

**Knowledge Management: A Review of the Literature  
and  
Implications for National Security Reform**

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## **Introduction**

In recent years, in accordance with the changing global landscape, knowledge management (KM) has become a widely discussed subject, and its understanding has become increasingly important for the organizations of today and of the future. The obvious promise offered by a holistic approach to organizational knowledge – treating same as an asset – invites attention and investment across the private and public sectors. However, efforts to improve in “doing KM” are often frustrated in implementation. Despite advances in organizational approaches and information/communication technology, the realities of social structures and elusive nature of KM components often intrude to frustrate success. This paper will not address these most interesting issues of KM – these are reserved for later PNSR products – but is intended to introduce key themes across the KM literature of interest to the PNSR task. In the interests of space, we therefore limit our discussion to

- Value of Knowledge – Knowledge as Asset
- Improve Organizational Decision-Making
- Improving Group Sense-Making

Beyond these key themes, several key insights emerge from the literature, and serve as initial observations for the establishment of a successful knowledge management regime.

- Common data abstraction, protocols and compatible business logic are essential for effective communication across information systems.
- Failure to automate processes sustains inefficiencies within, but particularly among, organizations.
- Process engineering and advanced information/communications technology can transform organizational structures.
- Establishing a learning culture is difficult, but essential, for an organization that seeks to effectively adapt to its environment.

- The long-term future is, by and large, unknowable and therefore ill-served by planning processes that assume predictability. Encoding assumptions about the future into data protocols or processes must be avoided.
- Organizations are best considered as having characteristics more closely resembling organisms than machines.
- Knowledge workers must focus on continuous learning and how to find the right data, information or knowledge that they need.
- Information is shared among trust networks, without which reluctance and miscomprehension characterize the transfer.
- A culture of sharing and teamwork is necessary to enhance knowledge management efforts—the absence of such a culture reinforces other incentives to hoard information.
- A long-standing organization should recognize its propensity to internalize a known method of operating, which often blinds the organization to new methods
- Knowledge location—the ability to locate a piece of information or expertise—should be supported by the proper mechanisms. Users, with the appropriate access to information, should not have to know where information is in order to find it.

### **Knowledge Management Literature Review – Themes and Background**

Knowledge Management (KM) is inextricably tied to several disciplines, as assumptions regarding the environment for management drive the approach to managing organizational and individual knowledge. KM represents an attempt to best understand the information environment, in order to facilitate decisions that further organizational goals. Embedded in this simple construct are assumptions and principles regarding:

- Individual and group cognition – *cognitive science*
- Decision-making processes – *ethnography, process analysis*
- Nature of the firm – *organizational theory, complexity*
- Information management – *organizational informatics*

The disciplines of interest are by no means subordinated to the study of KM, rather KM relies on an understanding of these in order to identify critical impediments and provide relevant solutions for knowledge management. The literature forces the reader to make several choices – as research in these disciplines over recent decades move management theorists to depart from mechanical models for organizations to organic models (Miller, 1992). Stacey (2000) defines these as mechanistic and systemic, but a broad agreement emerges in the literature regarding a move in the 1950s in organizational management literature – from principles that address human organizations as machines to ones that address them as systems or having attributes of organisms.

### **Themes across Literature**

While the KM literature and that of its component disciplines ranges from the academic to philosophical to business practice – we have focused here on core themes of highest interest to the task before the PNSR KM working group. We present these as broad solution areas, each supported by problem statements:

#### **Value of Knowledge – Knowledge as Asset**

Stewart (1997) asserts that today's (Western) economy is fundamentally different from yesterday's economy. The Industrial Age has been supplanted by the Information Age. The economic world we are leaving was one whose main sources of wealth were physical. The things we bought and sold were *physical objects*; you could “touch them, smell them, kick their tires, slam their doors and hear a satisfying thud.” The business organizations of that era were designed to attract financial capital in order to develop and manage those sources of wealth. While financial capital remains highly relevant; in this new era wealth creation is largely the product of knowledge. Knowledge and information – not just scientific knowledge, but news, advice, entertainment, communication – have become the economy's primary raw materials and its essential products. Knowledge is what we buy and sell. The capital assets that are needed to create wealth today are not land, not physical labor, not machine tools and factories. They are, instead, knowledge assets.

To succeed and use these assets, a company must show that it can effectively use intellectual capital. Intellectual capital is the sum of everything everybody in a company

knows that gives it a competitive edge. Companies such as Wal-Mart, Microsoft, and Toyota were able to surpass their competition because they could leverage intellectual capital. One elegant addition to this concept of intellectual capital is a further parsing of the phrase above, “that gives it a competitive edge.” As the recent growth of social software indicates, the intellectual capital of an organization is more than the sum of what its employees knows – in fact it is what they talk about and are willing to share. Knowledge that is not shared is not useful and therefore should be considered as potential capital.

Because knowledge has become the single most important factor of production, managing intellectual assets has become the single most important task of business. Allee (2003) posits that organizational value lies largely in the exchange of ‘intangibles’ across relatively porous organizational boundaries: “The premise for thinking of intangibles as assets is that knowledge, relationships, and ideas are more important for success today than are physical assets.” She goes further to detail that CFO Magazine actually publishes a “knowledge capital index” to track firms with high levels of investment in what are termed intangibles. Allee quotes from a Brookings Institution study for her definition: “Intangibles are nonphysical factors that contribute to or are used in producing goods or providing services, or that are expected to generate future productive benefits for the individuals or firms that control the use of those factors (155).”

