13 Measurement in the intelligent organization

13.1 The value of knowledge

It is intuitively clear that knowledge is one of the key generators of value in any business organization. However, when we try to put a number for this value, it is difficult. How could anyone have calculated the net present value of a steam engine two hundred years ago? What could be the worth of the innovation and insight that led to the development of the first transistor? What is the value of a new revolutionary computer algorithm that will be history tomorrow when an even better one emerges?

Knowledge, as such, has no intrinsic value, and only in relatively exceptional cases we can fix a price tag on a specific piece of articulated knowledge. The value of knowledge depends on a complex social system of activity that creates value using knowledge, and often knowledge transforms into value only at a later time and only for agents that have complementary resources available. We have know for almost a century how to make computer memory from magnetic materials; this knowledge just has not been worth much before there were computers.

The value of knowledge depends on the accidents of history and therefore it is impossible to accurately predict its worth. Examples of this phenomenon include the QWERTY keyboard design of typewriters (David, 1985) and the MS-DOS operating system (Arthur, 1989; 1996; 1990). Technological innovation creates competing designs for new products, and dominant designs emerge through increasing returns, network externalities, and complementary product designs that boost each others' sales (Utterback & Abernathy, 1976; Romer, 1998a; 1998b; Utterback, 1994). At best, it seems that we can heuristically estimate the worth of investments in knowledge as options that may enable future earnings opportunities.

The value of knowledge is difficult to estimate because of a fundamental problem: knowledge simultaneously underlies the social division of labor, enables effective action, and is the basis from which value is perceived. When new knowledge is created, it makes new ways of working possible. Social activity can be coordinated in a new way, and work can be made more efficient using the created knowledge, either directly, by knowing how to do things better or by

using it as an intermediate product; or indirectly, by embedding created knowledge into more efficient tools. Knowledge, however, can also change the perceived value of products generated. Generation of knowledge changes the value system, and therefore it is difficult to forecast the value of new knowledge. Moreover, the value system changes almost by definition when the product created in the work process is itself knowledge. This system of interactions is depicted in Figure 42.

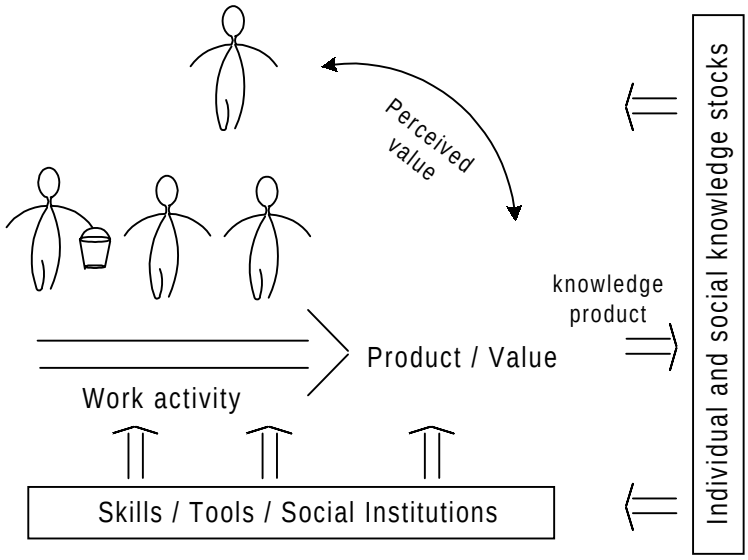

Figure 42. Components of the value creation system.

However, even if the value of knowledge is something we can not know in general or absolute terms, we still need to be able to measure organizations in the knowledge dimension. If knowledge is the key to effective action in intelligent organizations, we need to be able to tell how the organizational knowledge system works, where its bottle-necks are, and how the system could be improved. We also need to be able to show that our knowledge management efforts generate more benefits than costs.

