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THE PROBLEMS OF EMBEDDED INFORMATION SYSTEMS AND EMBEDDED KNOWLEDGE: IMPLICATIONS FOR SYSTEMS INTEGRATION AND KNOWLEDGE MANAGEMENT

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ABSTRACT

This research investigated the effects that embedded information systems and embedded knowledge had on a systems integration project following a corporate merger. Our study focused particularly on one aspect of knowledge – *the organization of knowledge*. The contribution of this research is the presentation of four dimensions for which knowledge is organized: knowledge routinization, knowledge acquisition and release, knowledge dispersion, and knowledge hierarchy and delineation. We provide multiple attributes within each dimension to aid in the identification of the characteristics that make up each dimension. The framework was derived from the existing body of literature on knowledge management, while the attributes were identified through an in-depth field study of a merger between two telecommunications firms that together formed the fourth largest long-distance company in the United States. The research closely followed the merged firm's project to integrate the information systems and the knowledge of two original procurement departments. The project provided a rich source of evidence for how embedded information systems and embedded knowledge can influence a firm's ability integrate information systems and manage knowledge.

Keywords: knowledge-based view of the firm; organization of knowledge; case study; knowledge management; information systems integration; mergers, acquisitions and alliances.

INTRODUCTION

Firms have spent a lot of time and resources implementing information systems (IS) to aid in the organization, distribution, and management of knowledge. Since the early 1970's and 1980's, IS departments have enthusiastically fulfilled requests to develop IS

applications that support oftentimes autonomous functions and manage knowledge across a diverse range of business operations. The result is often knowledge that has little to no consistency or integration across the firm. This poses difficulties when they attempt to use it to achieve specific business objectives [26, 24]. To further investigate these problems of knowledge management, we decided to study how embedded knowledge affected a

firm's ability to integrate IS. For our research, we focused on one aspect of a firm's knowledge - namely, the *organization of knowledge*.

Researchers conducting research within the knowledge-based view of the firm (KBV) body of research have concentrated on identifying structural features that characterizes the concept of the *organization of knowledge* [32, 62]. For example, Lam [32], proposed that knowledge is generally organized along three conceptual frames: coordination, structure, and use. These frames, which Lam found while studying joint product development efforts between a British and a Japanese firm, enabled her to show that the unique social setting of the firms affected how knowledge was organized. However, few research investigations have used this body of literature on embedded knowledge to research how it affects a firm's ability to integrate its IS. Similar to Lam, we studied a corporate merger of two telecommunications firms that together formed the fourth largest long-distance company in the United States. Our research closely followed the merged firm's 25-month attempt to integrate the knowledge and IS of the two original firms' procurement departments. Although the project was deemed a failure, it nevertheless provided a rich source of evidence for how embedded information systems and knowledge can affect the firm's ability to integrate IS.

We propose a framework of the organization of knowledge that can aid researchers to better identify and characterize embedded knowledge and to understand its effect on a firm's systems integration efforts. The proposed framework includes four dimensions (and their attributes): (1) knowledge routinization (knowledge sequencing & adaptability and knowledge documentability); (2) knowledge acquisition and release (knowledge extractability, knowledge gather & releasability, and knowledge protection and shareability); (3) knowledge dispersion (knowledge location, knowledge distribution, and knowledge retrieval); and (4) knowledge hierarchy and delineation (knowledge coordination, knowledge flow direction, and knowledge organization methodology).

To provide the scholarly context for our work, Section 2 reviews the systems integration and KBV of the firm body of literature. Section 3 describes the research approach used for this study to develop the framework inductively. Section 4 presents the background of Merge and the systems integration project. Section 5 introduces the framework, using the field case facts to illustrate the how embedded knowledge influenced the systems integration process. Section 6, concludes the article by discussing implications of the study for research and practice.

THEORETICAL BACKGROUND: SYSTEMS INTEGRATION AND DESIGN

Integration has been defined as "*the process of achieving unity of effort among the various subsystems in the accomplishment of the organization's task*" [32]. Lawrence & Lorsch [32, 233] defined this task as a complete input-transformation-output cycle involving at least the design, production, and distribution of some goods or services. As perceived by the IS field, integration is generally understood as the input-transformation-output cycle that combines and standardizes data elements and processes through the use of common or compatible systems across a collection of information systems.

Prior research on systems integration and design has proposed that a firm's existing technology and organizational capabilities can be used to create changes and improvements in an existing IS environment [20, 42, 3, 66]. IS integration has become increasingly important as firms have constantly attempted to improve efficiency, reengineer business processes, gain a competitive advantage, and compete more effectively. Hence, systems integration is understood as a dynamic process by which firms need to continually manage and achieve unity among IS [47, 52, 12]

Researchers have conducted numerous types of research surrounding the integration of IS, including the management of technology [6, 71], the planning process [37, 8], and the knowledge of the firm [21, 22, 29, 2]. For the purposes of this research, we focused our investigation on the knowledge of the firm because we were interested in better understanding how the knowledge of a firm had become embedded and identifying the effects that it had on the systems integration project. The Knowledge-Based View of the Firm (KBV) was an appropriate theory for our research, as it posited that IS should be developed, maintained, and integrated to help manage the knowledge of the firm [21, 29, 2].

Knowledge-Based View of the Firm.

The knowledge of a firm is comprised of both explicit (e.g., documented concepts, procedures, laws, and routines) and tacit (e.g., experience, relationships, and know-how) knowledge [68, 2]. Kogut and Zander [31] emphasized the strategic importance of knowledge as a source of advantage and established the foundation for an emerging KBV of the firm. This view goes beyond the traditional conception of knowledge as a resource that can assume a tacit or explicit form. Firm knowledge is context-bound and highly specific [59, 60, 52, 54, 56],

hence posing a difficult challenge for any firm attempting to effectively create, coordinate, and use knowledge to sustain an advantage [70, 7]. Researchers have found that what firms do better than markets is to create and transfer knowledge within the organization [30, 78]. In this view, knowledge is held by individuals (know-what and know-how), and is embedded in the organizing principles by which people voluntarily cooperate within an organizational context. Therefore, given that knowledge is difficult to imitate and dependent of existing capabilities and individuals in a firm, it can constitute the basis of sustained competitive advantage.

The KBV argues that the source of competitive advantage in dynamic environments is not knowledge that is proprietary to the organization, since the value of such knowledge erodes quickly because of obsolescence and imitation [17, 21, 22]. Rather, sustained competitive advantage is determined by non-proprietary knowledge in the form of tacit individual knowledge. However, since a firm's actions and activities usually require the combination of a wide array of specialized knowledge that resides in individuals, organizational capabilities are essential to the achievement of that advantage. In particular, the essence of organizations is their ability to integrate individual specialized knowledge and to apply it to new products and services. In this epistemology, knowledge is associated with a process phenomenon of knowing that is clearly influenced by the social and cultural settings in which it occurs.

Existing studies on KBV of the firm suggest that internal and external stimuli prompt firms to change the way in which knowledge is organized [22]. Yet, knowledge is possessed by individuals and not the organization, a critical element of sustained competitive advantage is the ability to integrate the specialized and tacit knowledge of individuals [38]. However, the difficulty of transferring knowledge [26, 49, 61] and the tacit nature of knowledge [60, 55] make it difficult for firms to change how knowledge is organized or integrated. One source of these incompatibilities stems from the manner in which IS [26, 79] and knowledge become socially embedded [32, 11]. This research defines socially embedded as the manner in which the social actions and experiences of the firm -- such as industry regulations, alliances, and organizational culture -- influence how it develops and manages its IS [79, 36] and knowledge [32]. This research focused on one particular aspect of managing the knowledge of the firm -- the *organization of knowledge*.

The Organization of Knowledge. The "*organization of knowledge*" is generally defined as the way a firm distributes, uses, coordinates, communicates, transfers, and structures knowledge [32, 62]. Given that

each firm competes in a unique environment and uses different combinations of knowledge derived from a variety of social settings, the organization of knowledge varies among firms [38] and become socially embedded. Differences in socially embedded IS and knowledge poses problems for firms when they attempt to transfer, share, and integrate knowledge within and outside the firm [24, 32, 11]. While reviewing the organization of knowledge body of literature, we identified four dimensions which aided in the conceptualization and characterization of concepts within the organization of knowledge body of literature. The four dimensions include *knowledge routinization, knowledge acquisition and release, knowledge dispersion, and knowledge hierarchy and delineation*.

Knowledge Routines. Routines are forms, rules, procedures, conventions, strategies, and technologies around which organizations are constructed and through which they operate [63, 41, 35]. Routines make it easy for firms and individuals to execute and reproduce reliable and efficient tasks within and across different organizational levels [19, 18]. Firms and individuals also use routines to create and maintain stable patterns of behavior that characterize their reaction to internal or external stimuli [79]. A firm's routines are context-dependent and of little use outside of the circumstance for which they were developed [22, 30, 52]. Hence, firms uniquely create and use routines to gain an advantage in the marketplace.

Researchers have argued that routines can also be the source of a firm's core rigidities [19]. In the context of quickly changing market environments, such as the financial stock trading floor where investors are expected to react to changing situations, fixed routines can hinder the flexibility and creativity of stock traders, when it prohibits them from deviating and adapting their actions from the firm specified processes and actions. While deciding to use routines, firms must constantly address the dynamic and delicate balance between sustaining a competitive advantage or contributing to core rigidities [19].

