Towards a Strategy for Knowledge Management

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ABSTRACT *Knowledge management is emerging as a significant organizational and management challenge. The pressures of the emergence of the global knowledge economy, and recognition of knowledge as a key and intangible asset are making the effective management of knowledge a priority. This surge of interest has paid relatively little attention to the object of management—knowledge. Epistemologists and sociologists have produced a variety of definitions and classifications, but there is no consensus. However, with the growth in IT capability, a clear operational distinction can be drawn between information and knowledge. The former can be captured, stored and transmitted in digital form. The latter can only exist in an intelligent system. This distinction is used to develop models of the interaction between knowledge and information, and of the appropriate balance between the two in different situations. On the basis of this model, the challenges of 'knowledge management' are:*

- *Establishing and optimizing the information–knowledge balance appropriate to (or providing a competitive advantage) a company or industry;*
- *Implementing IT-based productivity improvements in information management;*
- *Implementing people—and socially-based mechanisms to enhance knowledge management;*
- *Explicitly addressing the knowledge–information interface and mechanisms for improving the processes of transition from information to knowledge, and from knowledge to information;*
- *Identifying and maintaining the core knowledge of an organization.*

Introduction

> As the twentieth century draws to its close, the world economy is being reshaped in as fundamental a manner as at any other time in human history. At the heart of these changes lie two related forces: the explosion and convergence of computing, communications and media technologies, and the deregulation of economic affairs.[1]

This new set of economic activities, industry structures and trading relations are now generally described as the global knowledge economy. The ability to identify, locate and deliver information and knowledge to a point of valuable application is transforming existing industries, and facilitating the emergence of entirely new industries.

This has seen an emerging trend towards the challenge, and in some cases displacement of capital and labour intensive firms by knowledge intensive firms, and routine work by knowledge work.[2] Knowledge work involves the creation of new understandings of nature, organizations or markets and their application by a firm in valued technologies, products or processes.[3]

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This recognition of knowledge as the key to competitive advantage is raising many challenges for the corporate world and its managers, accustomed to assembling tangible physical, financial and human resources, and competing on price, quality and customer service. How can and should such a slippery object as knowledge be managed? Are there ways to locate and measure knowledge? What can be done to enhance the use and development of knowledge? These and related questions are emerging in the management literature.[4]

A number of distinctive approaches have emerged. One focuses on intellectual capital and its measurement and management. This is based on the recognition that traditional accounting and performance measures fail to identify, let alone capture the intangible assets that increasingly define the market value of a company, particularly those that are intensively knowledge-based. Skandia[5] has led the way in developing models to assess their intangible assets in human capital, customer capital and structural capital. Sveiby[6] has developed 'the invisible balance sheet' to account for knowledge-based assets.

A second approach addresses directly the management of knowledge itself. Here researchers and organizations are concerned with optimizing the knowledge creation, capture and flow into, and within a company. For Wiig[7] knowledge management is a more detailed and 'everyday management' approach than intellectual capital management; it focuses on facilitating and managing knowledge-related activities, such as creation, capture, transformation and use of knowledge.

This approach has largely been driven by the management consultant fraternity, which have identified a large new market. In a 1997 survey 94% of respondents said, they believe they could leverage the knowledge in their organization more effectively through deliberate management.[8] This is being transferred into substantial business opportunities. US companies paid US$1.5 billion in 1996 for knowledge management and are estimated to spend $ 5 billion a year by 2001.[9]

The scale of this potential market, together with a perspective that the core element—knowledge—is digitizable, has also attracted major software companies such as Lotus, Canon, and Microsoft to offer knowledge management applications.[10] Information and communication technology packages such as intranets, groupware, list servers, knowledge repositories, database management and 'knowledge action networks' are now available and in intensive development.

A third approach, largely the domain of economists and their critics, addresses the knowledge economy. Their concern is with deciphering the rules and best-practice models that will determine effectiveness, even survival, in the knowledge economy, and to provide a reliable basis for national assessment, policy, and regulation. Global management organizations (e.g. UN, World Trade Organization, World Bank) are also engaged in assessing the influences that the development of explicit knowledge management tools and knowledge companies will have on the economies of the world.[11]

While projections, and business consultancy race on, it is worth noting that relatively little attention has been given, in the context of the emergence of the global knowledge economy and knowledge management, to the core commodity itself—knowledge. What are the special characteristics of knowledge that will influence its economic value?