The problem of valuing knowledge in an organization is not about finding an absolute value, but in finding the contribution that

knowledge can provide in the context of a specific business strategy. Valuation of organizational knowledge is not about finding some absolute cash value or replacement cost, but of understanding the potential contribution within a given organization. Therefore, valuing knowledge in a business organization is tightly bound to the specific strategic goals and needs of the company. Although sometimes knowledge can be sold as licenses, goodwill, or as a product, majority of the knowledge capital in an organization does not have external market price. For example, knowledge embedded in business processes, corporate culture, best practices, core competencies, skills, or strategic visions are critical parts of the total stocks of knowledge in an organization, even when they can not be traded in the market. Even in those cases where articulated knowledge has a market price—for example, when a specific product design can be sold to an outside company—this price rarely reflects the value of the same knowledge can create within the focal company.

The value of knowledge is time-dependent, and new knowledge often generates benefits to the society as a whole. If the creator of knowledge has a good change of appropriating value created as a result of generating new knowledge, there exist clear incentives to take risks and invest in knowledge creation (Von Hippel, 1982; Teece, 1986). Sometimes the private and public benefits of knowledge are difficult to optimize simultaneously, as, for example, wide shearing of new ideas may limit the possibilities of the inventor to appropriate the value of invention. In such cases, society may set up institutions that both guarantee that there remains incentives to create new knowledge, and to promote the sharing of new knowledge so that their social benefits can be realized. Academic institutions of publishing new scientific findings and intellectual property rights are prime examples of such social institutions.

When a business organization invests in the creation of new knowledge, the appropriability, however, remains a problem. The results of R&D investments usually leak from the investing company in a few years, making it difficult to appropriate the “full” value of the investment (Griliches, 1995:78; Mansfield, 1985). Earnings capacity erodes over time as better products and processes become available, and when competitors learn to imitate and bypass protected knowledge. Therefore, quick appropriation of knowledge may be necessary to generate any value.

Sometimes the appropriability of knowledge may also result from foreknowledge. Discovery (recognition that something exists which

will not automatically be revealed by events) and foreknowledge (advance knowledge that something will happen) both lead to social and private benefits. As new knowledge may be used for various purposes in the society, the social rate of return may exceed the private rate of return. However, foreknowledge may enable one individual to gain at the expense of others, therefore creating private rates of return that often exceed the social rate of return. Specifically this is so for the inventor, who has foreknowledge of the potential uses and value of the invention. The inventor therefore can appropriate part of the value of the discovery using his or her foreknowledge (Geroski, 1995:93).

Based on the discussion above, we might therefore say that knowledge has no intrinsic value. This is simply because knowledge itself defines the values in any society and system of activity. Only after we have fixed some institutional stocks of knowledge we can talk about the incremental value that can be produced by some new knowledge. To the extent that this new knowledge does not considerably change the underlying institutions that provide the foundation for the value system, it may be possible to estimate the worth of knowledge. However, in general this is not possible. Therefore also the attempt to find a universally valid definition for the value of knowledge is futile. This is a rather radical conclusion as it means, for example, that the economic concept of utility is unfounded in theoretical terms. In the Bergsonian perspective on cognition we could say that life is in some fundamental sense creative, and there are no theoretical guarantees that the value system remains within any given constraints. Sometimes small perturbations may lead to small effects, sometimes not.

In the economic theory, Schumpeter argued that innovation and entrepreneurship that underlie the capitalist system "incessantly revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one. This process of Creative Destruction is the essential fact about capitalism" (quoted in Elliot, 1980). Similarly, Marx emphasized that capitalism is a dynamic process that repeatedly revolutionizes the systems and relations of production and society. Whereas Schumpeter saw the innovator as the primus motor in this change, to Marx and Engels the bourgeoisie, as a social class, was the source of this constant revolution in the capitalist system. The bourgeoisie:

> …cannot exist without constantly revolutionizing the instrument of production, and thereby the relations of production, and with them the whole relations of society. The need of a constantly expanding

> market for its product chases the bourgeoisie over the whole surface of the globe. The bourgeoisie, by the rapid improvement of all instruments of production, by the immensely facilitated means of communication, draws all nations, even the most barbarian, into civilization. (quoted in Elliot, 1980)