Knowledge Acquisition and Release. The management literature suggests that firms must be able to quickly acquire, extract, use, and release knowledge, in order to add value to the firm [39, 16, 13]. The KBV literature posits that the integration of knowledge through the recombination and release of knowledge is a fundamental process by which firms gain the benefits of knowledge and thereby create an advantage [58]. The ability to acquire or release knowledge depends on the degree to which the knowledge is organized and integrated. On one hand, tightly

integrated knowledge provides employees with access to a comprehensive set of the firm's knowledge. Firms that tightly integrate knowledge provide their employees with the ability to quickly grasp a comprehensive set of associations among the varying knowledge sources. An example of tightly integrated knowledge is a financial spreadsheet, where scenario analysis is done through the use of multiple spreadsheets. In this example, macros are used to manipulate the information according to how the user intends to use the information, affects multiple other applications, and the knowledge that resides in other spreadsheets. However, tightly integrated knowledge can sometimes be problematic for firms because its tight integration prohibits employees from understanding how to reorganize and recombine the necessary knowledge resources to react to market changes. Firms that compete in high velocity markets often prefer loosely integrated knowledge, as it aids them in their ability to quickly acquire, use, and release knowledge in order to add value to the firm [45, 16]. An example of loosely organized knowledge is a firm's use of multiple and autonomous information systems and applications that perform separate functions within multiple departments of an organization.

Knowledge Dispersion. Knowledge dispersion refers to the extent to which knowledge is or is not tightly held, self-contained, and located in the minds of individuals [72, 57, 18]. Galunic and Rodan [18] posited that the dispersion of knowledge influences the movement of knowledge throughout the organization because it affects how employees locate, hold, and share knowledge. Arrow [4] argued that, "the centralization of decision making, serves to economize the transmission and handling of knowledge" (p. 69). Conversely, if knowledge is dispersed, it often resides in collective patterns of interactions between a firm's employees [74]. Dispersion does not mean that knowledge is widely distributed, as Galunic and Rodan [18, p. 1198] explained: "A picture on a jigsaw puzzle is *distributed* when each person receives a photocopy of the picture. The same image would only be *dispersed* when each of the pieces is given to a different person."

Dispersed knowledge is typically useful for firms competing in numerous and diverse market segments because it allows employees the flexibility to organize and use knowledge according to market- or industry-specific opportunities or threats [40, 34]. However, dispersed knowledge can be problematic for groups and individuals when its existence or location may not be readily identified or available [64, 34]. On the other hand, some firms tend to favor knowledge that is organized at a central location because it provides a

centralized location for employees to access, use, and store a unified set of firm knowledge.

Knowledge Hierarchy & Delineation.

Knowledge hierarchy and delineation is concerned with how the boundaries of knowledge are defined and by whom. Adler [1, pp. 216] states, "*hierarchy uses authority (legitimate power) to create and coordinate a horizontal and vertical division of labor ... knowledge is treated as a scarce resource and is therefore concentrated, along with the corresponding decision rights, in specialized functional units, and at higher levels of the organization.*"

Management researchers have shown that firms use hierarchies to coordinate multiple units within a firm and to solve problems of divergent individual goals of coordinating and controlling knowledge [46, 65, 23]. From a KBV perspective, integration mechanisms, such as norms and directives, are means of instantiating hierarchies and are ultimately intended to affect the frequency and intensity of the interaction among employees and to coordinate and control knowledge [22].

Companies with a more bureaucratic style of management typically have hierarchies that are vertically differentiated. In this type of firms, upper-level managers typically determine how knowledge is organized [38]. Formal, top-down approaches for guiding the translation from verbal comments (i.e., tacit knowledge) to expert knowledge have been found to be crucial for building successful systems [28, 43] and knowledge [1]. Conversely, scholars have argued that an alternative approach to creating and managing knowledge emphasizes extensive knowledge sharing and commonly shared search heuristics [53, 73, 30, 31]. This type of firms tends to be structured with a relatively flat hierarchy and impose fewer formal norms and directives for their employees to follow [25]. They rely heavily on interaction among their employees to determine how knowledge is organized, coordinated, and controlled [27].

Overall, the existing KBV literature presented above was helpful in identifying the dimensions in the way that firms organize knowledge at a given point in time. However, there exists little research that explains how socially embedded IS and knowledge can affect a firm's ability to integrate IS. Hence, this juncture marks the point of departure for this research.

RESEARCH APPROACH

The research was designed as a longitudinal, exploratory, single case study. A longitudinal analysis of the phenomenon aided in providing a rich understanding and evaluation of continuity and change [75]. This research design enabled the researchers to explore the

phenomenon in a natural setting and to engage in theory-building in an area where there has been relatively little prior research and theory formulation [44], and where the researchers did not have any control over events. The research centered on a “how” question in order to explore and capture the nature of the investigation [75].

The strategy for data collection is described as triangulated because it involved multiple methods for collecting historical and longitudinal data and helped deal with problems of establishing construct validity and reliability [75]. The data, which were collected in two phases during a 25-month time period, which included a review of how the two merged procurement departments used information systems to manage and organize knowledge over a six-year time frame. In the first phase, the researchers collected both public and confidential corporate archival data relating to the evolution of the

systems integration process. The primary sources of data were archived corporate internal analyses, organization charts, strategic planning documents, minutes of meetings, external consultant analysis reports, and internal correspondence, memos, and e-mails. Secondary sources included industry reports, public disclosures, media publications, and Internet articles. While collecting archival data, the researchers documented the general direction of the system integration process, the primary actors involved, and the major decisions made over time.

In the second phase of data collection, 61 formal interviews were conducted with individuals who sponsored or were involved in the system integration process. Table 1 summarizes distribution of the interviews that were conducted by department and position of the interviewees.

Table 1: Number of interviews conducted distributed by department and position of the interviewees.

By Department:	Procurement	47
	Information Technology	15
	Finance	1
	TOTAL NUMBER OF INTERVIEWS	61
By Position:	Executive Management	2
	Director / Executive Director	11
	Senior Manager	6
	Program Manager	11
	Analysts	13
	Consultants	11
	TOTAL NUMBER OF INTERVIEWS	61

The interview format was semi-structured and used open-ended questions. The interviews provided a detailed account of how the systems integration decision was perceived and experienced; they also helped the researchers understand how knowledge was organized before and during the systems integration process. All interviews were tape recorded and transcribed within 24

hours of the interview session. To ensure accuracy and to promote triangulation, transcripts of the interview audiotapes were reviewed and verified by key actors involved with the systems integration efforts.

Also during this phase, evidence extracted from the multiple sources of data was coded. Analytical codes were created to reflect the themes used by the interviewees in explaining the organization of knowledge during the system integration efforts. The analytical codes and sources of evidence were then grouped into natural categories in order to segment the data into different dimensions of organizing knowledge. These dimensions were then used to segregate the data, to tabulate the frequency of events, and to document the evidence supporting theoretical predictions. Coding the data and grouping the evidence by dimensions also enabled the researcher to discover themes within the data, to raise questions, and to provide provisional answers about the relationships among the variables. This process of analysis also helped to expand and tease out the data in order to formulate new questions and levels of interpretation [9]. Once coding was completed, the researcher explored the data in order to generate meanings [9]. The researchers also conducted participant observation activities that totaled 42 hours and culminated in field notes and journal reflections. Covered were activities such as informal hallway conversations with employees, status report meetings, and planning meetings. A database was generated to organize and document the data collected from the field [75].

THE PROCUREMENT SYSTEMS INTEGRATION AT THE MERGED COMPANY

This section first presents information about the two companies before their merger and contrasts how they organized knowledge related to procurement in their respective environments. Then, it describes the procurement systems integration process that was followed and identifies instances of how the socially embedded IS and knowledge affected their systems integration project.

Antecedent Conditions¹

Conglomerate was a company that evolved over 120 years as a result of many divestitures of the former Bell Telephone Systems. The company employed more than 50,000 employees and was one of the seven regional Bell companies that operated in the traditionally regulated sector (i.e., local exchange) of the

¹ Due to the provisions of a confidentiality and non-disclosure agreement, organizational and individual names have been disguised.

telecommunications industry. The Federal Communications Commission (FCC) and state Public Utilities Commission (PUC) provided Conglomerate a monopoly position to supply local exchange services to more than 25 million customers in 14 states.

Conglomerate's procurement department had several responsibilities, including tracking, organizing, and reporting the company's purchasing activities to the FCC and PUC. In 1986, Conglomerate developed a homegrown information systems application called ORCHID used to centrally organize and manage all purchasing knowledge of the company. This application was heavily integrated with other applications within and outside of the department. The company used five application specialists and ten project managers to create and maintain detailed documents specifying the strict methodical and business procedures that employees needed to follow when using ORCHID. A project manager commented:

"The regulated environment forced our company to closely manage how our systems generated information ... Because of the threat of regulatory fines, the project managers determined and kept a close eye on how the (purchasing) information from our systems was stored and who had access to this information... The project managers identified a vision for where the information was located and how it was stored and shared within the organization. The employees took actions to make the vision a reality."

Changes (e.g., industry regulations, new competitors) in the regulated segment of the telecommunications were infrequent because the FCC and PUC controlled the market's activities, as exemplified by the following comment from a Conglomerate director:

"Our company was never worried about how to efficiently manage project costs or budgets. Because we operated in a regulated environment and almost everyone needs phone service, the costs could be passed on to our customers."