> An isolated 'piece of knowledge', statement, or theory, is quite literally useless, indeed has no meaning, unless it is embedded in a supporting context of well developed theory, evidence, and argument. …
>
> … making use of any piece of knowledge requires a considerable investment in establishing the necessary interpretive context of theory, concepts, data and tacit experience. …[12]

Thus, a public good is not necessarily a free good.[13] The extent of the public or private nature of scientific knowledge is highly variable, and context-dependent, rather than an intrinsic property of the knowledge itself: 'Degrees of appropriability and of rivalry are the outcome of the strategic configurations of the relevant actors, of the investments that they have already made or are thinking of making'.[14]

However, managing knowledge effectively will require the development of a much better understanding of the peculiar characteristics of this commodity, the ways in which it becomes embodied in economic goods, and the conditions governing its effective trade, transfer and ownership.

This paper develops a line of analysis, and consequent models, to pursue this objective.

Classifications of Knowledge

Intellectual reflection on knowledge has been pursued for about as long as records of human activity are available. Historical analyses customarily begin with reference to Plato and Aristotle. One branch of philosophy—epistemology—is devoted to this subject.

Traditional epistemology identifies three distinct kinds of knowledge.[15]

- knowledge of things and objects;
- knowledge of how to do things; and
- knowledge of statements or propositions.

However, the emergence of the knowledge economy has seen a growing interest in operationalizing categories of knowledge. For management purposes the traditional categories of knowledge are both imprecise and difficult to operationalise. A number of new classifications have been proposed.

Lundvall[16] has identified four categories:

- Know-what—knowledge about facts that can be broken down into bits and easily codified;
- Know-why—knowledge about principles and laws;
- Know-how—skills, the capability to undertake a given task successfully; and
- Know-who—information about who knows what and who knows how to do what.

This represents a straightforward extension of the traditional categories. However, Lundvall also introduces a distinction between types of knowledge which are 'information-like', and more complex types of knowledge. He provides an illustration of know-what and know-why as information in books, lectures or databases. We disagree with this analysis. As we will develop in a subsequent section, such information is just that, and needs to be transformed by an 'intelligent system' to become knowledge.

Collins[17] had earlier developed another classification system of knowledge as part of his sociological analysis of artificial intelligence. In this he makes a clear distinction between codified and non-codified knowledge. The four categories proposed are:

- Symbolic-type knowledge—knowledge that can be transferred without loss in codified form, i.e. in books and on floppy disk;
- Embodied knowledge—knowledge held within the body of a human, for example how to play golf; the knowledge is internalized, but not easily communicated;
- Embrained knowledge—knowledge held within the physical matter of the brain; certain cognitive abilities are related to the physical structure of the brain;
- Encultured knowledge that is linked to social groups and society.

Millar *et al.*[18] build on Collins' categories which distinguish between 'knowledge of

information' and contextual knowledge, by making a linkage with Lundvall's approach. His five categories are:

- Catalogue knowledge—that is know-what;
- Explanatory knowledge—that is know-why;
- Process knowledge—that is know-how;
- Social knowledge—that is know-who;
- Experiential knowledge—this category presents the new concept of 'what was'.

For Millar, catalogue and explanatory knowledge are symbolic and more readily transferable compared with the contextually sensitive encultured knowledge categories—process, social and experiential knowledge.

Also based on Collins' analysis, but with a focus on organizational design and management, Blackler[19] has proposed five categories of knowledge:

- Embrained knowledge—abstract knowledge dependent on conceptual skills and cognitive skills; generally conflated with scientific knowledge and accorded superior status;
- Embodied knowledge—action-oriented and likely to be only partly explicit; transmission requires face to face contact, sentient and sensory information and physical cues; acquired by doing and context-dependent;
- Encultured knowledge—related to the process of achieving shared understanding; embedded in cultural systems, likely to depend strongly on language, and hence to be clearly socially constructed and open to negotiations;
- Embedded knowledge—knowledge that resides in systemic routines; relies on the interplay of relationships and material resources; may be embedded in technology, practices, or explicit routines and procedures;
- Encoded knowledge—knowledge recorded in signs and symbols, such as books, manuals, codes of practice, and electronic records; encoding requires the distillation of abstract codified knowledge from other richer forms of knowledge.