New innovations destroy the value of old knowledge and change the social institutions that define values within social systems. This is also true for the economic value of new knowledge. In practice this means that the value of knowledge should be seen as a potential within a given situation and a system of social activity. When the situation changes the value may change as well. The realization of that potential depends on our own actions. Moreover, there are risks and unpredictability inherent in the utility of knowledge, and many—if not most—benefits of new knowledge may be unintended. Although we may predict that there is high potential value in some knowledge, there is no guarantee of that value or our ability to realize it, nor a single social system of activity that could put an objectively valid price-tag on it. Instead, we can believe that there exists an opportunity, estimate its value based on some articulated and many unarticulated assumptions, and trust that we can realize it with a reasonable risk.

It therefore seems that valuation of knowledge capital is in important ways a different task, and more difficult, than valuation of traditional marketable assets. This, however, does not mean that measurement of knowledge would be impossible or unimportant. Indeed, there are several alternative reasons and ways to measure knowledge.

13.2 Intangible assets and knowledge capital

During the 1990's, organization strategy has been focusing on organizational capabilities and competencies that underlie competitive advantage (Barney, 1997aTeece, Pisano, & Shuen, 1997; Tuomi, 1998b). One key enabler for organizational competencies is the aggregate of competencies of its employees. Therefore the measurement of skills in the organization has been viewed as a critical aspect of the measurement system of a knowledge-based organization. If we have highly skilled employees, and their skills are in areas that support the business strategy, the organization has a good basis for success. If there are gaps in skills, either development of skills is needed or we need to recruit people with the right skills.

Measurement of human capital in organizations is closely related to earlier attempts to measure human capital on the macro-economic level. Since 1950's there have been several attempts to measure individual skills and knowledge, and the return of investments in education and training (Kiker, 1966; Miller, 1996; Nordhaug, 1994). A recent OECD study on measurement of human capital defines it "as the knowledge that individuals acquire during their life and use to produce goods, services or ideas in market or non-market circumstances." (Miller, 1996:22) According to the study, there have been three common approaches to measure human capital. One method is to look at the cost of acquisition of certified knowledge, e.g., the cost of schooling and training. The second method is to test people for their competencies. The third approach has tried to estimate productivity increases based on achievement indicators, such as a person's income level, job security, occupational status, and past references. According to the OECD study, all these have had problems, and currently there do not exist effective systems that would provide accurate information for individuals, firms, and governments when they make investment decisions concerning knowledge and learning.

James Quinn has argued that there is little question that the intangibles of databases, know-how, technological understanding, communications networks, market knowledge, brand acceptance, distribution capabilities, organizational flexibility, and effective motivation are the true assets of most companies today and the primary sources of their future income streams. Yet, the asset value of these

intellectual and service infrastructures is nowhere to be seen on a corporation's balance sheets. Quinn goes on to say:

> …the value services contribute is often disguised (or treated only as an expense) by accounting conventions that allocate all benefits to product outputs. Increasingly, these accounting and economic measurement conventions are leading to poor managerial practices and to misguided national policies…These conventions, designed in the past, assume that capital—not talent or intellect—is the resource in short supply. (Quinn, 1992:243)

Although it is quite clear that the current accounting conventions do not create information that would be needed to make effective investments in intangibles, some recent literature on intellectual and knowledge capital has argued that markets do, in fact, estimate the value of organization's intangible assets (e.g., Edvinsson & Malone, 1997; Sveiby, 1997; Strassmann, 1998; Stewart, 1997). One source of this idea is James Tobin's observation that the market value of firms rarely reflect the value of their fixed and financial assets. Tobin's Q, the ratio between the market value of a company and the replacement value of its fixed assets, is a measure of this difference (Tobin, 1978). Some examples of market versus book values are shown in Figure 43.[72]

[72] The data in the figure comes from http://biz.yahoo.com/research/indgrp/.