Thus, the infrequent occurrence of change hindered the procurement department from knowing how to quickly modify its business operations. For example, a director from Conglomerate remarked on the typical employee's reaction after the Deregulation Act of 1996:

"Human nature and routine make it difficult for the employees to look outside the box to change their business processes. Many of the employees who are affected by the deregulation of the industry are resistant to change."

Entrepreneurial, established in 1988, was a broadband Internet-based communications company that competed in the unregulated (long-distance) segment of the telecommunications industry. With more than 10,000

employees, it was the first company to establish an Internet Protocol network that combined voice, data, and image. This network reached over 104,000 miles around the world and had more bandwidth than all of its incumbent competitors' networks combined. Entrepreneurial relied heavily on its shareholders' investments to support the company's quick expansion and followed a cost-conscious approach to its business operations to ensure shareholder value, as explained by an Entrepreneurial director:

"The company was constantly dancing to the beat of Wall Street... Many of the decisions made by the company had to be quick; implementing or acting upon a strategy had to be quick; actions to follow through with the opportunity had to be quick."

Within the procurement department, managers kept the business operations simple and adaptable to support the company's initiative to keep up with the constant changes and opportunities. An employee commented:

"Our company purposely did not attempt to create or establish any type of formal routines in our business operations... By not mandating any rules or procedures on our business operations, we are better able to meet these market opportunities and provide value to the firm."

The department's quick and nimble approach to conducting business influenced how information systems applications were implemented. Employees were given the flexibility to select applications that best matched their business opportunity, and only two application specialists (hereafter, Jim and Cheryl) were assigned to implementing and managing the procurement applications. An employee commented:

"[Upper-level managers] did not provide a specific approach for how to implement and use the IT applications in our department... Instead, we [application specialists] were given the ability to work individually to manage the IT applications used in the department."

Three stand-alone order-tracking applications were implemented to organize the purchase knowledge created from an analysis of the purchasing activities among multiple suppliers. Each application was designed to distribute knowledge generated from the company's procurement activity within the department, a feature that allowed employees to make speedy decisions. A project manager commented:

"We had over 500,000 computers that were basically being used as fancy calculators... Most of the systems [i.e., IT applications] in our company were stand-alone. The systems did not talk with each other because each served a different function... The entrepreneurial

style of our company did not require us to take the time to coordinate or standardize our systems."

The department's cost-conscious approach to conducting business encouraged managers to frequently rely on temporary assistance from internal and external consultants to complement the department's expertise. The consultants were often released when budgets became constrained, consequently causing a frequent loss of knowledge and expertise.

Merged was the company with over \$70 billion and more than 64,000 employees that resulted from the merge of Conglomerate and Entrepreneurial on July 18, 1999. It became the fourth largest long-distance company in the United States. An internal announcement on the merger characterized the newly formed company as having "the mindset of a hungry entrepreneurial start up and the resources of an experienced industry giant." A major challenge immediately faced by Merged was integrating the knowledge and information systems applications implemented and created in both procurement departments in their respective market environments (i.e., one traditionally regulated; the other, unregulated), as will be described next.

The Procurement Systems Integration Effort

This subsection does not attempt to identify and categorize every event in the chronology of the systems integration process. Instead, it presents key events that marked the dynamism of organizing knowledge in four phases—recognizing opportunity, launching the information systems integration project, rediscovering direction, and assessing reality and reallocating resources.

Phase 1: Recognizing Opportunity.

In July 2000, the chief executive officer (CEO) and chief financial officer (CFO) of Merged wanted to use cost savings to further justify the recent merger to their shareholders. In an attempt to save over \$3.3 billion through leveraged purchases against company's suppliers, they asked Merged's vice president of procurement systems department (hereafter, "Adam") to integrate the information systems applications of the two original procurement departments. Formerly Entrepreneurial's vice president of procurement, Adam immediately met with his senior director (hereafter, "Carol") to discuss this initiative, and together they created a procurement systems department integration taskforce.

After a one-month evaluation, the taskforce recognized that the two departments had developed and tailored their information systems to manage and organize knowledge according to their respective market

environments (i.e., regulated and unregulated telecommunications markets). The taskforce estimated that Merged would need to invest \$54.5 million to fully integrate Entrepreneurial's three order-tracking applications, and Conglomerate's ORCHID procurement system. The taskforce also calculated that only \$1.5 million was needed if the decision was to integrate just the order-tracking applications of both departments. Carol recalled:

"The [taskforce] found that the integration of the two procurement departments' order-tracking applications would deliver the largest and most immediate opportunity to save the [Merged] company money... The successful integration of the order-tracking application would have served as a proof-of-concept that all of our applications could be integrated."

A week later, the CEO and CFO approved the taskforce's recommendation and provided \$1.5 million for the department's integration efforts.

Phase 2: Launching the Procurement Integration Project.

In September 2000, Adam held a department meeting to announce the launch of the procurement integration initiative and set March 21, 2001 as the project's deadline. Unbeknownst to the taskforce, Adam also announced that he had selected an enterprise resource planning application (hereafter known as ERP APP) to centrally generate, track, and store purchase orders for both procurement departments. Adam based his selection on his own experience with using this application in several areas of Entrepreneurial and because he knew that Entrepreneurial had already purchased the application usage rights. However, he did not seek advice, feedback, or consensus from the taskforce. In addition, Adam considered Conglomerate's business operations as "old and bureaucratic." He stated that "The bureaucracy of the [Conglomerate's] procurement department caused their department to take too long to get things done." Thus, he requested employees from both departments to follow the Entrepreneurial streamlined and flexible methodology while gathering requirements for ERP APP.

Following the meeting, Adam hired a team of eight external consultants to help the taskforce design ERP APP; eight internal consultants from Merged's subsidiaries were also transferred into the department. An external consultant recalled his initial reaction:

"When this project was first kicked off, [Adam] shared his vision of the end goal... It was just like he gave us a car and told us to drive. However, without specific driving instructions, we didn't know how to get to the end

point together. Everyone involved followed different methodologies to gather requirements."

Conglomerate's Approach to the Systems Integration. Conglomerate's employees began to review the specifications used to design ORCHID. A Conglomerate application specialist remembered:

"In developing the requirements for [ERP APP], the project managers within our department were responsible for determining the overall direction for how the order-tracking information needed to be coordinated within the department. The application specialists helped out by providing them with the specific requirements needed."

Conglomerate's five application specialists believed that all employees involved with the integration should follow the formally documented procedures that were created for ORCHID because they believed it provided a sound chronological methodology to design and implement ERP APP. Thus, the specialists were hesitant to adopt Adam's suggested streamlined and flexible methodology as it was inconsistent with their prior experience and training. A project manager noted:

"A very detailed approach to conducting business was born out of the regulation requirements set by the FCC and PUC. Precise processes and routines were developed and implemented in our company to enable actions to be taken with predictable results... Our employees were encouraged to closely follow the procedures set by the company."

The heavily integrated modules within ORCHID prohibited the application specialists and project managers from extracting only the order-tracking module requirements. A project manager recounted:

"[Adam] and [the taskforce] wanted the application specialists who managed [ORCHID] to provide just the functional requirements necessary for integrating the application's order-tracking module. However, [ORCHID] touched so many aspects of the company and integrated so many aspects of the purchasing environment into one application."

Entrepreneurial's Approach to the Systems Integration. At Entrepreneurial, the two application specialists, Cheryl and Jim, relied on their intuition and experience in implementing the original three order-tracking applications to gather requirements for ERP APP. An Entrepreneurial director commented:

"In [Entrepreneurial's] environment, the application specialists generally do not follow any one type of set routines to address business opportunities... The logic behind avoiding having our employees develop

and maintain a specific routine is that when the markets change as quickly as they do, that routine or process becomes outdated and not useful to the company.”

Cheryl and Jim ignored Adam’s instructions to provide requirements that would allow the ERP APP to centrally generate and store order-tracking and purchasing knowledge. Instead, Cheryl and Jim were trying to make sure that the knowledge resided close to system users. Jim recalled:

“In our past business environment, there were no formal means of sharing information. Information was stored closest to the employees who generated it... If we needed information, we would just determine who had it and ask them for it.”

Carol explained Cheryl and Jim’s methodology:

“When the employees of [Entrepreneurial] first started to gather the requirements for [ERP APP], one employee actually took a cocktail napkin and jotted down some informal notes on what was required to integrate their three order-tracking systems. Right after that, the employee used those notes on the cocktail napkin to actually code and design the requirements for the new application.”

Events Influencing Merged’s Ability to Launch the Procurement Integration Project.

While Merged employees gathered requirements, they relied on the methodologies learned in their previous environments. Carol recalled the differences:

“I remember when we began our requirements gathering phase. The employees from [Conglomerate] wanted to formally document the requirements that they needed to integrate the systems... The employees from [Entrepreneurial] took a different approach. They took the requirements of the system integration on paper cocktail napkins and used them as formal means to communicate and document the requirements of the system... The different approaches created problems for the team.”

In mid-September 2001, Carol met with Adam and reported the methodological differences between the two departments. In an attempt to solve the problem, Adam introduced a simple five-step change process framework a week later. Cheryl and Jim, however, rejected the standardized framework immediately since they saw it as a constraint on their traditional flexible methodology for implementing information systems applications. A Conglomerate project manager recalled:

“The employees from [Entrepreneurial] had a ‘YAHOO!’ methodology to conducting business... Whether or not they fully understood the implications of

implementing a new application, they attempted to quickly implement the changes... An analogy of this methodology is a cowboy getting on a horse, yelling “YAHOO!,” and riding the horse as fast as he could! The cowboy knew that he needed to get somewhere, but wasn’t concerned with how he got there.”