Finally, Fleck[20] has developed a categorization scheme that also attempts to encompass knowledge source and storage, as well as how it might be acquired and how the different knowledge components might be linked to each other:

- Formal knowledge—embodied in codified theories, formulae; usually encoded in written or diagrammatic form; acquired through formal learning;
- Instrumentalities—embodied in tool and instrument use; requires other components—informal, tacit and contingent for effective use; learnt through demonstration and practice;
- Informal knowledge – embodied in verbal interaction, rules of thumb, tricks of the trade; held in verbal and sometimes written form (manuals, guidebooks); learnt interaction within a specific milieu;
- Contingent knowledge—embodied in the specific context; distributed, apparently trivial information, specific to a particular context; sometimes available as data which can be looked up; acquired by on-the-spot learning;
- Tacit knowledge—embodied in people; rooted in practice and experience, transmitted by apprenticeship and training;
- Meta-knowledge—embodied in the organization; general cultural and philosophical assumptions; can be local or cosmopolitan; acquired through socialization.

Based on these various analytical schemes, a new framework for the categorization of knowledge has been developed. It is designed both to encompass all the above models,

and to identify the relative degree of difficulty in transferring the categories of knowledge (Table 1). The difficulty in transferring knowledge is reflected in the order from left to right. Transfer of the left column category of codified knowledge is relatively easy; transfer of common, social and embodied knowledge is progressively more difficult.

The knowledge categories used in this framework are:

- codified knowledge, in our model essentially equivalent to information—knowledge that has been made explicit by a human; the method of making it explicit may involve writing it down or using other means of capturing, or may be in the form of a demonstration; it is in a readily transferable form.
- common knowledge—knowledge that is accepted as standard without having been made formally explicit, often in the form of routines or practices; commonly learned through working in a particular context.
- social knowledge—knowledge about interpersonal relationships and cultural issues; includes the knowledge of 'who can help me in this situation' to cultural issues in different roles.
- embodied knowledge—the experience, background and skill a person has accumulated during their lifetime; for this reason it is strongly connected to the person themselves. It relies on pattern and links a person can make to a given set of information to build and create appropriate knowledge to solve a problem.

This classification, in particular the distinction between codified knowledge, recognized now as equivalent to the common term, information, and other 'real' forms of knowledge, will be used to develop a reliable and coherent basis for effective knowledge management strategies and practices.

Information vs. Knowledge

Consideration of the distinction between knowledge and information[21] has not been a major issue within epistemology, still less in knowledge management. Experienced commentators like Peter Drucker have avoided providing precise definitions of knowledge. The most common practice is to use the terms interchangeably [22] or with a very similar meaning.[23]

In contrast, a common-sense hierarchy, distinguishing between data, information, knowledge and wisdom shapes much thinking, and debate. In this hierarchy data are unstructured 'facts' without meaning, information is 'data endowed with relevance and purpose',[24] knowledge embodies cognition, insight, erudition and scholarship and wisdom is a consequence of the fusing of knowledge with values and experience.[25]

Davenport *et al.*[26] propose a similar hierarchy: data are defined as simple observations, information as data endowed with relevance and purpose, and knowledge as valuable information from the human mind that includes reflection, synthesis and context. Many authors make a similar distinction, if only implicitly: 'knowledge enables people to act and to deal intelligently with all available information sources'[27] and 'knowledge is more than information … it is applied information'[28] show the intention of distinguishing between knowledge and information.