Knowledge has become the primary ingredient of what we make, do, buy, and sell. As a result, managing it – finding and growing intellectual capital, storing it, selling it, sharing it – has become the most important economic task of individuals, businesses, and nations. Success in a knowledge-based economy depends on new skills and new kinds of organizations and management.

### **Improve Organizational Decision-Making**

Davenport (1998) writes that developing a knowledge rich environment provides many benefits to an organization. When knowledge flows freely, its potential value becomes actualized. Productivity increases and innovations spring from the timely application of existing knowledge and the generation of new ideas in the knowledge marketplace. Knowledge buyers, sellers, and brokers get the knowledge they need to do their work

well and receive appropriate payment for the knowledge they share in the form of recognition and advancement. A thriving knowledge market contributes to the success of the firm.

In addition, a healthy knowledge market means that employees see that their expertise is valuable and know that others in the organization will cooperate with them when they also need expert assistance. They may be more satisfied with their work and work harder than those frustrated by lack of communication, wasted effort, and uninformed decision making. Also, an active exchange of information and ideas in an atmosphere of openness and trust enables employees at all levels to understand what is happening in the company. A shared awareness of corporate goals and strategies gives individuals cues for directing their own work toward a cooperative goal and makes them feel that their work is meaningful as part of a larger aim.

There are several components to the challenge of establishing and sustaining a knowledge market, in order to improve decision-making across an organization.

### **Organization**

The *mechanical* approach to organization theory, building on economic theory and a market view, holds that the ‘carrot and stick’ (incentives and sanctions) approach is the key to aligning individual self-interest with the organizational interest (Miller, 1992). The assumption here (rational choice theory) is that each individual behaves according to a personal utility function. This assumes that the proper system of wages and enforcement mechanisms will result in a smooth-running organization, with each individual working to his or her highest potential. The *organic* approach holds that no such economic system will ever address the management challenges in a firm. Instead, the role of management is to instill institutional values that eventually cause identification with the organization – and a transcending of individual self-interest in favor of perpetuating the firm (Selznick 1957).

Frederick Taylor wrote in 1911 introducing the concept of ‘scientific management’ (Taylor 1911). The organization here is an extension of the master-slave relationship, with the employee offering to provide his labor in return for compensation. Reducing the organizational dynamics to the pursuit of mutual “maximum prosperity,” Taylor believed

that optimizing the work processes for organizational goals would be sufficient for operating a firm. The employee was compensated, and this was considered sufficient to provide for his maximum prosperity – this characterization of the employee is referred to as the ‘economic man,’ driven only by wages. Taylor’s framework for organization included a clear delineation of hierarchical authority, management by exception, and task specialization. The firm was seen as a machine, and by setting the right incentives and optimized processes in place, management would only have to maintain anomalies within the structure.

This focus on top-down organization results in a KM approach that focuses on broadcasting directives to members of the organization – who each work within defined processes that are not fundamentally changed by new information.

*Organizational informatics* deals with the resolution of information asymmetries through enterprise integration. This field builds on an understanding of organizational theory, and examines the role of information and information systems in an organization. Regarding the role played by asymmetric information (or understanding), in the establishment and maintenance of hierarchies, this domain details how information asymmetries are either extended or mitigated through the application of information systems.

Hierarchical firms often contain vertical structures formed due to function specialization, and early implementations of information systems often focused on the integration of functions within these specialization areas. For example, the human resources department may have an information system and commensurate data stores that aid in the performance of the functions of this department. The same might be true for marketing, production, shipping, etc. **Without a common representation of the data stores and business logic embedded in the software, however, a cross-functional view of the enterprise data entails significant manual effort with little assurance the result is accurate.** The subsequent use of information systems addressed this problem by first addressing the inefficient intra-functional as well as cross-functional process flows. Commonly known as “Business Process Reengineering,” these efforts sought to realign inefficient processes to realize efficiencies and leverage emerging information technology (Hammer & Champy).

The growth of Internet technologies enables inter-enterprise process flows, lowering the contractual transaction costs associated with inter-enterprise cooperation. The hierarchy is an organizational structure that represents a coping response to the high transaction costs associated with routine business functional interactions, which otherwise would require contracts for each interaction (Coase 1937). Given that common data abstraction and ubiquitous communication technologies are reducing transaction costs, some believe the hierarchy is a doomed organizational structure (Davidow 1992). However, the transaction costs associated with the growth of hierarchies are not only those that can be mitigated by improved communication flows – the cultural impediments of uneven trust relationships require a negotiation of intent prior to interaction in a non-hierarchical organization. Fukuyama (1999) shows that the hierarchy is an established organizing principle, and the elements that lead humans to organize in this way are not obliterated by the information ‘revolution.’ While the firm persists, and organizational theory finds that hierarchies are likely to also persist, there is now greater pressure for firms to not only integrate specialized functional areas, but also “outsource” administrative functions, or functional areas in which they do not hold a competitive advantage.

This concentration on distinctive or core competencies (Selznick 1957, Quinn 1992) is not new; however, the ability of an enterprise to focus exclusively on these areas of expertise has never been greater. **Common data abstraction is possible, not only across functional areas within an enterprise, but also across enterprises engaged in a common process.** As an example, Quinn (1992) finds that Nike is not a producer of sportswear; rather they are a marketing firm. Having found a market niche, and defined the production requirements, Nike outsourced the actual production and shipping of the product. To the consumer, this is an invisible distinction; the product appears to be entirely the result of Nike production.

