3. The numbers in each column may add to more than 10 because one article may study interdependencies in more than one way.

<sup>2</sup> Categories: Crowston (task-task, task-resource, resource-resource), Malone (fit, flow, sharing), Thompson (pooled, sequential, reciprocal), IS/HR/Tasks (IS-Tasks, IS-HR, IS-HR-Tasks).

<sup>3</sup> NA: This category is NA (cannot be coded) if a paper does not delineate sets of activities or tasks.

**Table 4: Summary of interdependencies between intellectual resources**

A. Dependency of Workforce on IS	B. Dependency of IS on Workforce	C. Net Dependency (IS on Workforce)	E. Dependency of Workforce on Brand Standard	F. Dependency of Brand Standard on Workforce	G.Net Dependency (Brand Standard on Workforce)
80.9%	91%	10.1%	45%	71.4%	26.4%

**Figure 3: Resource fit and dependency model**