However, the emergence of the capability to digitally store, locate and transmit information, raises this issue to centre stage. Electronic connectivity provides the capability for purposeful, value-adding management of what is transmitted. If infor-

Table 1. Framework for categories of knowledge

Codified knowledge Effectively information of all kinds—facts and figures	**Common knowledge** Knowledge that is accepted as standard without being made formally codified	**Social knowledge** Knowledge of social links and shared values	**Embodied knowledge** Knowledge that is rooted in experience, background and skill of a person. It is strongly related to the person that holds it
Knowledge of things and objects **Knowledge of statements and propositions** *Musgrave* **Know what** **Know why** *Lundvall* **Explanatory knowledge** Know why Knowledge of information. *Millar* **Catalogue knowledge** know what Knowledge of information. *Millar* **Symbolic knowledge** information. *Collins* **Encoded knowledge** information conveyed by signs and symbols Books, manuals … *Blackler* **Formal knowledge** **Contingent knowledge** *Fleck* **Explicit knowledge** *Polanyi*	**Embedded knowledge** Knowledge that resides in systemic routines *Blackler* **Embrained knowledge** Knowledge that is dependent on conceptual skills and cognitive abilities Knowledge that or knowing about *Blackler* **Experiential knowledge** what was Context dependent knowledge *Millar* **Informal knowledge** **Meta knowledge** *Fleck*	**Know who** *Lundvall* **Social knowledge** know who Context dependent knowledge. *Millar* **Encultured knowledge** Other word social knowledge that reflects certain common experiences. *Collins* **Encultured knowledge** Share understanding of social links *Blackler*	**Embodied knowledge** Knowledge of playing Golf (feeling that it is right) *Collins* **Embodied knowledge** Depends on combining sentient or sensory info and physical cues Knowledge how or knowledge by acquaintaince (craft skills) only partly explicit *Blackler* **Tacit knowledge** **Instrumentalities** *Fleck* **Tacit knowledge** *Polanyi* **Know how** *Lundvall*
	Knowledge of how to do things *Musgrave* **Process knowledge** know how Context dependent knowledge. *Millar*		These concepts might contribute to either process knowledge or embodied knowledge depending on their content

mation can now be managed, there is an imperative that it should be managed, and that its management should assume a high priority.

Moreover, the fact that there is now a mechanism whereby information can be managed (the means are available to achieve substantial increases in productivity) implies, in the corporate world, that it should be pursued with great vigour. Under these circumstances, the question of whether, for management purposes, information can be assumed to be equivalent to, or at least possessing all the value when compared to, knowledge, may be seen as a matter of academic concern.

We challenge this assumption and pressure. The power of connectivity means may be as a mirage, unless they are connected with knowledge and outcome ends. In determining this, the central question would appear to be whether information is, or can be treated as equivalent to, knowledge. Is knowledge management nothing more than information management?

While the common practice has been to use the terms 'knowledge' and 'information' interchangeably, a number of commentators have emphasized the distinction. Thus, Marshall[29] and Courtney[30] have described knowledge as inside the mind and information outside the human mind. Courtney writes, 'information becomes knowledge when introduced into one's mental model. When transferred to another, this knowledge reverts to information, and so on. In other words knowledge is a personal thing.'

This insight offers the potential of a significant advance in the understanding of the links between information and knowledge in an organizational setting. If knowledge has to be translated back into information to be transferred between two intelligent systems, to be then absorbed and translated back into knowledge, information management plays a role in the dissemination of information but is not a distributor of knowledge.

A similar conclusion is reached by Davenport:[31]

> The need for a combination of technical and human elements is something information management systems projects, in particular, have in common with knowledge projects. But, in knowledge management initiatives, we observed that the complexity of human factors to be managed was much greater than for most data or information management projects. Unlike data, knowledge is created invisibly in the human brain, and only the right organizational climate can persuade people to create, reveal, share and use knowledge. Data and information are constantly transferred electronically but knowledge travels most felicitously through a human network.

The implication of this assumption is that knowledge can only exist within intelligent systems. This is at the moment only represented by the human mind, but might also be possible in some years in computers with artificial intelligence.[32] However, for the moment we are stuck with the individual human brain as the only medium that can hold and create knowledge in a variety of situations.