Serious examination of the role of information technology in organizational transformation can be traced back to the 1980s and the “MIT Management in the 1990s” research program (Scott 1990). The optimistic finding from this effort was that the organization of the 1990s would be sufficiently enabled by information technology – by automating organizational information processes, greater efficiencies and improvements in productivity would result. While the automation of Simon’s “means-ends” decision

hierarchy may have proven worthwhile, this does not address cross-functional information flows. **The late 1980s and early 1990s featured much of the same organizational inefficiencies as before automation, primarily because the inefficient processes were not addressed and subsequently automated.** Many internal departments continued to host positions whose primary purpose was to liaison with other departments. “Customer Service,” for example, became its own vertical department in many organizations, instead of a crosscutting perspective of the organization – from the point of view of the customer.

Penzias (1995) defined three temporal business 'eras.' The first two were the Quantity era, characterized by an emphasis on advanced planning, economies of scale, and hierarchical organizations; and the Quality era featuring an emphasis on customer feedback, economies of speed, and team-based organizations. The third era is the one we are now entering: the Harmony era, facilitated by the principles of knowledge management. This era is characterized by an emphasis on personalization, economies of convenience, and architectural organizations. As for the value of a firm, it has gone through a similar transformation. In the Quantity era, value was found in volume; in the Quality era, it was based on performance. In the Harmony era, value is gained through coherence.

Businesses and their employees shift their focus from internal matters to their customers, and technology becomes more aligned with its users and the surrounding environment.

Where Penzias seems optimistic, **others see the emergence of completely new organizational structures as a result of the process engineering and maintenance facilitated by the advances in information and communications technology** (Davidow, et al., 1992). The promise of the ‘extended enterprise’ is that firms will be free to concentrate on their distinctive competencies, freed from the need to maintain large hierarchies, within which reside supporting functions. This view appears to be in accordance with Coase, by providing a “new” method for reducing the transaction costs across an enterprise, aside from hierarchical structures. It exists, however, in conflict with Fukuyama, who claims that hierarchies are a natural social organizing tool, as well as Simon and Miller, who discuss the information asymmetries that occur within an enterprise. The optimistic school of thought voiced by Penzias does not seem to adequately address the elimination of contractual tensions among firms, or the apparent

assertion that information technology and improved processes do away with information asymmetries.

Notwithstanding the academic uncertainties regarding this issue, firms are coordinating if not yet collaborating using Internet technologies. For one example, the Internet, specifically through the use of “portal” architectures, is changing the historically closed relationship among a production firm and the members of its supply chain. Where General Motors once determined that purchasing the supplier was the preferred method for guaranteeing a desired stock inventory and cost, firms evolved to the use of electronic data interchange (EDI) in the 1960s. This is a closed information system, whereby the production firm dictated the format for data catalogs and responses to requests-for-quote (RFQ). In order to do business with large production firms, vendors had to purchase software and data platforms in order to compete for RFQs. For vendors, this often meant the purchase of several machines and software licenses, in order to compete across multiple production firms. Eventually, “value-added-networks” (VANs) arose as a business model, offering to translate a vendor’s data catalog and quote into the required format for multiple production firms. Today, “business-to-business” (B2B) technologies offer universal data catalogs, used by multiple vendors and multiple production houses. The cost of entering the supply chain for these large production houses is lowered, providing economic advantage to the production firm, and freeing the market for vendors within supply chains. While information asymmetries and the human incentives to organize hierarchically have not been eliminated, the emerging information technologies are facilitating structural change markets and firms.

The promise of Penzias and others may be found in the renewed emphasis on customer relationship management (CRM). With an informed consumer, a full participant in the next implementation of the B2B technologies (literally, B2C, where C equals customer – multiple vendors and production firms competing for the business of end consumers), firms are structuring their processes and information flows to efficiently compete in a marketplace now characterized by mass customization. Once only available to the elite, extensive product customization is now available to end consumers, mandated by customer expectation, and facilitated by low transaction costs as a result of information technology implementation.

## Culture

Agreeing with Selznick (1957), that the primary role of a leader is in institutionalizing a values system friendly to organizational goals, Schein (1992) establishes the primary role of culture in understanding an organizational structure, as well as its opportunities for success. The development of an organizational culture is a striving for 'structural stability,' and is the key role for the organizational leadership. As an organization matures, various elements of cultural dispersion (mergers and acquisition, geographic separation, etc.) will intrude on the overall stability of the organizational culture. These sub-cultures (or counter-cultures, which indicate increasing tension with leadership direction) become difficult to manage for the leader, as he must fight to merge basic shared assumptions that may be in conflict. Schein observes that leaders who fail to understand the cultures in which they are embedded will quickly become managed by them, instead of managers of them. Finally, Schein addresses the challenges to the leader in the 'new' economy. Agreeing with Davidow and Waldrop, he indicates that the most successful organizations will be those that are learning organizations. **Developing a learning culture, one that allows for near-constant change and adaptation to one's environment, is by definition difficult, since the establishment of a culture is the human desire for structural stability.**

An inconsistent or non-existent culture of sharing may exist in many facets of an organization leading to poor knowledge transfer and workplace openness and trust (Davenport 1998, Stewart 1997, Schein 1992, Brown 2000). A major issue is that an organization may reward hoarding information rather than sharing it. In many companies, promotions and recognition are awarded to those who find and develop the best ideas and strategies. Many times these people feel that sharing their knowledge would dilute their power and influence in the company (Davenport 1998). Knowledge monopolies may also exist where a group holds knowledge that others need, but sells it at a very high price. Often times these groups are unwilling to give knowledge or accept it from people in the organization with relatively low status. The drawbacks for the organization are that important knowledge will not always be available when and where people need it to benefit the company (Davenport 1998).