Conversely, the employees from Conglomerate initially welcomed the framework because they saw it as an opportunity for all employees to commit to a unified methodology. However, when they learned that Cheryl and Jim rejected it, they began to question its value.

In October 2000, the taskforce evaluated the progress of the integration project and found that the project was one-and-a-half months behind schedule. The team reported that the two main factors that contributed to the project’s delay were the complexity of extracting the requirements for only the order-tracking application and the continued differences in methodologies between the two merged departments. After this evaluation, Adam suspended the systems integration efforts, asked all employees to immediately stop all work on the project, and requested the taskforce to take two weeks to re-define the project’s strategy and direction. At the same time, he released the eight external consultants.

Phase 3: Rediscovering Direction.

In mid-November 2000, Adam met with the CEO and CFO to notify them that the integration efforts were over two-and-a-half months behind schedule. Adam requested an additional \$400,000 to hire more consultants to meet the March 2001 deadline. Adam claimed that the additional funding was the first step to delivering a portion of the \$3.3 billion cost savings. The CEO and CFO approved the additional funding. Following this meeting, Adam, without consulting with the taskforce, brought the eight external consultants back onto the project. The employees from the two departments noted Adam’s actions and returned to gathering requirements for ERP APP.

Conglomerate’s Approach to the Systems Integration.

Three of Conglomerate’s five application specialists began to follow Adam’s request to follow a streamlined methodology while determining requirements for ERP APP. In doing so, they abandoned ORBIT’s formally documented procedures and began to rely more heavily on their intuition and experience. As a result, the application specialists unbundled the integrated order-tracking functions of ORBIT (i.e., purchase tracking, depreciation monitoring, maintenance detection, etc.) and began to develop autonomous application functions for tracking purchases within ERP APP. By the end of the phase, one additional application specialist

followed the same approach. The fifth application specialist refused to change her approach, as she believed that the formal documentation aided her in gathering the appropriate requirements for ERP APP. Despite these behavior changes, however, all five of the application specialists continued to encounter problems extracting requirements from the order-tracking module of the heavily integrated ORCHID.

Entrepreneurial's Approach to the Systems Integration. Meanwhile, Cheryl and Jim continued to easily extract autonomous procurement tracking and processing functional requirements (i.e., purchase tracking, depreciation monitoring, and maintenance detection) from their stand-alone order-tracking applications to provide design requirements for ERP APP. Instead of following a systematic methodology as encouraged by their counterparts from Conglomerate, they continued to rely on their intuition and experience. Carol commented on their continued unsystematic approach:

“Development continued to be done in pieces. As these employees [i.e., Cheryl and Jim] found additional functional requirements to add to the system, they immediately coded and implemented them into the production version of the application.”

Recognizing the problem with their approach, Carol persuaded Cheryl and Jim to follow the project leader's objective of allowing the ERP APP to centrally coordinate and control the knowledge on Merged's purchases. In doing so, Cheryl and Jim abandoned their initial approach of allowing the users to control and manage the applications and began to provide design application requirements that enabled the ERP APP to centrally control, process, and store purchasing knowledge.

Events Influencing the Merged Department's Ability to Rediscover

Direction. In late November 2000, the taskforce met to redefine the direction and scope of the integration project. Carol recalled:

“The integration efforts got off to a false start. ... Because of the time constraint set by [Adam] and the objective to demonstrate the proof of concept, the employees began to provide specifications without fully understanding how it aided the team in designing the [ERP APP] application.”

The taskforce told Adam that they reevaluated the direction of the integration project and changed their recommendation to increase the project scope to include all other modules within ORCHID (i.e., budget tracking,

inventory, payments, assets, and accounts payable). The current scope of the order-tracking integration could be used in the short-run to demonstrate a proof-of-concept, but would not sufficiently track the purchases of both procurement departments. The taskforce estimated that the department would need an additional nine months to incorporate all of the other modules in ORCHID. Although Adam heard the team's recommendations, he decided to keep focus on integrating only the order-tracking applications.

A week after this meeting, the ERP APP vendor informed Adam that the new version of the application, ERP APP+, was to be released in June 2001. Adam realized that after ERP APP was implemented, the department would have to spend additional time and money to upgrade their application. The pressure of the new release forced Adam to decide whether he should continue with implementing ERP APP or redirect the department to implement ERP APP+.

Phase 4: Assessing Reality and Re-allocating Resources

In a January 2001 meeting, Adam met with the taskforce and was informed that the project was four months behind schedule because employees still had not provided the adequate application requirements. The taskforce recommended that Adam avoid restarting the project until the department could commit to a single vision, goal, and methodology. Despite the team's recommendation, Adam re-engaged the department's integration efforts because he was under pressure to quickly provide results to the CEO and CFO.

Adam held a department meeting a week later to reveal his decision to adopt the new version of the application. Adam justified his decision by stating that the project's anticipated completion date was already delayed by over four months and that there were additional functions in ERP APP+ that would make the order-tracking functions more robust and attractive to users. Adam acknowledged that the differences in methodologies between the two merged departments still existed, and instructed the taskforce to take a more proactive role in leading the project. Adam announced December 31, 2001, as the new deadline for implementing ERP APP+.

In August 2001, the CFO notified Adam that she had eliminated all corporate projects that did not provide an immediate return for shareholders. Since the procurement department did not show immediate results to saving Merged money, the CEO and CFO cancelled the department's integration project. Adam notified his department of this decision and abolished the taskforce.

He then released the eight external consultants and made a formal announcement canceling the project. Adam retained the internal consultants to help the two original procurement departments maintain their legacy order-tracking applications.

Conglomerate's five application specialists immediately went back to using their traditional documented sequential and fixed routines, which maintained the highly integrated and centralized ORCHID application. They also continued to take direction from upper-level managers for their daily business operations. At the former Entrepreneurial procurement department, Cheryl and Jim returned to being individually responsible for the three autonomous order-tracking applications and resumed following their intuition to maintain and enhance these applications. Reflecting on the integration project, Adam commented,

"I would categorize this integration effort as a 'train wreck.' The systems integration effort cost the company over \$1.9 million and ended up to be a total catastrophe ... because everyone wanted to continue to use their legacy systems and keep the security of their jobs."

DISCUSSION: REVISITING THE FINDINGS IN LIGHT OF THE DYNAMIC NATURE OF KNOWLEDGE ORGANIZATION PROCESS

Using the existing KBV literature to understand the way Merged used its IS to organize knowledge throughout the life of the systems integration project, the researchers identified four dimensions of the *organization of knowledge*. An analysis of the data revealed that the ways in which IS was used to organize knowledge was a continuous, on-going, dynamic, and evolving process, that was dependent on the way individuals interpreted their environments and took actions. Although Merged did not fully complete the integration of the two department's purchasing applications, the case data provide a rich source of evidence that illustrates how embedded IS and embedded knowledge affected a firm's ability to integrate IS. Based on a review of the KBV body of literature, we propose a framework of the organization of knowledge, presented in Table 2. In the following section, we use the framework to highlight and demonstrate changes in the organization of knowledge that took place over time at Merger and to show how embedded IS and knowledge hindered the firm's systems integration project.

Dimension #1: Knowledge Routinization

The data from the case reveal that over the 25-month systems integration project, the two merged procurement departments were able to change how routines were used to organize knowledge. However, change was slow and tedious due to the socially embedded IS and knowledge. The data indicated that throughout the project, the embedded IS and embedded knowledge constrained the ability of the team to integrate the purchasing systems. Within the 61 interviews, the researchers found 193 instances that identified routines as a key dynamic dimension for the process of organizing knowledge. Recall that routines are forms, rules, procedures, conventions, strategies, and technologies around which organizations are constructed and through which they operate [63]. The case data indicated that there were two distinctly different methods for how routines were used to organize knowledge. The differences are illustrated here in opposite polar which include *fixed routines* and *adaptable routines*.

A *fixed routine* is sequential in nature, and typically relies heavily on using explicit knowledge and detailed documentation to specify the exact steps needed to execute the routines. A fixed routine was more commonly seen at Conglomerate, where employees experienced little to no change in their daily business operations. Because this style of routinization was documented, it was fairly easy for employees to learn and use. Hence, fixed routines were easily reproduced in different business environments and initiatives. An *adaptable routine*, on the other hand, is flexible and adaptable, and relies heavily on tacit knowledge. It is difficult to document and reproduce because of the specificity and constant change involved with organizing knowledge for the business environment. Adaptable routines were more commonly found at Entrepreneurial, where changes were continual, requiring its employees to modify their use of routines to address these changes.

At Merged, the researchers found that two key attributes, *knowledge sequencing and adaptability* and *knowledge documentability*, determined the differences between how routines were used to organize knowledge (as summarized in Table 2).