On this basis it would seem appropriate to challenge the labelling of simple information management systems as knowledge management systems. Claims that an Intranet, which was designed to disseminate information, has becomes the number one factor in employees sharing knowledge,[33] should be suitably discounted. Information management systems may assist intelligent systems to create new knowledge, but they cannot disseminate knowledge itself.

We will proceed to use this distinction between information and knowledge to develop frameworks that explain the relationships between knowledge and information in an organizational context. These frameworks should in turn enable the identification of how far information management systems can help as a tool in the task of managing

knowledge and where other methods have to be developed to enable operative knowledge management.

The Knowledge–InformationModels

The previous sections address aspects of the difference between information and knowledge, as well as the different kinds of knowledge that are encountered in an organization. This section will develop a model to account for the interplay of knowledge and information in pursuing organizational objectives.

As indicated earlier, information cannot be a direct substitute for knowledge. Indeed, we will argue that misconceived efforts that have the effect of displacing knowledge management by information management are likely to be at best unsuccessful, and at worst, disastrous. The transmission (or diffusion, or sharing) of knowledge requires that it be translated into information and transferred. Successful transfer will usually lead to a re-translation into knowledge.

Of course, not all knowledge can be translated into information at any given time; the translation will depend on processes of codification of common, social and embodied knowledge—an element of the knowledge cycle that the sociology of scientific knowledge appears to have ignored. Furthermore, to be translated back into knowledge, the information has to 'make sense' in the context of the user. This context is constructed from experience, culture, social links and education.[34] It functions as a filter and enables the owner to create links between different sets of information.

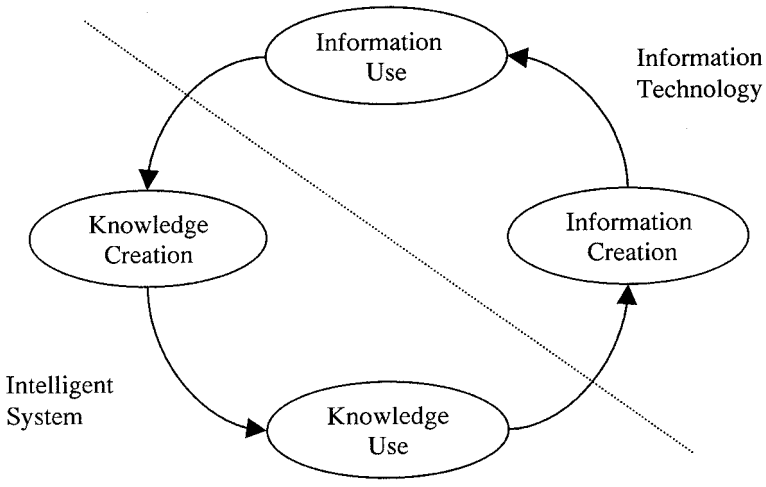

Figure 1. Knowledge–information cycle.

The Knowledge–Information Cycle developed here is designed to reflect the relationship between knowledge and information. On the knowledge side of the cycle there are the two basic steps of knowledge creation and knowledge use. Knowledge creation, it is argued, occurs in a wide range of processes, but they all involve the interplay of information with an intelligent system. This knowledge is 'held' within the mind until an encounter with a situation or other knowledge arises that draws on the explanatory power of the accumulated knowledge. The process of knowledge use can, on special occasions, lead only to knowledge creation. Far more commonly, the process of application to the real world requires that it be translated into some form of information.

This might be visual, a written report or oral communication. The new information that has been created can then be stored in some codified form, and/or directly used in addressing an issue, or communicating.

This cycle can be used to identify appropriate contexts and possible support systems, for the creation and use of knowledge and information. On the knowledge side of the cycle creation and use requires an intelligent system. The information side of the cycle offers the possibility of using information management systems or information technology to support the process and further steps like, information capture, storage, and distribution.

Figure 2 has been developed to provide a schematic representation of an organization's knowledge and information assets. They are represented by a rectangle shaped area. The knowledge–information boundary runs from the upper left-hand to the lower right corner to the right side of this knowledge–information cycle, the same as in the knowledge-information cycle.

