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Research Essay

MAKE WAY FOR K-MAN: INFORMATION MANAGEMENT INCLUDES KNOWLEDGE MANAGEMENT

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Warning: objects in the future are closer than they appear.

Wake up! The opening shots of an information revolution have already been fired. This revolution is changing society, economies, trade and military forces throughout the world.

The National Security Studies Course has devoted considerable time to discussion of some of the effects of this revolution. Examples have included the shifting balance between the rights of the nation-state versus the "human security" rights of the individual, the louder voice of non-state actors, new strategic approaches to management of human and material resources, and developments in contemporary leadership and command styles. Information technology is the molotov cocktail of both the Revolution in Military Affairs (RMA) and the Revolution in Business Affairs (RBA), currently being fomented in the United States, and spreading around the world. Philip Evans and Thomas Wurster argue that a fundamental shift in the economics of information is underway, and that this shift will force all businesses to re-think their strategic fundamentals.[1]

Fundamental changes h

information management has moved from being a specialist to a st

corporations are making the transition from information to knowledge ma nt, usually with tremendous results, but occasionally ensive failure. In m ny countries the military is following industry's lead. This paper will argue that Canada's defence establishment should apply the knowledge ma ment lessons that are being

[1] Ph B. Evans and Tho Wurster, "Strategy and the New Econo ic Information,"

learned in the market place, not just in technology, but also in management and organizational practices. Some definitions will provide a common foundation, then the concept of knowledge management and its place in information architecture and organizational culture will be described. Then, using contemporary examples from industry, the potential benefits and pitfalls of several knowledge management solutions will be demonstrated. Concluding that we must exploit the developments in this discipline carefully and pragmatically, the paper will recommend several principles for the Department of National Defence (DND) to observe as it embraces knowledge management.

THE VALUE OF KNOWLEDGE

We owe to Alvin Toffler the concept of a "Third Wave" civilization which is following on the heels of the first (agricultural) and second (industrial) waves. In his 1980 description of this third wave, Toffler stressed the importance of information and the power of computers.[2] In 1993 he went further, in stressing that the greatest asset corporations often possess is not material assets, but the ideas inside the heads of their employees. This knowledge-capital, unlike the more traditional forms of capital, could be shared and re-used by the employees, and in fact was an inexhaustible resource which could be used to create yet more knowledge if the company were clever enough to exploit it.[3] Unlike every other resource, knowledge builds on itself to create more knowledge and wealth.

Peter Drucker has also stated that the decisive factor in the wealth-producing capacity of developed nations is no longer the traditional capital, land or labour resource

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[2] Alvin Toffler, La Troisieme Vague, trans. Michel Deutsch (Paris: DeNoel, 1980) 198, 213.

base. All three have been subordinated to the importance of knowledge. Drucker, who claims authorship of the term "knowledge worker", argues that the developed world is now entering a post-capitalist, or at least an "information capitalism" phase.[4] The steady rise in service workers over manufacturing workers in developed countries is a testimony to this assertion, especially when one considers how many of those service workers are in fact knowledge workers: those in education and training, the financial industry, law, management, and government services, to name a few.

American white-collar workers became more numerous than blue-collar workers in 1976. Knowledge and information work currently account for 60% of the American gross national product.[5] The growing importance the United States places on knowledge is evidenced by statistics showing the resources it is investing in knowledge: 20% of gross national product in 1993 (comprising youth education, industry subsidization of employees' continuing education, and research and development) versus 2% in 1914.[6]

In an insightful article, Joseph Nye and William Owens cite America's information advantage as the power resource of the future. In their words "Knowledge, more than ever before, is power."[7]

Let us accept then, the premise that 'knowledge' is a vitally important part of today's and tomorrow's world. But just what do we presently understand about this common-place word that we have extruded from its Greek origin (logos): through a

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3 Alvin Toffler, Powershift: Knowledge, Wealth and Violence at the Edge of the 21st Century (New York: Bantam Books, 1993) 61.

4 Peter F. Drucker, Post-Capitalist Society (New York: HarperCollins, 1993) 8.

5 Kenneth C. Laudon and Jane P. Laudon, Management Information Systems: New Approaches to Organization and Technology (Upper Saddle River: Prentice Hall, 1998) 6. Further references to this text will be simply: Laudon.