Table 2: A Grounded Framework of Dynamically Organizing Knowledge at Merge

Dimension	Attribute	Opposite Poles of the Dimension	
		Characteristics at: <i>Conglomerate</i>	<i>Entrepreneurial</i>
Knowledge Routinization	Knowledge sequencing & adaptability	Fixed Routines	Adaptable Routines
		Organizing knowledge follows a sequential routine or process Reliable and predictable use of routines and processes to conduct business Heavy customization of routines	Organizing knowledge follows a non-linear approach to following routines or processes, if any Flexible and adaptable routines used
	Knowledge documentability	Translate tacit knowledge to written procedures and routines to be shared within the department Heavy use of Explicit knowledge	Translation of tacit knowledge not easily reproduced due to uniqueness and socially embedded knowledge use Heavy use of intuition and employee expertise
Knowledge Acquisition & Release	Knowledge Extractability	Tightly bundled	Loosely Bundled
		Heavily integrated knowledge Difficult to break down / extract knowledge from applications	Loosely integrated knowledge Easy to break down / extract knowledge from applications Segments of knowledge easily transferred to other applications
	Knowledge gather and releasability	Relative difficult time gathering / releasing knowledge	Relatively easy time gathering / releasing knowledge
	Knowledge protection & sharability	Employees protect and control knowledge obtained from applications and systems	Employees share knowledge from application

Table 2, Cont'd: A Grounded Framework of Dynamically Organizing Knowledge at Merged

Dimension	Attribute	Opposite Poles of the Dimension	
		Characteristics at: <i>Conglomerate</i>	<i>Entrepreneurial</i>
Knowledge Dispersion	Knowledge location	Concentrated Knowledge	Dispersed Knowledge
		Location of knowledge determined by central authority Location of knowledge is concentrated in a general location	Location determined by employees most actively involved with knowledge Knowledge is located among numerous area within the department
	Knowledge distribution	Distribution of knowledge determined by central authority	Distribution of knowledge determined by employees
	Knowledge retrieval	Knowledge retrieved through a system of formal interactions	Knowledge retrieved through a system of informal interactions.
Knowledge Hierarchy & Delineation	Knowledge coordination & control	Bureaucratic Hierarchy	Consensus Hierarchy
		Coordination and control of knowledge determined by upper-level managers Waterfall knowledge organization specifications to lower level employees Coordinate and control knowledge through explicit rules and directions	Coordination and control of knowledge determined by application specialists. Bubble up knowledge organization specifications to business unit division levels. Coordinate and control knowledge through use of intuition, experience, and interactions among employees
	Knowledge flow direction	Top-down knowledge organization. Waterfall knowledge organization to lower level employees	Bubble up knowledge organization
	Knowledge organization methodology	Explicit norms and directions established and used to organize knowledge Low levels of interaction to organize knowledge	No pre-determined methodology to determining how knowledge is organized High levels of interaction to organize knowledge

Here, we define *knowledge sequencing and adaptability* as the manner in which firms use and follow a sequential routine or process routines and processes to organize knowledge and to create stable patterns of behavior [35, 19, 18, 52]. *Knowledge documentability* is defined as the ability to translate tacit knowledge to explicit written procedures and routines to be shared within the department [56, 21, 5].

The case data revealed that the two merged procurement departments changed their approach to knowledge routinization over each phase of the systems integration process, as shown in Figure 1. The difference was greatest immediately after the merger, which illustrates the dissimilar approaches that the two procurement departments followed to manage and organize knowledge. Conglomerate's procurement department mapped closely to the fixed routine pole. Its application specialists created formal documents to specify the exact routines that they needed to follow when using and maintaining ORCHID. Routines ensured that the application specialists adhered to the FCC and PUC guidelines and regulations. However, over the course of the systems integration process, Conglomerate's employees changed their methodology of using routines to organize knowledge, moving from the fixed routine pole toward the adaptive routine pole.

In the second phase of the systems integration process, Adam introduced a formal analysis framework and suggested that all employees engage the order-tracking integration project with a more flexible and streamlined approach. He asked the application specialists to abandon using their traditionally documented routines and to rely more on using tacit knowledge (i.e., experience and know-how) when gathering requirements for ERP APP. Despite Adam's request, the application specialists attempted to transfer and apply their formally documented routines to the Merged department's integration efforts. By the end of the third phase, four out of five application specialists from Conglomerate had abandoned using their formally documented routines and began to rely only on their intuition and experience while designing the functionality of ERP APP.

Entrepreneurial, on the other hand, mapped closely to the adaptable routine pole of the knowledge routinization dimension. Its two application specialists, Cheryl and Jim, generally fostered a flexible and nimble business environment by avoiding formal routines. They relied more heavily on their intuition and experience when using routines to organize knowledge. An adaptable routine approach enabled them to address business opportunities in a flexible and fast manner. Furthermore, these application specialists did not change

how they used routines to organize knowledge throughout the four phases of the system integration process.

The case indicates that in the final phase of the systems integration process, when the CFO cancelled the integration project, Carol asked the employees from the two merged departments to return to using and maintaining their legacy order-tracking applications. Conglomerate ultimately returned to the fixed routine pole of the knowledge routinization dimension, using their formally documented routines to track inventory orders. Entrepreneurial remained at the adaptable routine pole of the knowledge routinization dimension, which Cheryl and Jim continued to rely on their intuition and experience to use and maintain their three order-tracking applications. The merged procurement department accepted both the adaptable and fixed routine methods of using routines to organize the knowledge.

This research found that the embedded differences between how the two procurement departments in terms of the routines they used to organize knowledge hindered the taskforce ability to establish and maintain change during the systems integration process. The variance was specially attributed to the application specialists' adopting idiosyncratic routines based on their individual experience and intuition. This research also found that even though the two procurement departments eventually agreed to follow common routines to organize knowledge during the systems integration process (i.e., a more intuitive instead of a pre-determined approach), the taskforce was still unable to establish and maintain change.

Dimension #2: Knowledge Acquisition and Release

This study found that there were socially embedded differences in how the two merged procurement departments acquired and released knowledge. The differences contributed to problems when Merged attempted to integrate IS. Within the 61 interviews conducted for this research, 89 instances of this finding were identified. As mentioned above, the integration of knowledge through the recombination and release of knowledge is a fundamental process by which firms gain the benefits of knowledge and thereby create an advantage [58]. An analysis of the data revealed that there were two opposite polar methods of organizing knowledge to accommodate the employee's ability to acquire and release knowledge.

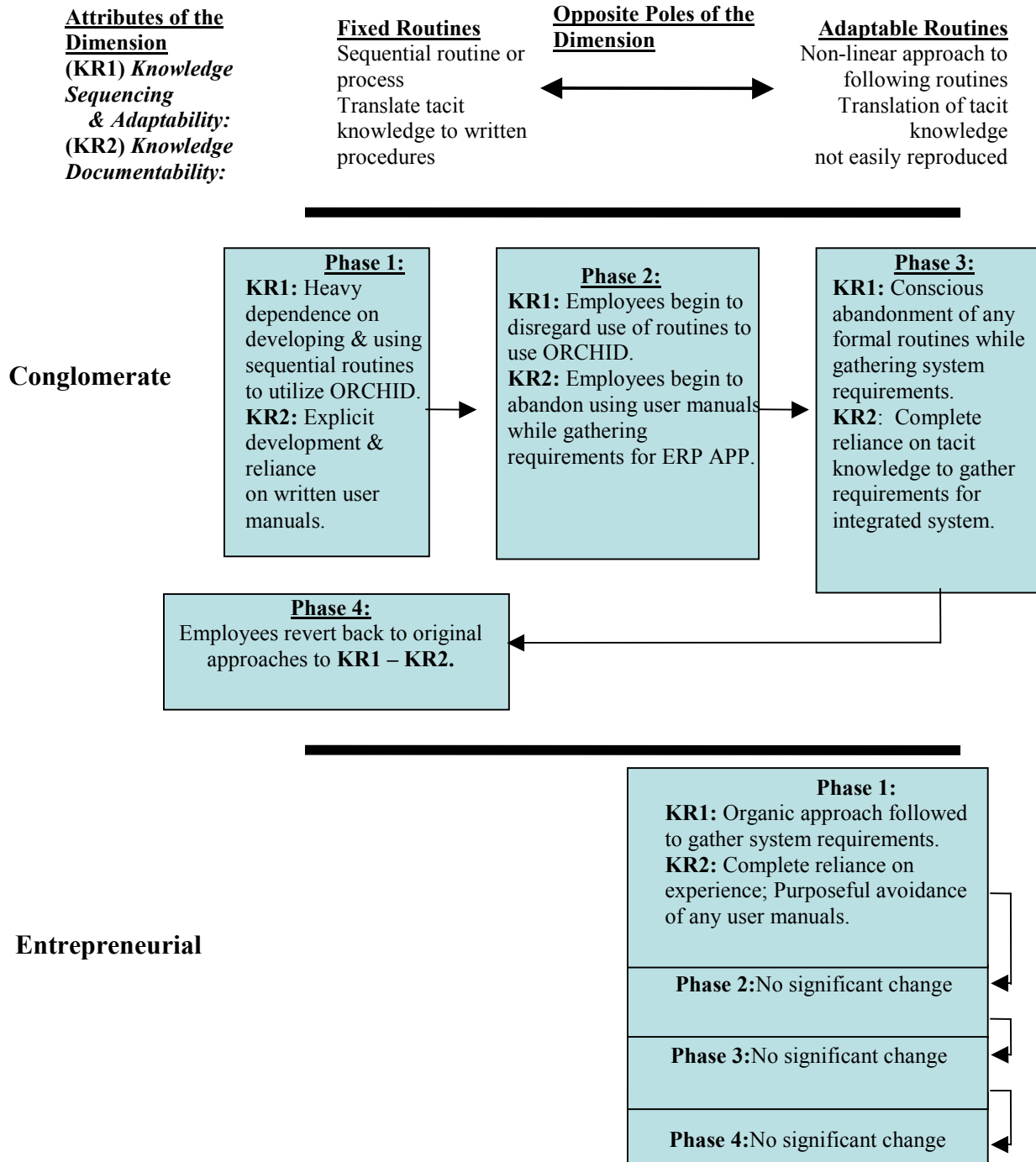


Figure 1: Changes over Time in the Attributes of the Knowledge Routinization Dimension at Conglomerate and Entrepreneurial

The knowledge acquisition and release dimension is anchored by opposite poles of *tightly bundled* and *loosely bundled knowledge*. *Tightly bundled knowledge* is knowledge that is heavily integrated and comprehensively organized to enable employees to have access to an aggregate view of the knowledge available to the company. For this investigation, the differences in knowledge acquisition and release between two merged departments were identified by analyzing how knowledge was organized to allow the departments to gather, extract, transfer, release, and recombine knowledge to create value. In contrast, *loosely bundled knowledge* is knowledge that is freely organized and not integrated. This knowledge is organized in a manner that allows users to easily extract knowledge, as well as share knowledge with other segments of the business.