Clearly any organization will possess both knowledge and information assets, but the mixture may vary according to the extent to which activities are largely routine, and hence based on established procedures and information, or highly innovative and novel, which will require the support of a strong knowledge capability.

This line of analysis can also be applied to tasks within an organization.

There are, however, two extra features of this model.

The arrows that run in counter direction on top and bottom of the model signify the combination of information and knowledge that is necessary to perform a task. A relatively novel task for which there is only limited information on which to build needs a rich base of knowledge to be performed effectively (far left-hand side of the model). This scenario is common during new development phases. In contrast, a task with a rich information base may require only a low knowledge content (far right-hand side of the model). This is common in standardized work or processes.

However, information content can never substitute totally for all knowledge necessary, because knowledge is essential to connect and put information into action.[35 36] This area has been called 'core knowledge' remnant knowledge in this model. This is illustrated in the following example.

Imagine you were taking your first trip to Singapore. Information of forecast minimum and maximum temperature (28–35°C) provide only a very limited guide to what clothes to pack, and what to expect. A much more detailed information base is

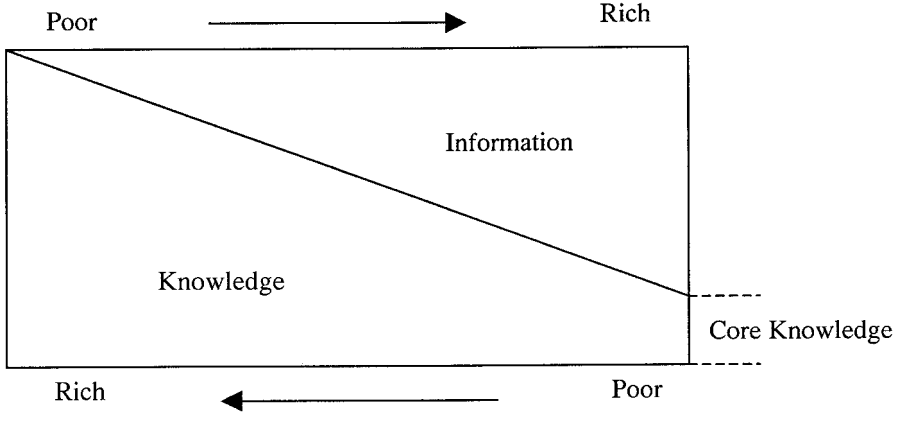

Figure 2. Knowledge–information balance.

required, as in a travel guide. Alternatively, the experienced traveler, with a well-developed knowledge base, requires only the most cursory of information to be well prepared.

The framework of knowledge classification developed earlier, helps to understand the concept of core knowledge better. In the framework four classifications are explained. The three classifications on the right-hand side of the model, Common Knowledge, Social Knowledge and Embodied Knowledge are involved in building the core knowledge of a person. Each of these classifications has a part that can not be translated into or expressed as information. The sum of these parts is the core knowledge of the person. A person with a lot of social contacts, experience, and skills has a larger core knowledge than someone without them.

This concept of core knowledge can be applied also to organizations. The two extremes of the knowledge–information relationship continuum can be represented by mature, manufacturing industry, on the one hand, and service industry, on the other.

The first scenario represents a knowledge–information balance for a manufacturing company (Figure 3a). The necessary core knowledge is small because processes are mainly standardized and tasks are repetitive, as is typical of process line work. The workers get all their instructions (information) prepared by engineers and need only a minimal level of basic knowledge to understand them. This approach is strongly reflected in the standardized procedures of ISO 9000 and Total Quality Management.

Indeed, it would be possible to characteristics the whole TQM movement in terms of transition from specialized knowledge, held by a few, through codification and capture in the form of information, accessible to many.

The second scenario represents a knowledge–information balance for a service company (Figure 3b). In the service industry or function many tasks are based heavily on customer involvement and substantial flexibility is required to meet the varying customer needs and to creative and design new service products. The critical importance of knowledge capability, as an intangible asset, is dramatically illustrated by Sveiby's case study of the advertising company Saatchi and Saatchi. The core knowledge, in our model constitutes the major component of these intangible assets.