6 Drucker, 186.

myriad of words such as logic, tautology, symbology, technology, and the word knowledge itself? We need to consider, not just pure definitions of several related words, but also how they are connected to each other and to the organizational environment of business or military establishments.

THE MEANING OF KNOWLEDGE IN THE ORGANIZATION

Information

While data are merely a stream of simple, objective facts, they can be condensed, analyzed and placed in a given context, and thereby become information, or an actual message with meaning[8]. Although information, a compilation of data, is now of use to humans, its very volume in the modern environment can limit its usefulness. Managers can be swamped by a flood of detailed information, and yet be unable to find that one nugget that would let them comfortably make a critical decision or recommendation.

Military analogies to this situation are numerous, not only in office environments but also on operations. For example, during the war in the Persian Gulf, the difficulty in identifying the essential pieces of information in a flood of background noise may have been the weakest link in the decision-making process.[9] For information to become knowledge, that is an active, useful element in someone's mind, is the ultimate goal of information systems. The discipline that identifies the required information products, and the tools and processes that will provide them, is known as information management. Much information management work is concerned with the design and maintenance of

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[7] Joseph S. Nye, Jr., and William A. Owens, "America's Information Edge," Foreign Affairs 75.2 (1996): 20.

[8] Thomas H. Davenport and Laurence Prusak, Working Knowledge: How Organizations Manage What They Know (Boston: Harvard Business School Press, 1998) 4.

[9] Colonel Edward Mann, "Desert Storm: The First Information War?" Airpower Journal Winter 1994, 9.

information systems, and with ensuring that information is structured in such a way as to maximize its usefulness to the organization.

Information Systems

A common understanding of information systems is key to understanding the thrust of this paper: an information system may be either technical (i.e. based on computer and communications equipment) or behavioural (i.e. involving management, organizational aspects and the interaction of humans). Most often, an information system and related issues can best be understood by realizing that the overall system is made up of both technical and behavioural aspects. This is the approach that will be used in this paper. Indeed, the increasing power and complexity of computers and communication technologies is resulting in the merging of the technical and human element in the information management equation.

A useful definition of an information system is: a set of interrelated components that collect, process, store, and distribute information to support decision-making and control in an organization.[10] In military organizations two major categories of information systems are Management Information Systems (MIS) and Command and Control Information Systems (C2IS). This paper will emphasize the former, both because their utility is more widespread at the strategic level, and because more current examples exist in industry, which at present is leading the military in the drive towards knowledge management. As noted by DND in 1996, however, the difference between MIS and C2IS is diminishing with each advance in technology.[11]

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[10] Laudon, 7.

[11] Colonel A.R. Brown, Director Information Management Strategic Direction, "Information Technology Directions for the Department of National Defence and Canadian Forces", 3. Accessed via http://131.137.96.10/diso/library/power/power_e.htr on 2 February, 1999.

As information systems have become more powerful, they have been able to hold more data, and process the data more rapidly into useful information. As computers have become more capable, small personal (and portable) computers have assumed some tasks previously performed by central mainframes. In parallel with the growth in the power of hardware, has been the accelerating growth in the size, complexity and ability of software. As the "brains" of the computer, software is at the very heart of recent developments in information system capabilities.

This organizational change (more dispersed computing ability throughout the organization) placed informational power in the hands of more workers. The next logical organizational and technical step is for the personal computers of employees to be linked by communication networks, so that workers can share the information contained in their computers. As management facilitates this information exchange among workers, it almost accidentally transforms information management from its pedestrian, data-focussed origins to a richer and more productive level of capability, dealing in what we call knowledge.

Knowledge

Knowledge is to information what information is to data. While information and knowledge are not mutually exclusive, the latter is generally understood to be broader and richer, and to be contained in the minds of those who are well educated or experienced in one or more fields: it is experience-based and judgement-informed awareness. Knowledge is information to which the receiver of that information applies context (his framework for viewing life) and experience (previously acquired knowledge). Whereas information becomes obsolete, knowledge is expanded with each

use, and has no limits to its growth.[12] The following captures the broad notion of knowledge as it applies in this paper:

> Knowledge is a fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information. It originates and is applied in the minds of knowers. In organizations, it often becomes embedded not only in documents or repositories but also in organizational routines, processes, practices, and norms.[13]

The problem confronting many organizations today is that they are just learning (or re-learning) the true value of knowledge. Solutions that are being sought often combine both a re-examination of the structure and processes of the company, and the use of technical systems. Two problems are particularly widespread.