At Merged, it was found that three key attributes, *knowledge extractability*, *knowledge gather and releasability*, and *knowledge protection and shareability*, determined these differences in how the two merged firms organized knowledge to enable the acquisition and release of knowledge (as summarized in Table 2). *Knowledge extractability* was seen as the ability to break down and extract knowledge from a firm's existing knowledge base [69, 5]. *Knowledge gather and releasability* was classified as the firm's ability to gather, recombine, and release knowledge [10, 58, 69, 76]. *Knowledge protection and shareability* was characterized by the ability to protect and share knowledge [74, 39, 14, 64].

At Conglomerate, employees were able to access all aspects of the knowledge at once because knowledge was organized in ways that integrated almost all aspects of the firm's knowledge. However, it was often difficult for the same employees to extract, reorganize, and recombine the knowledge needed to react to a firm change or to take advantage of a new opportunity. In contrast, Entrepreneurial tended to favor knowledge that was loosely organized so that it could easily extract and recombine segments or portions of knowledge resources to react or create market changes. Thus, knowledge was organized according to a specific activity for which it was generated and was broken into easily manageable and usable segments.

The case data reveal that the trajectory of the two procurement departments on the merged company's ability to acquire and release knowledge was different, as shown in Figure 2. The differences were greatest immediately after the merger. Conglomerate initially mapped closely to the tightly bundled pole. Its procurement department was heavily integrated and bundled within ORCHID, which made it fairly easy for the employees of the procurement department to generate

the reports for the FCC and PUC. Over the course of the systems integration process, however, Conglomerate's application specialists changed their method of acquiring and releasing knowledge. In particular, early in the third phase, Adam requested that the application specialists extract only the order-tracking requirements for the taskforce to design ERP APP. By the end of that phase, four of the five Conglomerate application specialists designed ERP APP with autonomous functionality.

Conversely, Entrepreneurial initially mapped closely to the loosely bundled pole. Cheryl and Jim, Entrepreneurial's two application specialists, implemented three independent order-tracking applications to track the company's purchases. The loosely bundled order-tracking applications made it simple for users to extract purchasing knowledge and to make quick decisions. Furthermore, throughout the four phases of the systems integration process Entrepreneurial remained at the loosely bundled pole of the knowledge acquisition and release dimension.

When the CFO cancelled the order-tracking integration project in the final phase of the systems integration process, the application specialists from the two departments returned to their original methods of acquiring and releasing knowledge. Conglomerate's application specialists went back to using ORCHID, which heavily integrated the department's procurement knowledge, while Entrepreneurial's Cheryl and Jim continued to work with their three order-tracking applications, which loosely organized and generated procurement knowledge for the department.

This research found that the socially embedded differences between the two procurement departments in terms of the acquisition and release of knowledge hindered the taskforce's ability to recombine and release knowledge during the systems integration process. The case data show that the socially embedded differences between the two firm's approaches to organizing knowledge prohibited Merged from recombining and releasing knowledge resources.

Dimension #3: Knowledge Dispersion

The third dynamic dimension of knowledge organization found in this study, dispersion, was found in 129 instances of the 61 interviews that were conducted. For the knowledge dispersion dimension, the case data revealed two opposite poles of *concentrated* and *dispersed knowledge*. Bear in mind that knowledge dispersion refers to how knowledge is or is not tightly held, self-contained, and located in the minds of individuals [57]. *Concentrated knowledge* is organized so that it resides in one general location, its distribution is determined by a centralized authority, and it is generally

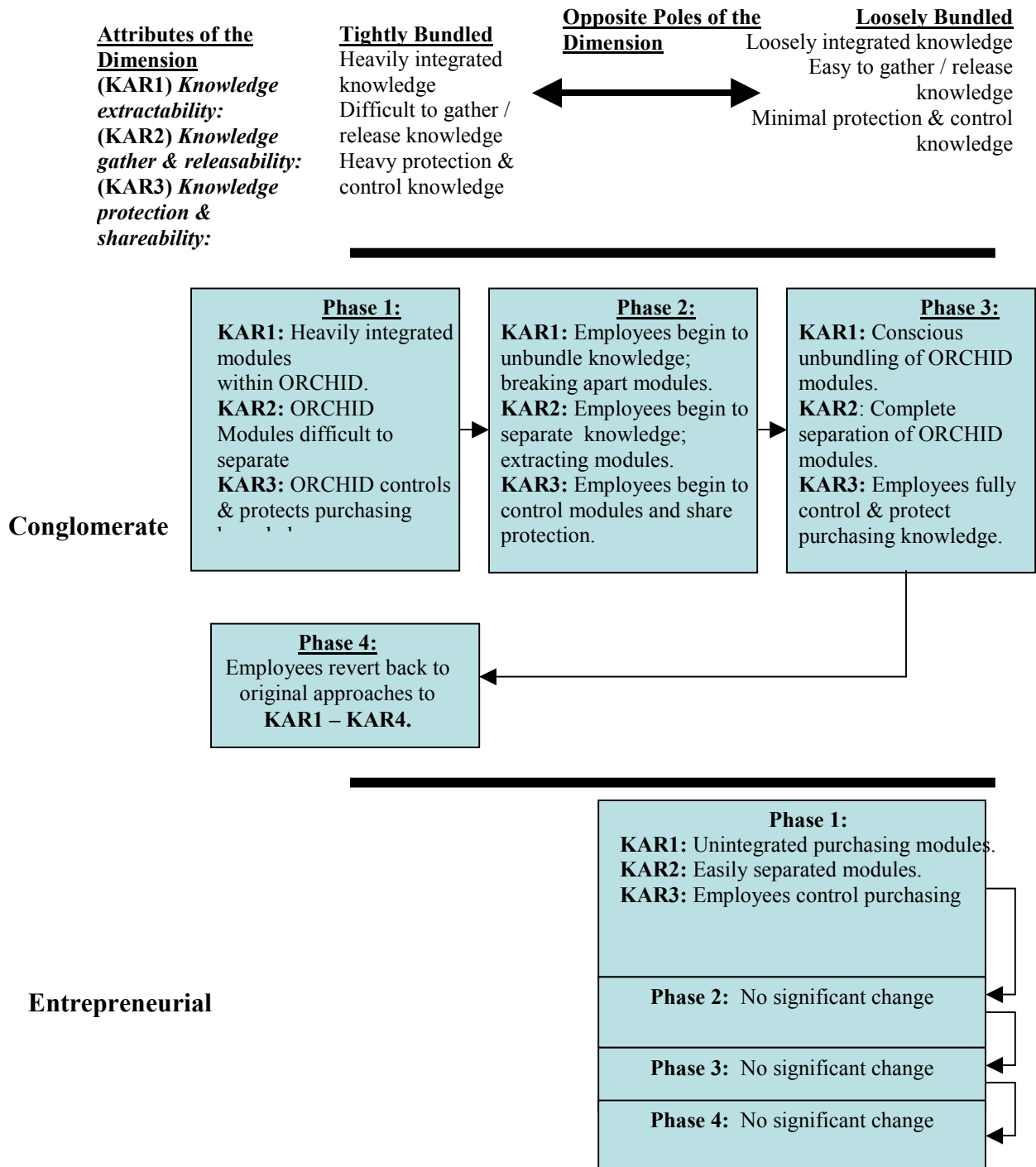


Figure 2: Changes over Time in the Attributes of the Knowledge Acquisition & Release Dimension at Conglomerate and Entrepreneurial

retrieved through a system of formal interaction. In contrast, *dispersed knowledge* resides at numerous locations within the firm, employees determine its distribution and it is generally retrieved through a system of informal interaction. An analysis of the case data revealed that the team experienced difficulties in locating and retrieving knowledge, as it resided within embedded IS and knowledge.

At Merged, the researchers found that three key attributes, *knowledge location*, *knowledge distribution*, and *knowledge retrieval*, determined the differences in knowledge dispersion and anchored each of the merged departments (as summarized in Table 2). *Knowledge location* was defined as the ability of the employees to locate and store knowledge [18, 34]. *Knowledge distribution* was distinguished by the process of how knowledge was distributed or concentrated within the organization [18, 74]. And, *knowledge retrieval* was characterized by the degree of formal or informal interactions to retrieve knowledge [39, 14, 64].

At Conglomerate, ORCHID was an example of a system developed to concentrate knowledge by centrally organizing and managing all purchasing knowledge of the company. At Entrepreneurial, the employees that were most familiar with generating, managing, and maintaining the knowledge tended to determine where the knowledge was located. Knowledge often resided among these employees and in their interactions. Dispersed knowledge was often generated and obtained from context-specific information systems applications and was organized in a fashion that encouraged employees to interact with one another. Examples of dispersed knowledge are the knowledge that was kept on the individual application specialists.