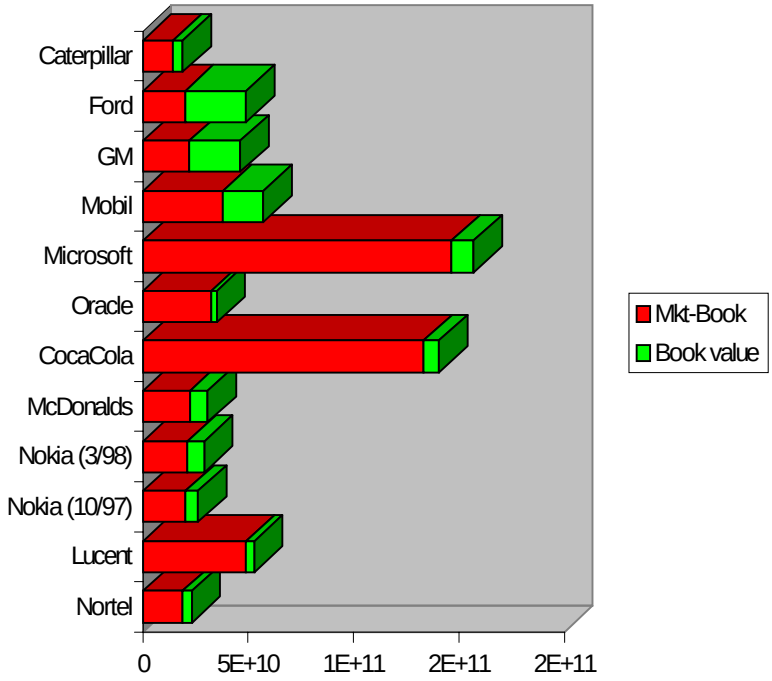

Figure 43. Market and book values of some companies.

In the discussions on intellectual capital, Tobin's idea has been developed further. If the stock market values a company right, the difference between market value and book value could be taken as a simplified measure of the value of its intangible assets. As a first approximation, we could then argue that this difference is exactly what we mean by intellectual capital. This approach has been used, for example, in Skandia (Edvinsson & Malone, 1997:52). Paul Strassmann (1998) applies a similar idea in his definition of knowledge capital. In this view, knowledge capital or intellectual capital is the source of economic value added by the organization, over and above the return on its financial assets. The obvious counter argument, however, to such market based corporate level valuations of knowledge capital is that it assumes that markets really can and do value the intangible assets of a company. If the problem in the first place was that companies should start measuring their knowledge capital as this major asset is not

known well enough within the company, it is, however, unclear that it is better known and more accurately valued outside the company.

Human capital has been viewed as one of the main forms of knowledge capital. More broadly, knowledge capital is usually understood to comprise different complementing types of accumulated intangible capital (c.f. Lynn, 1998; Amidon & Skyrme, 1997). Sveiby (1997:10) uses the terms internal structure, external structure, and employee competence. Brooking (1996) uses the concept of intellectual capital, and decompose it into market assets, human-centered assets, intellectual property assets, and infrastructure assets. Edvinsson and Malone (1997) also use the concept of intellectual capital and compose it into human capital and structural capital. Hubert Saint-Onge (c.f. Edvinsson & Malone, 1997:36) refines the intellectual capital model, and distinguishes two types of structural capital, separating customer capital from organizational capital. Roos and Roos (1997) further explicate the intellectual capital model, dividing organizational capital into process capital and renewal capital.

There is considerable overlap in these conceptualizations, and some opportunities for confusion as well. There is broad consensus, however, that knowledge capital can be depicted as three overlapping circles, one representing human capital, another organizational capital and the third customer or relational capital (c.f. Lynn, 1998:16). Combining this visualization with Sveiby's typology of knowledge assets we get Figure 44. In this figure, internal structure denotes those intangible assets or accumulated capital that can be understood to reside at the organizational level. Examples of such assets may include processes, ways of working, best-practices, organizational culture, organizational structure, and information systems. Competence, in contrast, denotes human capital in its traditional form, including know-how, capabilities, skills and expertise. The third form of knowledge capital is that of external structure. Various authors emphasize different aspects of this external structure, focusing, for example, on customer capital that includes customer satisfaction, loyalty, level of backorders, and brands.