Large decentralized organizations waste considerable resources in learning the same thing repeatedly in various parts of the enterprise. Data or information that might exist in documents or on computers in one office are not accessible to workers in another office, who may not even know they exist. A classic example is a consulting company with branches performing much the same function all over the world. A consultant working with a client in Europe might find an innovative solution that also would be of use to a consultant in Asia, if only he knew about it.

The other problem becomes evident when companies that have downsized discover that departing workers took not only their gold watches, but also irreplaceable expertise that was contained nowhere in the company but in their heads. For example, Ford forgot how to build an automotive design team, and International Harvester forgot

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[12] David B. Harris, "Creating a Knowledge Centric Information Technology Environment" Seattle: September 15, 1996, 2 and 4. Accessed via http://www.htcs.com/ckc.htm on 23 April, 1999.

[13] Davenport and Prusak, 5.

how to design and construct a truck factory.[14] The crux of the issue is that members of a company (or a military, or any other organization) hold a huge amount of implicit knowledge in their heads. Often unaware of the extent of their own knowledge, they have absorbed experiences, training, education, values and concepts and created a unique and hugely complex 'knowledge base' which allows them to make judgements and decisions quickly and correctly in a myriad of situations. In military terms, the brilliant commander's "coup d'oeil", or ability to size up the situation on the battlefield almost intuitively, is the epitome of the human mind's ability to absorb and re-process knowledge.

These challenges in today's globally competitive environment, and technology's promise for the storage and exchange of information and knowledge, have created the concept of knowledge management. The level of interest is indicated by the fact that there are 37,900 web pages and over 200 recent books on the subject.[15] Ironically the very technology which permitted downsizing, removal of layers of management, and decentralization of operations has both contributed to the above problems and is now being applied as 'techknowledgy' to remedy those problems.[16]

Knowledge Management

The concept of knowledge management is too new to have a universally accepted definition. Despite this, the growth of products on the market, both applications and services, has been explosive, and is expected to surpass US$5 billion by 2002.[17] The

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[14] Ibid, x.

[15] Charnell Havens and Ellen Knapp, "Easing into Knowledge Management," Strategy & Leadership March/April 1999, 1. Accessed via http://proquest.umi.com/ on 15 April, 1999.

[16] I wish I could take credit for this creative distortion. Alas, see Davenport and Prusak, 127, as they make the critical point that technology is part but not all of knowledge management.

[17] Denise Romberg, "Knowledge Management Market to Hit $5 Billion." Computing Canada Nov 9, 1998, 1. Accessed via http://proquest.umi.com/ on 20 April, 1999.

reader can see from the following offerings, however, that there is a commonality in what is meant by the term.

"The process of collecting, organizing, classifying and disseminating information throughout an organization, so as to make it purposeful to those who need it."[18]

"The systematic leveraging of information and expertise to improve organisational [sic] innovation, responsiveness, productivity and competency."[19]

"…the task of developing and exploiting an organization's tangible and intangible knowledge resources."[20]

In simple terms, knowledge management involves making the best use of information and knowledge assets (no matter where they are held) so that they can be applied across the organization. It makes shared information (more) useful. Two common functions of knowledge management follow.

In some applications it applies rules and context to raw information, reducing its volume but increasing its value as an aid to decision-making. In other cases, its focus could be on merging explicit knowledge (derived from information easily represented and stored in information systems) and the tacit knowledge in the heads of experienced professionals. The merged product would then be accessible and of use to a greater number of personnel in the organization. In both these examples, it follows that effective knowledge management requires good communications linking the available information (in paper or electronic media), the available knowledge (in the minds of workers), and all

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[18] Sam Albert, "Knowledge Management: Living up to the Hype?" Midrange Systems Sep 7, 1998, 1. Accessed via http://proquest.umi.com/ on 20 April, 1999.