Figure 3 graphically illustrates the dynamic nature, key events, and the actions that fostered Entrepreneurial's continual move toward the concentrated knowledge pole of the knowledge dispersion dimension, while Conglomerate remained at the concentrated knowledge pole. Initially, Conglomerate designed, implemented, and used ORCHID to centrally generate, store, track, and control order-tracking knowledge. Furthermore, as the case data reveal, the application specialists and project managers from Conglomerate did not change how knowledge was dispersed across all four phases of the systems integration process. Given that the Merged taskforce wanted to implement ERP APP in order to centrally generate and store order-tracking knowledge, the former Conglomerate's application specialists were not required to change their methods of dispersing such readily available knowledge.

On the other hand, Entrepreneurial's procurement was dispersed and redundant among the department's order-tracking applications. Over the course of the systems integration process, however, Entrepreneurial changed its method of dispersing knowledge. In the third phase of the systems integration process, Cheryl and Jim abandoned the concept of allowing application users to control and store order-tracking knowledge and implemented the application to centrally generate and store order-tracking knowledge.

After the CFO cancelled the integration project in the final phase of the systems integration process (assessing reality and re-engaging resources), the taskforce asked the application specialists from the two procurement departments to return to their traditional methods of dispersing knowledge. Entrepreneurial returned to the dispersed knowledge pole of knowledge dispersion dimension; Cheryl and Jim reverted to the methodology of allowing the three order-tracking applications to disperse knowledge within the department. This research found that the socially embedded differences between the two merged procurement departments in terms of the dispersion of knowledge hindered Merged from sharing and utilizing knowledge during their efforts to integrate IS.

Dimension #4: Knowledge Hierarchy and Delineation

The last dimension of the dynamic organization of knowledge revealed in this research was knowledge hierarchy and delineation. Evidence supporting its importance in the procurement systems integration process was identified in 129 instances of the 61 interviews conducted. Recall that knowledge hierarchy and delineation is concerned with how the boundaries of knowledge are defined and by whom. The data showed that there were differences between the two departments on how knowledge was coordinated and controlled. The knowledge hierarchy and delineation dimension is anchored by two opposite polar characteristics of *bureaucratic* and *consensus hierarchy*. *Bureaucratic hierarchy knowledge* organizations tend to rely on upper-level managers, such as directors or project managers, to determine how knowledge is coordinated and controlled within the firm. *Consensus hierarchy knowledge* organizations, on the other hand, tend to delegate the authority of coordinating and controlling knowledge to the lower-level application specialists of the firm.

The researchers found that three key attributes, *knowledge coordination and control*, *knowledge flow direction*, and *knowledge organization methodology*, determined the differences in knowledge hierarchy and delineation (as summarized in Table 2). *Knowledge coordination and control* is defined as the firm's reliance

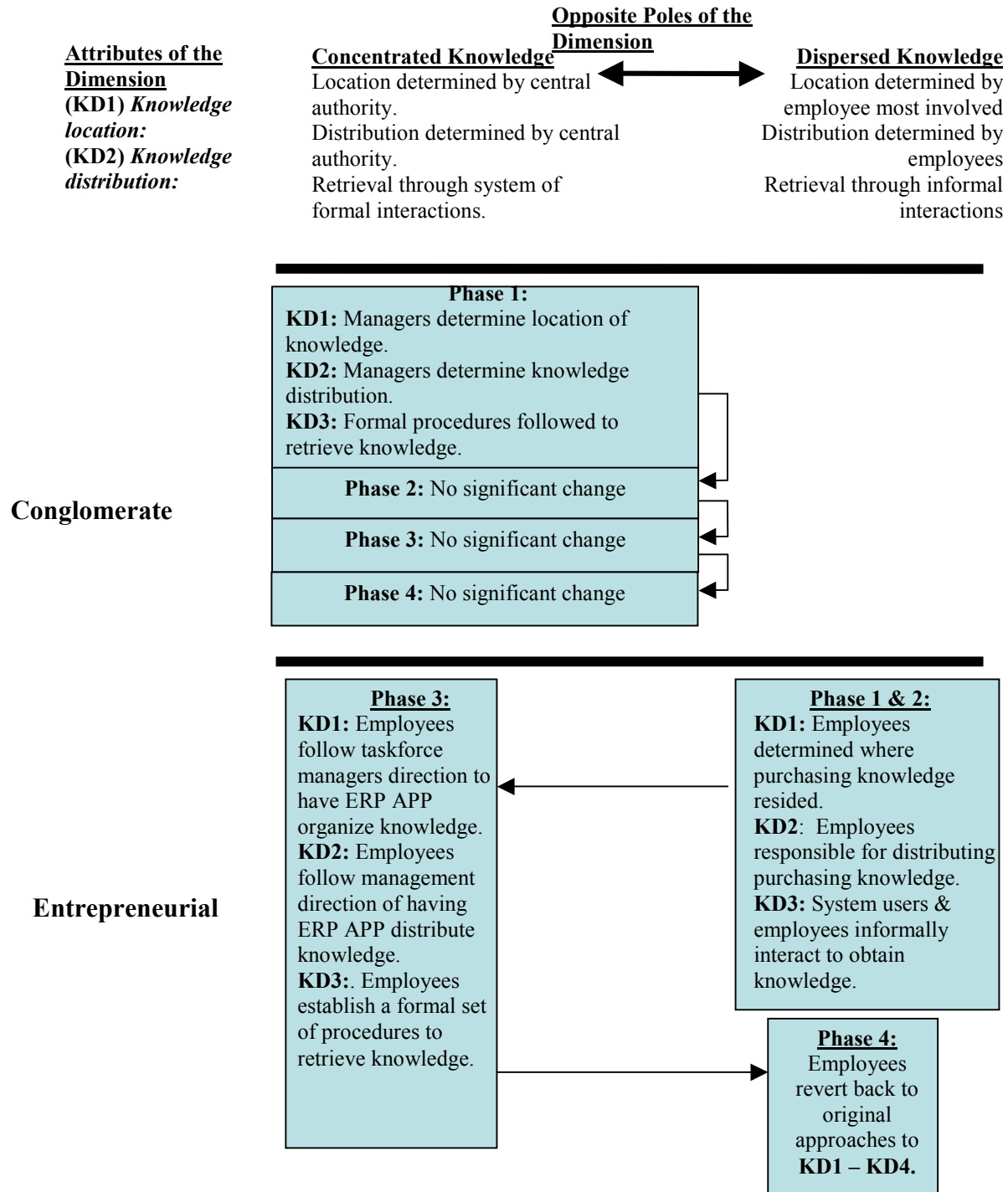


Figure 3: Changes over Time in the Attributes of the Knowledge Dispersion Dimension at Conglomerate and Entrepreneurial

on organizational hierarchy to determine how knowledge was organized to ensure coordination and control [1, 53, 4, 50]. This research identified *knowledge flow direction* as the general approach for how knowledge organization flowed within the organization [30, 31, 46, 65, 21]. And, *knowledge organization methodology* refers to the use of explicit norms and the directions established and used within firms to organize knowledge [28, 4, 30, 31, 50].

At Conglomerate, managers determined explicit directives, regulations, and methods for organizing knowledge and provided them to the rest of the employees. At Entrepreneurial, the organizational structure was fairly flat and employees were given the responsibility to freely interact with one another to coordinate and control knowledge. The directions, regulations, and methods for organizing knowledge tended to be determined by these employees and bubbled up to upper-level managers.

As the case data suggest and Figure 4 illustrates, Conglomerate initially mapped closely to the bureaucratic hierarchy pole. In designing ORCHID, Conglomerate's project managers gave specifications to the application specialists to minimize the risk of their company's being in non-compliance with FCC and PUC regulations. Furthermore, it did not change its method of knowledge coordination and control at any point in the four phases of the systems integration process. Since the taskforce provided guidelines for how ERP APP organized knowledge, the interaction among the application specialists of this department was minimal. The application specialists were not required to collaborate with each other to determine how ERP APP coordinated and controlled order-tracking knowledge.

In contrast, Entrepreneurial initially mapped closely to the consensus hierarchy pole. Entrepreneurial managers encouraged a flexible work environment and did not enforce any pre-determined method for designating who should organize the department knowledge. Cheryl and Jim were given the responsibility of coordinating and controlling the department's order-tracking applications. Throughout the procurement systems integration process, however, Entrepreneurial changed its method of using hierarchy to organize knowledge. In particular, during the third phase of the systems integration process, the case noted that Carol convinced Cheryl and Jim to follow the taskforce's direction of allowing the ERP APP to coordinate and control order-tracking knowledge. By the end of the third phase, both departments mapped closely to the bureaucratic hierarchy pole on the knowledge hierarchy and delineation dimension.

In the final phase of the systems integration process, when the CFO announced the cancellation of the

systems integration project, the two procurement departments returned to their traditional methods of coordinating and controlling knowledge. The data indicated that because the two procurement departments adopted different methods of using hierarchy to organize knowledge, the taskforce encountered socially embedded differences in coordinating and controlling the requirements to design ERP APP.

Implications

Across all four dimensions, an analysis of the case data indicated that embedded IS and knowledge impeded the systems integration efforts at Merged. This has important implications for both research and practice. For researchers, this study is significant in that it represents one of the first in-depth case studies that shows, through the use of four dimensions of organizing knowledge, how a firm's systems integration efforts can be influenced by socially embedded knowledge. Past systems integration research has discussed how embedded resources can hinder the systems integration process, but little research exists that identifies and classifies attributes that make up the constructs for the *organization of knowledge*.