Stewart states that a lingering problem in organizations is the idea that “if I’ve found a particularly clever solution to a...problem, it is not in my self-interest to post that solution to a knowledge database” (Stewart 1997). Without a culture of teamwork and compensation/rewards that support it, a rich garden of knowledge will be nonexistent. Culture also becomes prevalent when groups demonstrate internal misunderstandings due to a lack of common language and concepts in terms of which to communicate and how to state the problem (Schein 1992). This often occurs in companies that have long promoted individualism rather than group problem solving (Brown 2000).

Organizations that have existed for a long time and have a long history of success with certain assumptions about themselves and the environment are unlikely to challenge or reexamine those assumptions. The old ways are sources of pride and self-esteem. Such assumptions now operate as filters that make it difficult for managers to understand alternative strategies for survival and renewal. These assumptions can lead an organization to poor performance if new environmental demands require real changes in how the organization defines its missions, goals, and means to accomplish them (Schein 1992).

Mergers and acquisitions bring their own challenges because, more often than not, they blend two cultures that possess no shared history into one organization. This may doom the success of the combined companies early on (Schein 1992). In the case of joint ventures, early interactions may lead to mutually negative stereotypes. Schein (1992) provides an example where a U.S. firm and a German firm were forced to work together. In this case, their leaders provided strong crosscutting training on what the other culture was like. However, this created strong stereotypes and mistrust from both sides. They were unable to discuss cultural differences in the workplace due to fear of offending each other. To fix itself, the group had to choose procedures on the basis of which cultural assumptions were best suited to each problem. They learned to rely on comparative advantage of expertise, and a new culture arose by taking assumptions from each parent.

When two cultures are brought together, there may be barriers to accepting and absorbing knowledge fully. Entrenched interests in parent companies may cause workers to resist being told how to do things by new coworkers or managers, even if the suggestions are

demonstrably superior. Also, business units may not share information because they still believe they can solve certain problems more effectively than their counterparts (Davenport 1998). Stewart (1997) agrees that the concept of “if they didn’t do the work themselves, they’re convinced that it was done wrong or that they can do it better” is a major problem that commonly exists in such situations.

The next challenge for the knowledge market is **knowledge location: the right piece of knowledge is often hard to locate** (Davenport 1998). Mechanisms for getting access to knowledge that can best be found outside one’s own organization or department tend to be weak or nonexistent. For example, two authors (Davenport 1998 and Stewart 1997), found that workers spend the equivalent of two or three weeks per year searching for information that others already have. Time constraints to search for the best possible solution will cause people to buy convenient information, such as whatever knowledge the person in the next office may have, rather than deal with the effort and uncertainty of trying to discover who in the company knows more. This creates high search costs in pursuit of optimal knowledge and, especially in larger organizations, decreases the likelihood that employees will know how or where to find important information (Davenport 1998).

**Trust** must be built within the knowledge market to attain reciprocity, i.e. knowing that the person you just gave information to will do the same for you when you need it; this is an important tool in knowledge sharing. Honesty must start with upper management who can create an environment of openness with their employees and also follow through with their promises. Davenport (1998) states that face-to-face time is more beneficial than merely emailing one another to receive information. Groupware systems online do not build the same levels of trust because they are impersonal and do not allow participants to gauge one another as one would by having direct contact. Schein (1992) agrees that if a company becomes too dependent on groupware, managers realize that they are missing face-to-face interaction that helps gauge whether or not their message is getting through and how the other person is reacting. He goes on to state that communication requires face-to-face contact so that one can, at any given moment, assess the full range of cues such as tone of voice, timing, and body language to determine how one’s message is

being received. Organizations must be aware that over-reliance on this type of technology may create problems of trust and openness (Schein 1992).

**Reciprocity** is one of the key elements to information sharing because if you provide honest, factual, and beneficial information to a knowledge seeker, you are much more likely to build a strong reputation for possessing accurate information as well as receiving accurate information from others. It is up to the leaders of these organizations to create a sharing culture and unite the groups involved. Trust will not exist within an organization if management is unwilling to share authority and power, or fill knowledge databases with what they want their employees to know. By building trust in the workplace, the organization will be much more successful at sharing important knowledge and creating a friendlier, more open environment (Davenport 1998).

To move an organization in the direction of openness and effective information flow, one must begin developing a culture that encourages sharing. Davenport states that if organizations truly recognize the pressing need for knowledge sharing, they need to reexamine their policies of allowing knowledge hoarding to be commonly accepted, and look into adopting policies for successful sharing (Davenport 1998). Stewart agrees that a culture for sharing must be developed by supporting the human and structural capital on which the company depends. He states that organizations must determine what kinds of people and knowledge they need, what skills are essential to their business, how they acquire and keep those skills, how results should be rewarded, what kind of environment employees need to do their best work, and what systems can connect specialist knowledge workers with the least amount of bureaucratic drag (Stewart 1997).

Davenport declares that a knowledge-oriented culture is one that rewards those who are willing and able to share, and provides time and space to do so. Support from senior management will demonstrate to employees that knowledge sharing is important and hoarding information is not. Rather than rewarding individuals who have all the information and develop things on their own, management needs to encourage sharing. Rewards should be non-trivial so that employees will be motivated to attain them. Promotions need to be based on the openness of employees, their willingness to admit that they need help, and their demonstrated ability to do everything in their power to find

the best and most effective answers to a pressing need. A company formally tracking and rewarding knowledge sharing will increase the likelihood of cooperation leading to some future, tangible benefit (Davenport 1998).