[19] Andrea Wharton, "Common Knowledge," Document World Oct/Nov 1998, 1. Accessed via http://proquest.umi.com/ on 20 April, 1999.

[20] Jenny C. McCune, "Thirst for Knowledge," Management Review Apr 1999, 1. Accessed via http://proquest.umi.com/ on 19 April, 1999.

those who need access to this knowledge in order to use it and build upon it. Ikujiro Nonaka has written an excellent description of the value gained when tacit (human) knowledge and explicit (technical or documented) knowledge are exchanged to produce completely new knowledge that has its own value.[21]

The leadership has two primary tools to effect knowledge management. First, there will be a need to build technical systems for the retrieval and manipulation of information held in various locations, such as company data bases. Second, the culture of the organization must be such that it encourages knowledge sharing for any of this to work effectively. Each of these requirements represents significant challenges, and will be discussed separately.

Information Architecture

The rapid development of information technology has created a rising expectation from business users. This expectation in turn has created the demand for ever-more complex computer systems to complete ever more complicated tasks, reaching farther and farther up the corporate chain in both visibility and usefulness. So pervasive is the technology, and its influence, that fundamental decisions now are a matter for the principal leadership, not for the information technology staff. One such decision is the selection of the information architecture for the organization. Information architecture is defined as the particular form that information technology takes in an organization to achieve selected goals or functions.[22] Will it be distributed or centralized? How broadly will the organization's outposts be linked to each other and to central assets such as data

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[21] Ikujiro Nonaka, "The Knowledge-Creating Company." Harvard Business Review November-December 1991: 98-99.

[22] Laudon, 26.

warehouses? How heavily and frequently will the organization invest in leading-edge systems and applications?

These questions and others demand that the leadership have a clear sense of their organization's imperatives, and what information technology can do for them. Well informed, they will be equipped to direct information architecture suited to their needs. In a wholesale embrace of the technology, the architecture would ascend through four levels:

I-operational (or functional) systems – perform basic, specific tasks in human resources, accounting, finance, etc. Known as transaction processing systems, these systems handle only data: they will not be examined further in this paper.

II-knowledge systems – harness cross-functional knowledge and distribute it across the organization

III-management systems – help senior management evaluate programmes or options, by such tools as Decision Support Systems (DSS)

IV-strategic systems – give leadership global insight into the functioning of major business lines, and the wherewithal to weigh and make strategic choices, using Executive Information Systems.[23]

The chart below summarizes the uses and relationships of the four levels of information architecture:

[23] Laudon, 27.

System Level	Input	Processing	Output and User
Strategic (eg EIS)	Consolidated internal reports, and trends; external reports.	Identify trends, warning of new opportunities or threats, a change in the operating environment.	Senior executives, top decision makers of the organization.
Management (eg DSS)	Courses of action to solve a problem	Analyze and compare options	Programme or business line managers
Knowledge Systems (eg OAS, expert systems, data warehouses)	Documents	Manipulation, transfer of information	Knowledge workers, design and other teams
Operational (TPS) Systems	Data(eg personnel and financial)	Perform calculations of benefits, pay, etc	Pay and costing information

The reader may well ask whether a decision to purchase information technology is an all-or-none equation. The answer is no. While there are clear synergies to be gained by constructing a completely integrated system of systems throughout the height and breadth of an organization, the prohibitive cost, the rapid changes in technology, and the high training and turbulence cost make this impractical. Rather, the organization's leadership must identify which of its functions would most benefit from the available technology, and would best fit the organizational culture of the company.

Before leaving the technical aspect of information management, it is important to understand that information systems are comprised of four elements that cannot be separated. The visible foundation of course is the hardware, the actual computers, monitors and peripherals that the user sees and touches. In order that the hardware be capable of performing its function, it must hold software, both the system software that tells the machine how to function, and whichever applications the user adds in order that this particular machine can do a specific task, such as decision support. All software

depends on a database of some type, which gives it a store of information from which it draws in order to make its choices. Lastly, and becoming increasingly important as knowledge management becomes commonplace, is the telecommunications network that allows computers and their operators to exchange data and information, and to collaborate on development of a new body of work.[24]

A particularly dynamic communication medium that promises to become more and more important for corporate information systems is the internet, and its associate, the World Wide Web. Internet technology, especially the ubiquitous communication network that has now encircled the globe, greatly facilitates many aspects of knowledge management that are discussed in this paper. Whether aiding information exchange, permitting collaborative work among dispersed teams, or facilitating the monitoring of international and corporate events, the internet will be a part of the communications element of all major information systems. As it is a complex subject in its own right, the internet will not be discussed in any detail in this paper.