These two scenarios illustrate how the model can be applied in an organizational framework to identify, at a fairly general level, the appropriate combination of knowledge and information. The model offers the possibility of assessing the ratio between knowledge and information for different areas in the organization as well as for the whole organization.

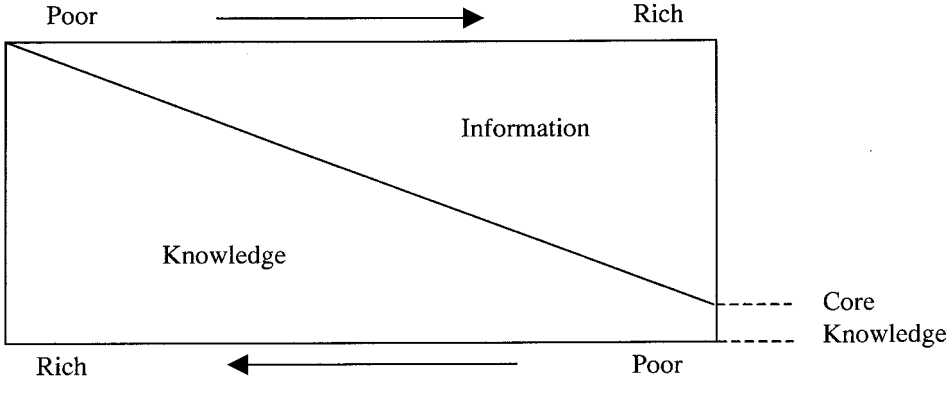

Figure 3a. Knowledge–information balance for a manufacturing company.

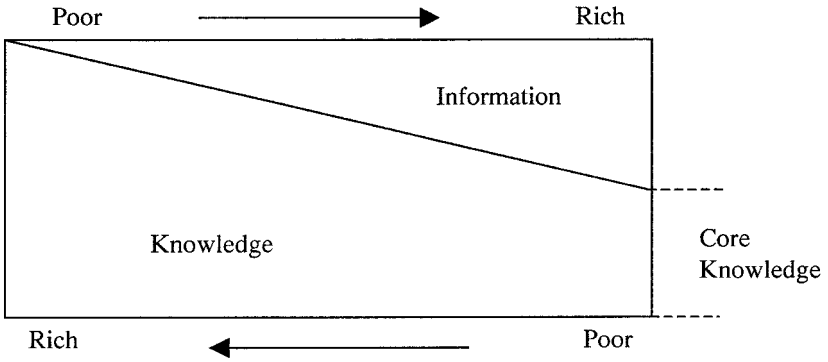

Figure 3b. Knowledge–information balance for a service company.

Several conclusions can be drawn:

- Even if much information is created and distributed in the organization, a determining factor is the scale, appropriateness and availability of the core knowledge base. It cannot be replaced with information alone.
- The core knowledge bases for different areas in the organization have to be identified to enable a targeted use of resources. Too much information for employees with a lot of knowledge might be a waste of resources; not enough information for employees with a small knowledge base might pose a threat to the success of the organization.
- During the creation of information in the organization the core knowledge to use this information should be identified. This will enable a targeted distribution of this information to users that have the adequate core knowledge base to create new knowledge from this information.

The knowledge–information cycle and the knowledge–information balance with the knowledge information balance (Figure 4).

During the creation process of new information the information base is being enriched. This enrichment moves the knowledge–information boundary on the right-hand side down, towards the lower right-hand corner of the rectangle. The movement