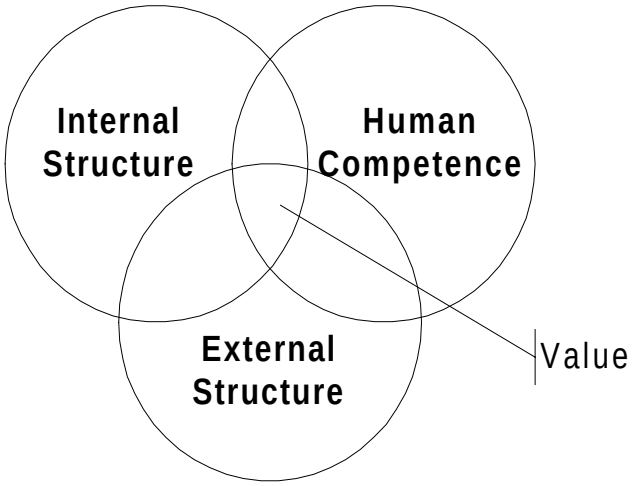

Figure 44. Three components of knowledge capital.

Value is created only when the different forms of intangible assets complement each other. For example, skills, know-how and capability often exist only in relation to organization's internal structure. Human knowledge can create value only if it is complemented with systems of activity where this knowledge can be transformed into intelligent action. Some forms of human competence are idiosyncratic to the specific organization, whereas other forms may be usable in other organizations, or even in the society outside organizations. In many cases we are specifically interested in highly idiosyncratic forms of employee knowledge, as those forms of knowledge that require a tight match between idiosyncratic internal structure and organization specific competencies are usually the most difficult to imitate by competitors.

The external structure could probably be best conceptualized as those structures that enable the organization to produce value, but which are not "internal" to the organization or which are not reducible to the competencies of its employees. Examples of external structure would therefore include external logistics, customer relations, reputation, alliance networks, inter-organizational sense-making networks, negotiation power, and other forms of capital that have been

accumulated through the history of the organization. Although most authors on knowledge capital do not address institutional systems that underlie profit making—such as legal institutions that enable contractual relations or educational systems that provide basic skills—these social and institutional forms of capital may in some cases be highly relevant forms of external capital. In contrast to most categorizations of intellectual capital, it would also appear logical to include patents, copyrights and trademarks into external structure. These are used to limit competition and negotiate licensing agreements within the network of inter-organizational actors. Internal capital should, however, include product and process designs and trade secrets that are used in value generation. Sometimes trade secrets, for example, are treated in the literature as "intellectual property" along with trademarks, and both are included as forms of organizational capital (e.g., Lynn, 1998:14).

Developing the Skandia intellectual capital valuation scheme, we can represent knowledge capital as shown in Figure 45. In this decomposition the main distinction is between accumulated employee competence and organization level accumulated intangible capital. Competence is enabled by skill, but mobilized through attitude. One component of human capital is also intellectual agility, which refers to the flexibility of using knowledge in different contexts (Roos, Roos, Dragonetti, & Edvinsson, 1997). Some skills, for example, may be highly flexible and easily transferable, whereas some may be highly idiosyncratic and lose their value when the situation changes. Structural capital, in turn, is composed of capital accumulated in internal and external structure, and also of renewal capability that underlies flexibility and learning of the organization.