Organizational and Management Issues

Before key decisions on information architecture are made, the leadership must address fundamental questions about how the organization will work. These involve such issues as how much devolution of authority, and surrender of control, is acceptable? If shared knowledge systems facilitate the cooperative work of personnel throughout the organization, will management permit collaboration across the organizational matrix (across the chain of command)? Can the organization create a culture in which employees readily share knowledge, and are rewarded for it? Can the leadership commit to conducting the necessary training so that personnel quickly realize the potential

[24] Ibid, 16.

benefits from the new technology? In many situations, the lack of formal training on new systems severely reduces the benefit that is received, and may indeed produce a net loss in effectiveness as workers try and fail to use the new systems, than develop their own methods of going around it. This analysis (of information architecture options) might best be directed by someone other than the organization's principal information technology officer, often called the Chief Information Officer. Use of a generalist instead of this specialist would ensure that the truly strategic focus would be retained. Questions such as what we do, and why we do it would then be addressed satisfactorily before considering how such functions might be performed.

All these questions highlight the behavioural aspect of investment in new, more sophisticated information technology. One can well imagine that these questions are even more problematic for a military organization than for many corporations. To better appreciate both the potential that new systems offer, and the challenge they produce to management, we will next study several applications--commercial and potentially military-- which can help an organization to manage knowledge. It will become clear in studying these examples that the technical and human dimensions of knowledge management are truly two sides of the same coin. Because they cannot be separated from one another, both will be mentioned in the following analysis of the three upper levels of information architecture.

ARCHITECTURE AND APPLICATIONS OF KNOWLEDGE MANAGEMENT

Level II - Knowledge Systems

Knowledge management at this level is usually categorized in one of four functions: to distribute, share, capture and codify, or to create knowledge. Systems and

processes have become specialized, depending on which of these functions is being performed.

Knowledge distribution is greatly aided by Office Automation Systems such as word processing, imaging and calendar control, especially when workers are linked electronically. Those who have used a typewriter will appreciate the imbedded knowledge in a word processing application, which contains a library of spelling, grammatical and formatting rules.

Knowledge sharing is facilitated by Group Collaboration Systems. The use of groupware and internet technology to create intranets within the organization, or extranets to specific external parties, multiplies the information sharing and coordination of large, far-flung organizations and the building of alliances. A leading groupware product is Lotus Notes, which provides document workflow, collaborative document processing, and multimedia capabilities.[25] Such technologies have clear applicability to such military tasks as doctrine writing and throughout the fields of research and programme management.

Capturing and codifying knowledge is the function performed by artificial intelligence systems, in the constant struggle to formalize and replicate the complex processes of the human brain. Artificial intelligence tasks include robotics, natural languages, and expert systems. To discuss only the latter case, the expertise of a human in a specialized domain of knowledge is captured in a computer program. Such a system may hold up to 10,000 rules in its schema of questions and answers, as it replicates, for

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[25] Charles B. Wang, Techno Vision II: Every Executive's Guide to Understanding and Mastering Technology and the Internet (New York: McGraw-Hill, 1997) 214.

example, the diagnostics check on a car.[26] Chess applications, another example of an expert program, can now defeat over 99% of the chess players in the world.[27] This environment, with clearly defined rules and a huge but calculable range of options, is a perfect vehicle for the development of expert systems. In another application, virtual agents have begun to appear as customer service representatives on the Web. Known as "chatterbots" or "klones", these expert systems draw on a huge catalogue of information, and are successfully answering 85-90% of customers' queries, with a more personal response and less cost to the Web-site owner than E-mail.[28]

Despite these successes, expert systems are not advancing as rapidly as it was once thought they would. They continue to be challenged by the complexity of the human thought process, and quickly become out of date when the organization changes or when the human experts find yet another way to conduct the task. However, the work that has gone into creating them has shed new light on how learning occurs, and therefore how to encourage learning and the sharing of new knowledge in the workplace.