Another technique for creating a knowledge sharing culture is pooling a variety of talents and backgrounds together to create workforce diversity, which in turn will increase the chances of a successful outcome. This will bring together people with different perspectives to work on a problem or project, forcing them to come up with a joint answer by relying on the comparative advantage of each member (Davenport 1998, Schein 1992). To do this, the organization must have employees who are willing and able to learn new things because “people are capable of making astounding leap in intuition and, at the same time, of tenaciously clinging to the details of petty, unproductive routines” (Davenport 1998). These employees should be encouraged to change jobs often and master new disciplines.

Davenport, Stewart, and Schein all agree that creating a strong knowledge structure and providing multiple channels for knowledge transfer will facilitate knowledge sharing within an organization. Schein states that **the flow of information is critical to the health and effectiveness of an organization**, and that coping with the new global environment requires: (1) importing information efficiently; (2) moving that information to the right place in the organization where it can be analyzed, digested, and acted upon; (3) making the necessary internal transformations to take account of the new information; and (4) getting feedback on the impact of its new responses (Schein 1992). To best move this information, Davenport believes that firms should link team members electronically, and offer both virtual and physical spaces dedicated to knowledge exchange such as ‘talk rooms’ or knowledge fairs (Davenport 1998).

Stewart believes that to properly share information there must be continuous recycling and creative utilization of shared knowledge and experience. This, in turn, requires the structuring and packaging of competencies with the help of technology, process descriptions, manuals, networks, and so on. Once packaged, these become a part of the company’s structural capital. This creates the conditions for the rapid sharing of knowledge and sustained, collective knowledge growth (Stewart 1997).

To use more of what people know, companies need to create opportunities for private knowledge to be made public and tacit knowledge to be shared. One way to do this is through informal networks or “communities of practice.” These internal networks demonstrate valuable information flow to those analysts working to solve similar problems and achieve a unified goal by sharing their expertise (Davenport 1998, Stewart 1997). Brown also believes that larger networks of practice that include a number of members involved in common practice with common knowledge across organizational boundaries are necessary. Links to each other may include newsletters, websites, and ‘listservs’ to keep in touch and stay aware of events in the field. They are notable for their extended reach through information technology and their strong demonstration of reciprocity – trusting that the person you are passing valuable information to will give you beneficial information in the future (Brown 2000). If a networked organization is to work, everyone must have a higher level of trust and must be willing to accept that power and status will be based on factors other than their control of information (Schein 1992).

Davenport and Stewart mention than either a Chief Knowledge Officer (CKO) or a “knowledge manager” could help an organization move on the right track towards better knowledge management. A CKO would sit in a senior management role on the level of chief information officer and other functional and business unit leaders. This appointee would, among other responsibilities, design, implement, and oversee the knowledge infrastructure, manage relationships with external providers of information and knowledge, focus resources on the type of knowledge it needs to manage most, and lead the development of a knowledge strategy (Davenport 1998).

Lastly, to emphasize sharing in an organization, the leader needs to have a strong and clear vision. Both Davenport and Schein agree that **clarity of vision and language are needed to support cooperation across the organization**. Leaders must provide an effective process of learning to assure the members that transition to a sharing culture is both possible and effective. In a rapidly changing world, the leader must not only have vision, but must be able to impose it and develop it further as external circumstances change (Schein 1992). By demonstrating a clear and common goal from the top, and providing many of the sources needed for effective knowledge management that have

been discussed, firms will unite and move forward in the new global environment (Davenport 1998).

### **Process**

Peter Drucker notes that the modern business enterprise arose after the Civil War in the U.S., and after the Franco-Prussian War in Europe. The author details two major evolutions since that time: 1) the succession of professional management to run family-owned business (Georg Siemens' Deutsche Bank between 1895 and 1905), and 2) the establishment of the militaristic command and control management model. This model was first seen in management restructuring initiated by Pierre S. du Pont, and was first noted in the U.S. with Alfred P. Sloan's redesign of management structures at General Motors (Drucker 1998).

Process management can be traced to the systems thinking that followed the application of Taylorism during World War II. "Work was viewed as a complex system with measurable inputs and outputs, which required vigorous controls and measures. Process flow diagramming was developed to describe such work systems. As their complexity grew, demanding mathematical techniques for queue analysis, optimal routing, and so forth, the discipline of operations research was born (Davenport 1993, p. 315)."

Taylorism, however, involved little analysis of the cause of defects. The application of scientific management in industry was little more than product inspection and the discarding of products that did not meet a certain output standard. Davenport holds that process "thinking" originated with the 'quality movement.' The emphasis on the customers and outputs of work processes is noted from the 1980s, but these first 'quality' thinkers were split on the issue of innovation and process. Edwards Demming and Joseph Juran recognized the advantages of measuring and improving the quality of processes, but did not believe management would accept anything other than continuous incremental improvement (Davenport 1993). Demming's work at Bell Labs is credited with the emergence of quality control, "strict analysis and control of the production process for manufactured goods (Davenport 1993, p. 320)."

Hammer & Champy refer to the emergence of process emphasis as a gradual event, occurring sometime after 1980. "The persistence of performance problems in the face of

intense efforts to resolve them drove corporate leaders to distraction. After a while, understanding gradually dawned on American managers: they were getting nowhere because they were applying task solutions to process problems (1997).” The repeated lesson, through Hammer & Champy, Rummler & Brache, and Davenport: incremental functional improvements ignore the process chains that create value in the business cycle.