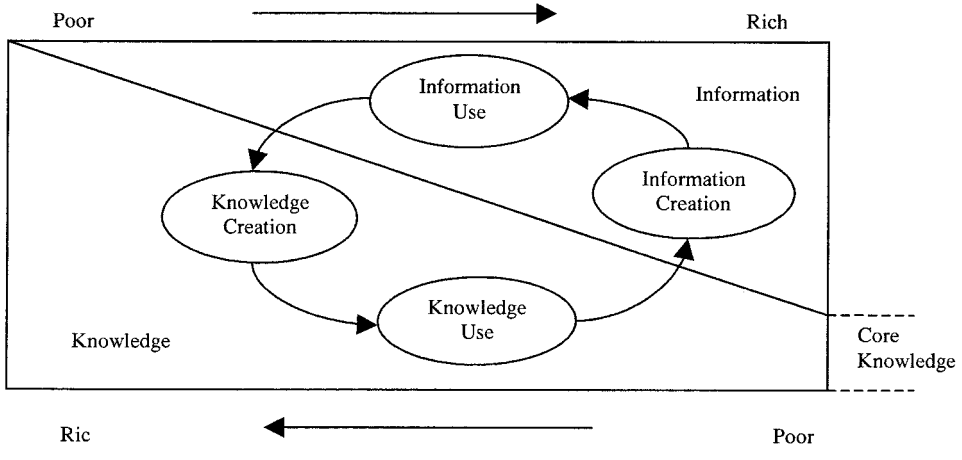

Figure 4. Knowledge–information management model.

of the boundary is effective as long as new information is being added or until the boundary reaches the core knowledge area. After that, more information does not lower the core knowledge base but is only excess information that increases cost. However, the life of information in the world today is growing ever shorter, as committed knowledge and information generation makes previous information obsolete. This reduces the amount of information in the information base and the knowledge–information boundary starts to move again. This time the right-hand side of the boundary moves up towards the upper right corner of the rectangle. It moves away from the core knowledge area. This results in an increase of the necessary knowledge base to perform. The need for higher qualified and experienced employees is the consequence.

The process of creating information and building the information base of an organization is therefore only one task. It is also important to identify and characterise the core knowledge base, and to be adopting and updating this base.

On the basis of this model, the challenges of 'knowledge management' are:

- Establishing and optimizing the information–knowledge balance appropriate to (or providing a competitive advantage) a company or industry;
- Implementing IT-based productivity improvements in information management;
- Implementing people—and socially-based mechanisms to enhance knowledge management;
- Explicitly addressing the knowledge–information interface and mechanisms for improving the processes of transition from information to knowledge, and from knowledge to information;
- Identifying and maintaining the core knowledge of an organization.

Conclusion

(1) Knowledge and information are different. Knowledge requires the context of an intelligent medium. Knowledge results from combining information in order to form a mental picture and to act on the basis of this picture. In these circumstances, knowledge is used as a tool during the thought process. Information is created when knowledge is expressed and represents the outcome of a knowledge process. It supports knowledge but can not substitute for it. Consequently, even the best information management systems are not able to manage knowledge

(2) A boundary between knowledge and information can be clearly established. This, at least in operational terms, as knowledge exists only within an intelligent system; information can be captured, and transmitted, in digital form. This boundary is obvious in every communication that an intelligent system is involved in (visual, written or spoken) because what is communicated is not knowledge but the result of a knowledge process and can never contain all the parts that have been involved in the process of reaching this result.

(3) Knowledge cannot be managed with the same tools as information. Software- and electronic network-based information management systems have no capability to manage knowledge. Attempts to capture or store knowledge on a medium without intelligence requires the knowledge to be transformed to information, whereby the essential knowledge ingredients are lost. Other non-digital methods of capture and storage are required to manage knowledge. To manage knowledge, tools have to be developed that address the

special features of knowledge. These include the complexity of knowledge structure. The knowledge classification framework developed in this paper provides the basis for identifying the different aspects of each kind of knowledge as they occur in an organization and for effective design and management of the knowledge structure.

(4) The interaction of knowledge and information can be described in a model. To use information a certain standard of knowledge is necessary because information can not substitute knowledge. This is labelled core knowledge. Each unit or batch of information needs an appropriate level of knowledge to be understood, and acted upon.

(5) The management of information is already well developed; the management of knowledge is still in its infancy. Information management systems are widespread and becoming more sophisticated every day. Technology-based, their introduction presents challenges akin to that of any other management system. Knowledge, because of its complexity and its union with intelligent systems, poses a greater challenge.

The models presented and the conclusions reached in this paper are only a first step in the direction of understanding the challenge of the management of knowledge. They are intended as frameworks to further understanding and as possible tools to identify the area where the greatest impact on the knowledge management of an organization can be made.

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