An offshoot of the expert system is the neural network, which attempts to emulate the processing patterns of the biological brain, and thereby to "learn" from a recurring pattern of events. [29] Neural network applications are proving valuable in narrowly defined applications in medicine and science.[30] When this technology is more mature it will provide considerable value to lessons learned staffs. Expert systems offer a

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[26] Laudon, 565.

[27] Major M.W. Fortin, "Knowledge Management: the Way Ahead for the DND/CF." Ex New Horizons 1997-98. 14. Accessed via http://www.cfcsc.dnd.ca/irc/nh/nh9798/0035.html on 8 April, 1999.

[28] Robert Cribb, "Net Androids Answer Customer Questions." The Toronto Star 25 April, 1999: BE 2.

[29] Laudon, 572.

[30] Ibid, 574 describes a neural network being used to examine Pap smears for cervical cancer, with ten times the accuracy of humans, and requiring one-fifth the time.

myriad of military applications, whether operational research, strategic force planning, or logistical planning.

Systems assigned to the creating knowledge function are called Knowledge Work Systems. In assisting workers to create new products or find ways to improve existing ones, computer-aided design applications and virtual reality systems are becoming common. Frequently their biggest limitation is the willingness of people to use them. This underscores the point that if leadership decides to introduce sophisticated systems into the work place, subordinates must be involved in the process so that the necessary cultural adjustments can be made. Knowledge work applications offer value for requirements and equipment purchasing staff, and for training missions.

Level III - Decision Support Systems for Management

Decision support systems combine sophisticated analytical tools and user-friendly software to analyze important blocks of data. By so doing, they help management to solve problems by considering "what if" models as possible options.[31] Decision support systems provide data in a form suited to analysis, they incorporate models that can be run through different options, and their user interface is easy for the manager to use, with no programming required. In addition, they normally incorporate electronic mail messaging as another way to receive data.[32] Their incorporation of data manipulation, use of heuristics (general rules of thumb) and simulations, plus their ability to provide a historical decision-tracking capability, are a great help in making new decisions.[33]

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[31] Ibid, 591.

[32] Vicki L. Sauter, Decision Support Systems: An Applied Managerial Approach (New York: John Wiley & Sons, 1997) 16.

[33] James M. Kerr, The IRM Imperative: Strategies for Managing Information Resources (New York: John Wiley & Sons, 1991) 53-54.

An example of one specialized task is a process called data mining. Many companies now compile massive data warehouses that allow relationships to be drawn between various elements of each record. Data mining with powerful software tools allows the company to determine previously undetected patterns, trends, associations, changes and anomalies in these pools of data.[34] By using this knowledge with other decision support processes the company can react to and even anticipate changes. A retailer may determine for example, what day and time certain things sell more quickly, permitting a more efficient programme of inventory control. Wal-Mart's extensive use of data mining allows it to minimize store inventory, yet succeed brilliantly at having enough of its 100,000 items in stock when needed by customers.[35]

Data mining assists companies in learning more about their customers, and permits them to target promotional campaigns very precisely. For maximum usage of this capability, the company will install the necessary communication network across the organization so that various staffs can do their own analysis from the same data warehouse. Credit and debit card transactions are a boon to data miners, who sift through the data to identify buying patterns, then launch very specific promotional campaigns at this well-defined target market. American Express has mastered this technique.[36]

Data mining has at least three applications for the Canadian Forces. Supply chain management is a challenge for any military organization, which would benefit from the technology and process in use by Wal-Mart.[37] As well, personnel records are

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[34] Wang, 222.

[35] Laudon, 598.

[36] See ibid, 56, to learn how American Express uses datamining to treat each of its 30 million card holders as a "market of one". This is the ultimate in "mass customization."