**While efficiencies may be gained at the functional level through continuous improvements to functions (*kaizen*), only the cross-functional processes offer the opportunity for real organizational change.**

Recognizing the transforming capabilities offered by a thoughtful incorporation of information technology to processes, Davenport points to his own work as the first to recognize that radical process innovation, as enabled by information technology, is now possible. Demming and others had recognized the possibilities of radical innovation in processes, but believed the incremental continuous approach involved less risk to the enterprise, and allowed for a more measured assessment of the costs and benefits – Total Quality Management (TQM) embraced this incremental approach to process improvement.

The domain of process analysis is closely aligned with organizational informatics and organizational theory – it stands on its own largely because of the work done in business management research. The methods and techniques employed to increase functional efficiencies or engage in a transforming exercise of process reengineering are all part of process analysis and management. In treating an enterprise as a complex adaptive system, process analysis assesses the effectiveness and efficiencies of an enterprise within its environment. “How we do what we do,” is a quick way to understand the role and centrality of process and associated analysis and management to a firm.

Where organizational informatics focuses on the role of communication and information processing systems within an organization – and how emerging technologies in these areas can effect change – and organizational theory carries with it a larger sociological focus; process analysis and management is often the application of these two domains to an enterprise. The literature on this topic varies among different schools of thought – most of which differ primarily in the degree of control each assumes an enterprise has

over its processes. **(One major reason process management across the extended enterprise is so difficult – how does an enterprise manage processes outside the firm, assuming management implies a degree of control?)**

Rummler & Brache characterize processes as occurring in “the white spaces on an organizational chart (1995).” This aligns with Davenport, who notes that “process structure can be distinguished from more hierarchical and vertical versions of structure. **Whereas an organization’s hierarchical structure is typically a slice-in-time view of responsibilities and relationships, its process structure is a dynamic view of how the organization delivers value.** Furthermore, while we cannot measure or improve hierarchical structure in any absolute sense, processes have cost, time, output quality, and customer satisfaction. When we reduce cost or increase customer satisfaction, we have bettered the process itself (1993, p.6).”

The idea that an enterprise should concern itself with the processes, in addition to the organizational and functional hierarchies, is not new. After all, mass production was a process innovation, as is *kanban* – the “just in time” inventory initiatives of 1950s Japan (Womack, et al.). What are new are the opportunities for process innovation provided by information technology. Davenport offers a lengthy discussion of the role of information technologies in process innovation and explores in detail how emerging information technologies offer the promise of radically changed processes (1993).

Building on this idea of “radical change,” Davenport (1993) notes that the Total Quality Management (TQM) initiatives referred to programs that emphasized an incremental improvement in existing work processes. Reengineering (Hammer & Champy), business process redesign, or process innovation, on the other hand, refer to discrete initiatives designed to radically alter the way in which work is accomplished. Because of its disruptive nature, Davenport presents process innovation as a rare initiative, as compared to TQM or other programs - which focus on continuous, hence incrementally measurable, improvement. It is these strains of thought - incremental continuous functional improvement; incremental process improvement; and radical process innovation – which come together in the notion of holonic enterprises.

Holonic enterprise is a framework that appears to allow for continuous yet measurable process innovation. As described in McHugh (1995) and Sullivan, et al. (1999), this systems framework provides both structured, measured components and a capability for innovation by allowing for what Mintzberg termed “adhocracy.” While Davenport (1993) did not allow for continuous process innovation, considering it unwieldy and disruptive, the increase in the rate of technological change led to a shift in thinking.

**Organizations may be best thought of as near biological – with mechanisms that allow the firm to change processes to best match the opportunities and constraints of the dynamic environment – this analogy highlights the behavior exhibited by firms that survive.** In any period of change, theorists grasp at often extreme concepts to explain the setting and recommend coping behavior.

The term holonic originated with Arthur Koestler’s “The Ghost in the Machine,” and is derived from the Greek “*holos*” meaning whole, and “*on*” meaning part. According to Sullivan, et al., a “holonic network is a set of companies or organizations that acts integratedly and organically; constantly re-configured to manage each business opportunity a customer presents. Each holon in the network provides a different process capability and contributes to the outcome. Each node within the holon understands and contributes to the core processes and core competencies of the holonic enterprise (Elzinga, et al., 1999).” The concept is one of autonomous nodes in a network, each adaptable to the environment of the extended enterprise (McHugh, et al. 1995). This is a framework for considering processes that extend past the enterprise – whether to outsourced support functions or to partners in the value chain.

Holonic systems (holarchies) consist of holons incorporated in a hierarchical structure. A holon is an entity, able to exist and act autonomously, but which adapts its behavior in order to achieve the overall system goal. Herbert Simon’s parable of the watchmakers is an oft-cited “real-world” use for holons. In this parable, Hora and Tempus are watchmakers who are often interrupted to answer customer calls. For each watchmaker, this means the parts must be placed on the work surface, so that their hands are free to deal with the customer transaction. Hora thrives while Tempus goes poor – for the simple reason that every time Tempus answers the phone, the thousand parts of the watch must be re-assembled. Hora, however, builds his watches by assembling ten components

that fit together. Recovering from the interruptions is easier for Hora because he is creating, in effect, ten “sub-watches” for each watch. Tempus must navigate hundreds of parts each time he returns to the work bench, while Hora is able to pick up from where he left off. The components represent persistent structures, combined in different ways to create different overarching structures.