This study complements the existing KBV research stream by proposing a framework of the organization of knowledge, presented along four dimensions (and their attributes) in Table 2: (1) knowledge routinization (knowledge sequencing & adaptability and knowledge documentability); (2) knowledge acquisition and release (knowledge extractability, knowledge gather & releasability, and knowledge protection and shareability); (3) knowledge dispersion (knowledge location, knowledge distribution, and knowledge retrieval); and (4) knowledge hierarchy and delineation (knowledge coordination, knowledge flow direction, and knowledge organization methodology).

While the framework presented here is grounded in the path that unfolded at one specific organization, Merged, aspects of this framework should generalize to other cases. No claim is made that the dimensions and their attributes presented in this paper are exhaustive. Further research is clearly needed in order to test the applicability of the framework in other contexts; obviously, not all strategies require the same dimensions in organizing knowledge. However, as our understanding grows, we may learn when specific actions are needed to manage embedded knowledge during a company's attempt to integrate IS. Future studies can examine, for instance, what organizational actions enable firms to reduce time in establishing knowledge routines (dimension #1), focusing on knowledge acquisition and

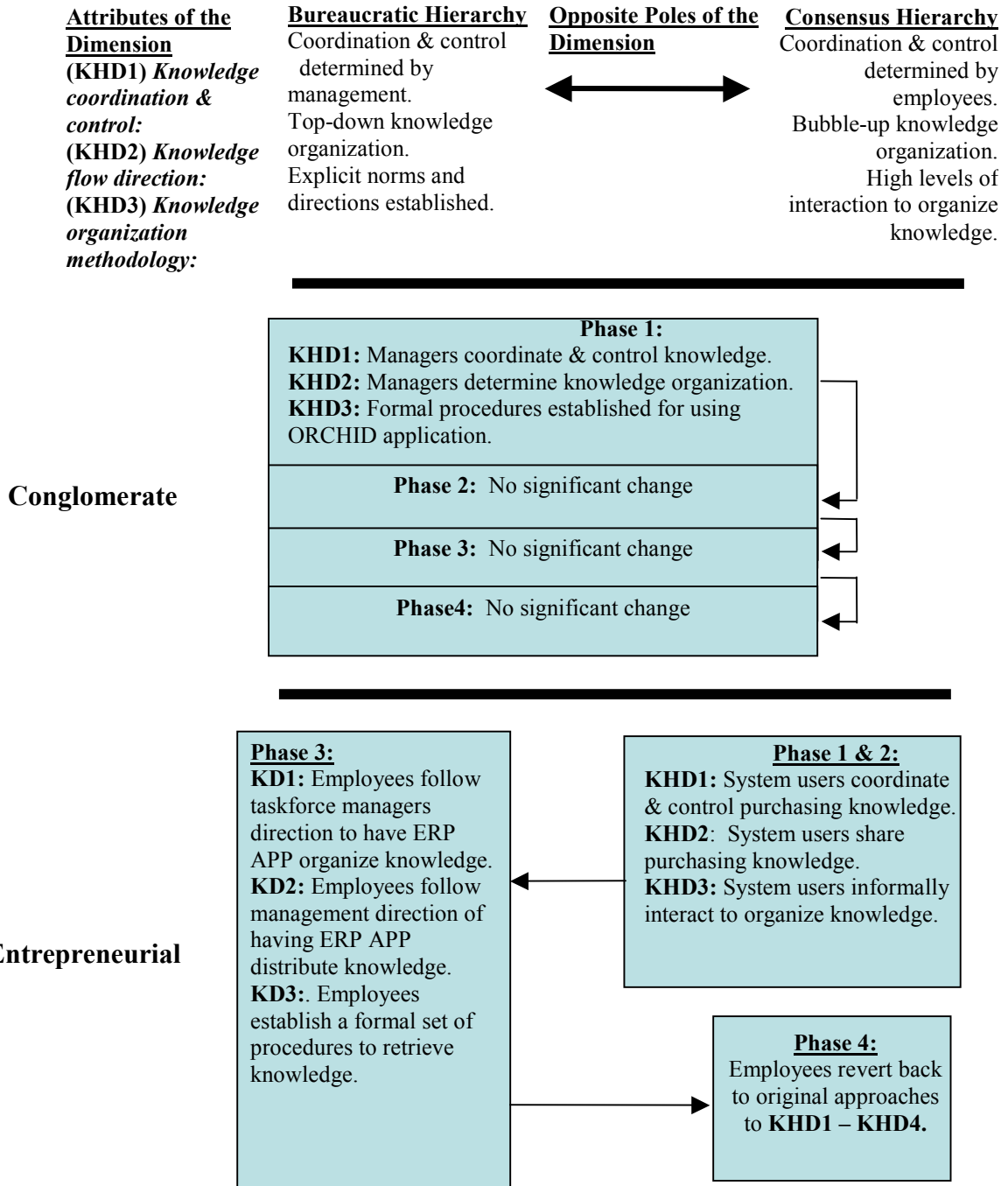


Figure 4: Changes over Time in the Attributes of the Knowledge Hierarchy and Delineation Dimension at Conglomerate and Entrepreneurial

release (dimension #2) or matching abilities to disperse or centrally control knowledge (dimension #3), and how knowledge hierarchy and delineation affects the frequency and intensity of the interaction among employees (dimension #4).

For practitioners, this study underscores the need for managers to identify and to understand how socially embedded tacit and explicit knowledge is essential in creating value for the firm. This knowledge resides in individuals, organizational capabilities, and interactions of individuals with one another and the external environment. Managers need some awareness of tactics that can be used to identify and manage the organization of knowledge. This study provides insights into how IS and knowledge can become socially embedded and how it can affect a firm's systems integration project. Furthermore, as summarized in Table 3, the framework presented here provides the basis for a set of normative suggestions and pitfall-to-avoid that managers could follow in this endeavor.

SUMMARY AND CONCLUSIONS

Given today's business environment dynamics, there can be no doubt about the value of better understanding how socially embedded knowledge and embedded information systems can affect a firm's system integration efforts. This research uses the KBV body of literature to articulate for the first time, a framework on the organization of knowledge. Within the framework, we present four dimensions on the organization of knowledge and their associated characteristics and attributes which can be used to identify embedded knowledge that can affect a firm's ability to integrate IS.

At Merged, the data suggest that throughout the procurement integration project, there were socially embedded differences in the approaches that the departments took to distribute, use, coordinate, communicate, transfer, and structure knowledge. This study highlights the fact that a wide array of tacit and explicit knowledge resides in individuals, in organizational capabilities, in interactions of individuals, and in the external environment. The way that knowledge was organized by these two departments was a slow and gradual process that was cumulative and very dependent on their social and cultural settings. Within a systems integration environment, this socially embedded knowledge hindered change. In particular, the integration at Merged was challenged by differences in the way both departments organized their knowledge along four

dimensions: knowledge routinization, knowledge acquisition and release, knowledge dispersion, and knowledge hierarchy and delineation. These dimensions are proposed as a framework of dynamic knowledge organization. The study also contributes to practice by providing suggestions to managers concerning tactics that may prove useful in evaluating and enacting changes for identifying and managing how knowledge is managed over time.

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Table 3: Suggested Strategies for Identifying and Managing the Dynamic Nature of Organizing Knowledge.

Dimensions of Organizing Knowledge	Normative Suggestions	Pitfalls to Avoid
Knowledge Routinization	<p>Take the time to understand how tacit and explicit knowledge contributes to the creation and establishment of department or organizational routines.</p> <p>Establish formal routines for processes and tasks that are often Repeated with little to no variation. Foster innovation by allowing employees to apply best known methods and techniques (tacit knowledge) to less-critical processes.</p>	<p>Force employees to follow routines (or the absence of routines) that are inconsistent with the business environment.</p> <p>Attempt to copy other firm’s routines (best-known procedures & processes) without knowing how it will benefit and be intertwined with your organization’s business environment.</p>
Knowledge Acquisition and Release	<p>Ask both the IS professionals and business managers to explain how and why knowledge is acquired, retained, or released within the department.</p> <p>Match the department’s ability to acquire and release knowledge with the potentially quickly changing dynamics of the business environment.</p>	<p>Get rid of knowledge just because it does not serve an immediate need within the organization.</p> <p>Keep and actively use all knowledge that the firm has obtained in the past.</p> <p>Prohibit the department from cleaning out all unnecessary knowledge.</p>
Knowledge Dispersion	<p>Match the company’s strategy to the department’s ability to disperse or centrally control knowledge.</p> <p>Remember – there should be a good balance between dispersing knowledge and fostering innovation and control.</p> <p>Understand how employees interact with each other to obtain knowledge.</p>	<p>Ignore how fast the employees need to obtain knowledge.</p> <p>View the dispersion of knowledge only through technology-centric lenses.</p> <p>Allow employees to keep knowledge at their desks and to themselves.</p>
Knowledge Hierarchy and Delineation	<p>Understand the levels of control that managers want over the coordination and control of knowledge.</p> <p>Agree on the direction for how knowledge flows within the organization and the specific department (i.e., Upper to lower; lower to upper; or bi-directional).</p> <p>Establish and enforce rules for coordinating and controlling knowledge.</p>	<p>Dictate how knowledge is coordinated and controlled without fully understanding how employees best need to receive or share knowledge.</p> <p>Assume that managers know how to coordinate and control knowledge best.</p>

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