[37] For a discussion of supply chain issues, see Hau L.Lee and Corey Billington, "Managing Supply Chain Inventory: Pitfalls and Opportunities." Sloan Management Review Spring 1992. 67.

voluminous, difficult to access and hard to keep current: storing them in the correct data warehouse and distributing the appropriate software would greatly facilitate their access and updating by authorized staff from many different locations. This capability would be much more vital in wartime than it is now. Thirdly, the military intelligence function by its very nature amasses large quantities of data, fuses or amalgamates them into useful information, and draws conclusions or makes predictions. This entire task lends itself very well to data mining and other decision support applications. [38]

Level IV - Executive Information Systems (also called Executive Support Systems)

This category of information system serves the strategic level of the organization by creating a generalized computing and communications environment. By providing easy access to critical internal information such as operating trends and performance, as well as incorporating data about external events, these systems aid the analysis of fundamental issues facing the organization, rather than solving specific problems. Compressed and filtered information, displayed on advanced graphics software, provides timely indications of strategic threats and opportunities. Historical and competitive data, as well as communications capabilities, assist in answering fundamental questions about possible new business directions.[39]

These systems monitor particular facts about the business and its environment, and automatically alert their user when those facts require special attention.[40] Such systems are expected to improve the quality of planning and decision-making at top

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[38] A useful catalogue of datamining applications is contained in Lieutenant-colonel Frederic Hingray's "Knowledge Discovery in Databases(KDD) and Data Mining." Exercise Leonardo da Vinci, February, 1999.

[39] Laudon, 47 and 607.

[40] Kerr, 68.

levels of the organization, reduce the time leaders spend finding problems and opportunities, and improve organizational control.[41]

Executive information systems would clearly be of use to the members of Armed Forces Council and the Defence Management Committee. The extensive reports and briefings they receive could be reduced if they had ongoing access to the summarized status of current programmes, the budgetary situation, performance measurement and operational readiness. However, such a tool would produce a net negative effect unless it were to be supported by computerized systems at the level below it. If not, introduction of strategic systems would probably increase further the already heavy demands on staff to provide status reports to the strategic leadership.

This concludes the survey of the three upper levels of information architecture found in large corporations. It can be seen that many applications at the knowledge and decision support levels would have great utility in a national military headquarters. Some cautions have also been identified, however. To minimize these dangers, and to maximize the benefits that DND might gain from introduction of such systems, a cautious approach is warranted. In the next section several observations are drawn for those who are considering the purchase of knowledge management systems.

LESSONS IN APPLYING KNOWLEDGE MANAGEMENT

Identify Mission and Tasks

Decision-makers must be clear on the departmental mission and subordinate tasks. Technical solutions should be considered only for tasks that would clearly benefit from information technology. A generalist, not an information technologist, should be placed in charge of the study and implementation, with the necessary communications

[41] Sauter, 375.

and computer experts in her team. She must be given sufficient opportunity to brief the strategic leadership on her findings. A key decision at the outset is whether the department wishes to become a learning organization, devolving power and information. (Devolution of authority has already happened in some respects) Each potential acquisition must be studied to see how it will change the organization and the processes currently in use: those changes must be acceptable and achievable, and cannot be counter-productive.

Consideration of Cultural and Personnel Impacts

Many personnel are still adjusting to the flood of recent changes throughout the department and the Canadian Forces. In addition, many members of the staff do not yet perceive a net benefit from the information revolution. Office automation has permitted the dismissal of many low-end information workers (clerks and secretaries), with the result that many staff must do their own administrative work, in addition to the 'knowledge' work that their job description lists. Accordingly, all serious considerations to buy new sophisticated systems must give four things to those who would be affected. They must be consulted on whether or not they get the system. Tangible evidence must be provided that the proposed system would improve, not degrade their work environment. Commitment must be given to provide sufficient training for all users before installation. Commitment must be made to ensure adequate technical support after installation.

As knowledge will always be based on information, information workers will always be necessary. In order to free knowledge workers (such as staff officers) to become active learners in the knowledge environment, some information processors must

be returned to headquarters. Old ideas about what non-commissioned members or clerical staff can do need to be rejected. Such 'information processors' should be added to staffs to build the data bases, the information bases, and the knowledge bases that form the foundations of knowledge management systems.

Ensuring a Tangible Benefit

Despite the synergy provided by a complete system architecture, the expense and disruption of implementation would be huge. In addition, for a diverse institution like DND the greatest gains might be achieved in the lower systems, applied only to select functions where the need is greatest. The value of a complex executive information system is hard to demonstrate at this point, especially as it would produce inordinate demands on lower levels unless they had systems capable of supplying data and information in the required form. Accordingly, use of technical systems would be best limited to specific functions for which the technology has already developed a strong ability. Such areas are collaborative doctrine writing and compilation of lessons learned (knowledge-sharing systems), as well as operational research, requirements and programme management, intelligence, and logistical planning (decision support systems).