McHugh et al. provides a framework for these holonic nodes, identifying – for business purposes – four roles: Operational, Support, Supplier, and Integration. This taxonomy assumes that the enterprise has properly identified those distinctive competencies that are associated with the functions in an “Operational” node. The authors begin the discussion by clarifying that business process reengineering is not overtaken by this approach – rather the establishment of a holonic enterprise is the next step for those firms which have analyzed, assessed, and reengineered their processes. McHugh et al. further point to case studies, extended enterprises that have used the holonic network approach to executing their mission. One area of interest to the business community is the region of Northern Italy where family affiliation and historic partnerships have created a lasting network of business arrangements. With an average enterprise staff of 45, and faced with geographic and political remoteness, the firms in this region may provide fruitful data for research into this area of organizational structure.

During the late 1980’s, the changing political and budgetary environment created pressures that led the DoD to consider innovation in organizing its logistics chain – but the Gulf War of 1991 provided an early proving ground for some of the more interesting applications. McHugh et al. detail the rapid evolution of an identification beacon, characterizing the process of the source selection, prototyping, and deployment as one benefit of a holonic approach to acquisition in time of war (1995, p. 40). Sullivan, et al. lists the current initiatives in the DoD Acquisition Reform Council, Marine Corps, and the Special Operations Warfare Center and School.

There should be no surprise that the foundation for the establishment of holonic “virtual” extended enterprises is trust. Whether it is the family relationships in Northern Italy, the national security urgency of the Gulf War, or the mutual risk associated with U.S. automobile manufacturing – some trust-building mechanism(s) must be in place to

facilitate the implementation of a holonic enterprise. This notion of holarchies and holonic enterprises provides one answer to organizational imperatives implied by Sullivan, et al.'s observation: "integration, interdisciplinary cooperation, and international cooperation will be the basis for the new business process model of the 21st Century (1995)."

### **Planning**

Management's interaction with the firm consists of establishing the vision, strategic planning, measurement of performance with respect to the plan, and resource allocation. The element not heretofore discussed is strategic planning. Mintzberg takes on the notion of strategic planning as practiced by most enterprises, but reserves a disproportionate amount of criticism for the Department of Defense. **He presents the analytic crowning achievement of the McNamara Pentagon – the Planning and Programming Budgeting System (PPBS) – as a failed attempt to predict future environmental factors.**

**Mintzberg's chief complaint regarding the practice of planning is that it arrogantly assumes knowledge about the future, and assumes that strategy is developed from planning. In fact, strategy is an input, formulated before planning and implementation.** Mintzberg details several planning models, including SWOT (strengths, weaknesses, opportunities, threats). In this classic 'design' model of planning, executives consider these four elements, and analyze their environment and enterprise (and values) in these terms. The belief is that out of this joint analysis will emerge a strategy and the beginning of a plan. He terms this the "grand fallacy" of strategic planning – analysis is not synthesis, therefore strategic planning is not strategic formulation (1995, p.321). Mintzberg takes issue with the planning literature, relying as it does on a rational theory regarding business strategy and process management. He details a study by J.T. Peters et al., showing the error rate for intuitive versus analytic thinking. An analytic examination of a business situation/strategy would lack the "gut instinct" of an intuitive review. The study showed the quantity of errors was lower with analytic thinking, but the errors that were made were disturbing in their magnitude. "In other words, informally, people get

certain kinds of problems more or less right, while formally, their errors, however infrequent, can be bizarre (1995, p.327).”

Coming to the conversation from the planning perspective, then, **Mintzberg reaches the conclusion that the correct formulation of strategy would reflect a hybrid of analysis and intuition.** Structured, measured decision processes combine with the human element and the unparalleled ability of the human mind to make random, serendipitous connections. Too often, planning is analogous to looking for one’s keys under the well-lit lamppost, far from where they were dropped. Planners conduct detailed budget analyses, with little thought given to the intuitive formulation of strategy. This is not simply a sin of omission; Mintzberg claims a focus on the “knowable” crowds out the creative. “The numbers game can, in fact, impede strategic thinking by focusing so much attention on extrapolations from the status quo that serious change in strategy is never even entertained. Bear in mind that performance control, unlike action planning, overlies naturally on the existing [emphasis in the original] organizational structure; this makes it difficult to consider changes that reconfigure that structure, as serious shifts in strategy often do (1995, p. 86).”

Mintzberg’s contribution to the conversation regarding process analysis and management goes to the heart of the problem. Pure intuition, the kind practiced before the birth of the managed enterprise, is insufficient given the complexity of the environment. Pure analysis, the kind practiced in the 1960s Pentagon, will reinforce the existing structures, and offer little chance for creative restructuring – or innovation. In establishing a framework for discovering strategy, both “halves of the brain” must be present.

### **Improving Group Sense-Making**

*“Representations in the electronic world can become chaotic for at least two reasons: The data in these representations are flawed, and the people who manage those flawed data have limited processing capacity. These two problems interact in a potentially deadly vicious cycle. The data are flawed because they are incomplete; they contain only what can be collected and processed through machines. That excludes sensory information, feelings, intuitions, and context – all of which are necessary for an accurate perception of what is happening. Feelings, context, and sensory information are not soft-*

*headed luxuries. They are ways of knowing that preserve properties of events not captured by machine-compatible information (Weick).”*

The CIO for the Department of Defense, in May of 2007, published its Information Sharing Strategy<sup>1</sup>. In recognition of the challenges facing a Department that cannot predict with whom it will need to establish quickly trust and information networks, the Strategy states up front:

*“The Department must have the ability to transfer information to and obtain information from external partners overcoming situations where these partners may have disparate processes and capabilities and whose role and nature may not be known prior to an event. The DoD will share sensitive information currently protected by statute with authorized users, while maintaining an awareness of where and how this information is used.”*

As part of the Strategy, DoD introduces and lists elements of “information mobility:”

*“Information mobility is the dynamic availability of information which is promoted by the business rules, information systems, architectures, standards, and guidance/policy to address the needs of both planned and unanticipated information sharing partners and events. Information mobility provides the foundation for shared situational awareness. Trustable information must be made visible, accessible, and understandable to any authorized user in DoD or to external partners except where limited by law or policy.”*

The elements include: Technology, Workforce Competence (literacy), Social Networks, Policies and Security. In order to facilitate the flow of information across new or *ad hoc* networks, the Strategy envisions working these levers to achieve its goal of information sharing for mission success.

**The objective of many information sharing efforts within the context of command center operations and other related initiatives can be characterized as having a shared purpose of “situational awareness.”** The missing modifier is “shared” in front of situational awareness, and these initiatives also gloss over the goal of group wisdom

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<sup>1</sup> In the interests of full disclosure, this author was part of the research and writing project that produced this Strategy.

that leverages not only a shared situational awareness, but also a shared intuition regarding the incremental decisions inherent in these situations. Gompert also points out that the term of art in the Department of Defense was a “common operational picture,” which the authors points out is not the same as a “complete operational picture.” The common operational picture (COP) was envisioned as allowing a hierarchy of command centers to have the same information inputs from major command down to the lowest decisional level in military hierarchy. Gompert indicates this is an impossible goal, and encourages the continuing decentralization of decision authority to allow local commanders to make decisions using information that likely only they have in the time needed to decide. This last point is interesting, in that an unintended consequence of a “common operational picture” may be the re-centralization of decision-making authority. There is anecdotal evidence that this may have been an issue late in the Afghanistan campaign of 2002 – where higher headquarters (and legal staff) began to assert their hierarchical prerogative over local operations.

Snowden, et al, refer to an external definition (Future Systems Directorate (FSD) for Singapore Defense) for ‘sense-making:’ “exploiting information under conditions of uncertainty, complexity and time pressure for awareness, understanding, planning and decision making.” One element defined by the FSD needed to improve sense-making was ‘cognitive precision,’ how accurately does an individual or group perceive its environment. “[Cognitive precision is] about individuals and teams being well-aligned to reality – possessing the most accurate, unbiased perspective of the problem by taking into account relevant weak signals before arriving at an unbiased hypothesis or solution to the problem.”

Snowden then relates barriers to sense-making which are key to understanding core challenges in establishing shared context. The preferred construct for shared sense-making remains, in national security terms, physical proximity among decision-makers so that incoming information can be absorbed with as much non-verbal context as possible – in addition to judging how ideas and concepts are being received by the group.

Snowden’s barriers include:

- **Cognitive biases.** Gompert also touched on this, playing up the role of internal bias, groupthink, etc., in decision making. While decision-makers will point to the role of “the right information at the right time” as key to their decisions – research indicates that internal bias accounts for more decision processes than the individual knows. This is one reason that “capturing” an expert’s approach to decision making will always fall short of capturing core elements that remain unarticulated and often unexamined. Wiig (1993) warns that while humans identify patterns and form grand hypotheses from limited information, this comes with a significant downside: “the same facility is also a significant liability when we use it to create patterns and beliefs that are based on limited information and we continue to act on them in the false belief that they represent ‘the whole truth.’” Consider a large meeting in an office building where a fire alarm suddenly sounds. Despite training and warnings, a group of adults will not, as one, spring from their chairs and depart the building. Instead, they will subtly reinforce each other’s expected patterns (i.e., there is no danger), eventually going so far as to say: “this is probably a test.” Cognitive bias is a powerful influence in group, as well as individual, sense-making.
- **Insensitivity to weak signals.** Humans process information against internal patterns. Kurtz & Snowden (2003) quotes Douglas (1966) to illustrate: “...whatever we perceive is organized into patterns for which we the perceivers are largely responsible...as perceivers we select from all the stimuli falling on our senses only those which interest us, and our interests are governed by a pattern-making tendency, sometimes called a schema.” Information which falls outside preferred patterns, or which does not easily fit into expected patterns, can be discarded from the conscious mind.
- **Knowledge stovepipes.** Nissen (2006) states the obvious: “Inter-unit knowledge flows are important...for organizations that seek to maintain consistent work processes, technological environments, and product quality levels across units. Whether the products of interest are semi-conductors, pharmaceuticals, software applications, or government services, knowledge is required to perform the work

processes and such knowledge must flow between units to ensure consistent organization-wide performance.” Consider the national security system as a collection of units, with varying roles depending upon the nature of the challenge, and the need for knowledge flow across these units becomes self-evident. The term has become broadly used, and refers to an organizational bias towards optimizing information flows for local effect, weakening the processes and motivation for cross-organizational flows. The problem is not limited to disconnected information systems alone. Critical barriers here include Agency-specific classification schemes, cultural issues involved in citing work from another Agency’s analysts, historic mistrust of perceived political agendas, etc.

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There are dozens of approaches to KM, and numerous approaches to capturing the appropriate literature for understanding the field. We limited our approach here to the key themes of interest for the PNSR KM Working Group – working in close association with our peer groups: Knowledge as Asset, Sense-making and Decision Support. We expect this work to evolve over the course of the study and eagerly seek ideas and feedback regarding the product to date.

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