Maintaining Flexibility

Information technology is changing rapidly: what seemed inconceivable a few years ago soon becomes commonplace. This fact argues against attempting to maintain leading-edge systems. It also argues for an incremental approach. Making a small investment in a specific system which gives a clear benefit can be justified: when successive new applications are developed, and become reliably useful, the choice remains to buy them at that time. This approach is influenced by the Japanese attitude

towards acquiring information technology, which is much more selective than the prevalent American approach.[42]

Cooperation with Others

Canada is one of the most 'connected' countries on earth. These relationships with other countries, especially those of similar economies, culture and values, can provide priceless information on the subject of knowledge management if experiences are shared. Active collaboration with such countries in research and development will multiply DND's awareness of the utility of new technology and of necessary changes to process. Canada's participation in NATO's C3 Board Sub Committee, and partnership with Australia, New Zealand, the United Kingdom and the United States will continue to be valuable.[43]

Communication Links

It is worth stressing that the communication links between computers or people are a vital part of any knowledge management system, just as they are a core part of all information systems. If decisions are made to purchase sophisticated systems that facilitate the freer exchange of information and remote collaborative problem solving, then consideration will have to be given to provision of greatly improved communication links. This will increase the architecture costs, but will be vital to tap the potential of the knowledge-storing and knowledge-sharing system. For maximum interoperability, web-based communications-- using intranet, internet and extranet-- will outperform proprietary systems and greatly facilitate knowledge sharing.

Lessons for DND

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[42] Bensaou and Earl, 121.

Operational, or transaction processing systems, are already used extensively in DND. Many knowledge systems are also being used, primarily in Office Automation applications, and through intranet usage. There is potential for more benefit to be gained by development of expert systems in such areas as lessons learned work, mission planning and programme management tasks. Decision support systems also show promise for mission planning, logistic support planning, programme management and many other applications. It is in this area that the greatest potential for application to DND use lies. Executive Information Systems, on the other hand seem to have limited applicability at this time. While designed to synthesize a host of external and internal information sources to permit a strategic view of the organization's situation, they would require extensive computerization below the executive level to make this possible. At present the benefit gained would seem not to be worth the expense and disruption required.

CONCLUSION

This paper has shown the importance that knowledge holds in today's society. It has defined knowledge and knowledge management as the terms are currently being used in business circles to describe a sophisticated component of information management. A description of the three upper levels of information architecture followed, with frequent reference to the human behavioural equation- i.e. the organizational or management factors that must be considered along with the technology. This section also identified

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[43] Major Robert (Bob) Weisman, "Canadian Information Technology and C4I: The Integrated Information Environment and International Missions." NATO's Sixteen Nations No. 3/97, 86.

several military applications for systems, particularly at Levels Two and Three, knowledge systems and decision support systems respectively.

Several lessons gleaned from industry's experience in the acquisition of knowledge management systems were then presented. Briefly, these emphasized the need to proceed cautiously and pragmatically in this dynamic and expensive field. An organization such as DND can ill afford the cost and disruption of a wholesale conversion to new technology. Thus, the identification of which tasks would benefit most dramatically from knowledge management systems must be done. At the same time, the department (and especially the Canadian Forces) must clearly articulate how willing it is to adapt its culture to best exploit the technological capabilities. Any acquisition decisions should be made with the input of those groups in the organization who will be most affected. Thorough education and training (before and after installation) are essential.

To date the information revolution has predominantly affected low-end data and information-processing work. The net result for knowledge workers has been an increase, not a decrease in their workload, as their support staffs have largely been dismissed. Knowledge management systems can correct this mistake, if information processors are returned to the job, if knowledge workers are properly prepared for the new technology, and if the organization is willing to embrace the necessary managerial changes.

Knowledge management requires a clearer strategic focus than does a system that stays purely in the information realm. DND can benefit from knowledge management

technology and processes. They must be adopted deliberately for specific tasks, with the requisite cultural adjustments.

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