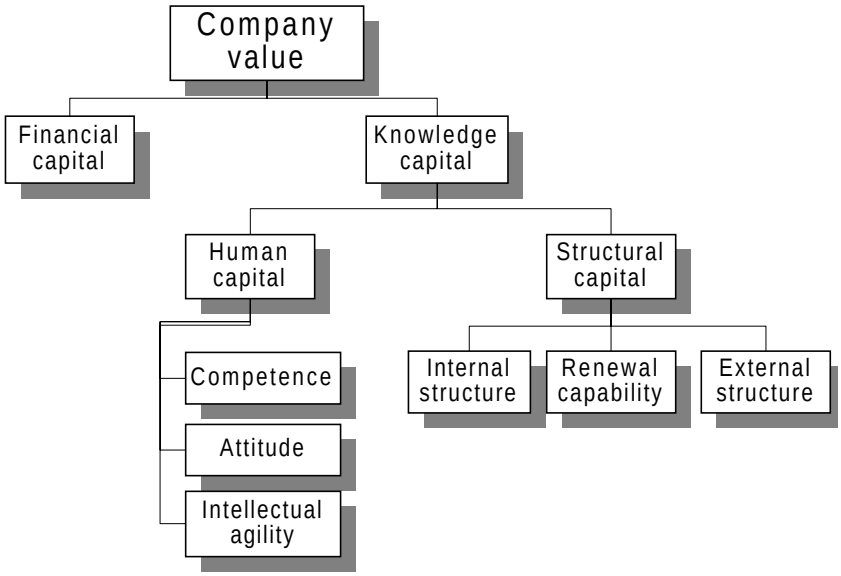

Figure 45. The components of knowledge capital.

13.3 Measuring knowledge

When we try to measure organizational knowledge, it is not sufficient that we understand the nature of knowledge, in abstract terms. In addition to the object of the measurement we have to consider the subject, as well. An intelligent measurement system is related to the needs of the measurer.

There are several starting points for developing a measurement system. Some visible knowledge management initiatives have focused on improving financial accounting conventions so that investors, customers, and other stakeholders could better value knowledge and competencies in the company. In other cases, companies want to benchmark their knowledge processes, understand the impact of their knowledge management initiatives, develop core competencies, or estimate the value of accumulated intellectual property.

In general, when creating a practical system for knowledge measurement within an organization, one has to start with the strategic vision of the organization. Only if we know what is the purpose of the organization and organizational development, we can device a set of measures that tell us whether we are moving in the right direction. In addition, the measurement system needs to include diagnostic, process maturity, and result measures. Further, knowledge management initiatives need to be connected to existing organizational practice, and therefore also the measurement system needs to be connected with existing measurement approaches and practices. In addition, the various motives for measuring knowledge have to be integrated within a common framework that binds the different actors together on a conceptually robust foundation that can adapt to the changing business environment, tools, and practices. Utilizing such measurement systems within and across communities of practice, we can also get meaningful measures that are directly related to specific practices and the actual work done within the organization.

Table 14 summarizes some of the motives to measure knowledge in organizations. The best practices mentioned in the table are discussed in detail in (EIRMA, 1999).

Stakeholder	Why	Best practices
Stockholders (current and future)	Helps underpin expectations Return on their investment Transparency Understand market value vs. asset value	Tobin's Q Strassmann Skandia Navigator
CFO (CEO)	Value acquisitions and divestments Raise new capital easily Avoid financial surprises Current systems are imperfect Leading indicator of performance Price global transfers of IPR (taxation etc.)	Tobin's Q Strassmann DOW IAM Balanced scorecard Brand valuation
Strategic management and business development	Measure health Differentiate options Analyze strengths / weaknesses / opportunities /gaps Benchmark against competitors Articulate new options Measure knowledge sharing vs. strategy Level of investment in knowledge activities	IHI KMAT StageGate Sveiby / Celemi / Balanced scorecard Knowledge options
Organization Development / Change agents	Justification of activities and projects Learning Benchmarking of knowledge processes Spread of best practice Tools and diagnosis for culture issues	Success stories KMAT IHI StageGate Knowledge markets
Line management	A way to value employees & teams Competence management and development needs A dimension to appraisal Prioritize resource allocation Improving efficiency of knowledge work Stimulus and change	Modified EFQM Business Excellence Model Knowledge-sharing rewards

Table 14. Reasons to measure knowledge (EIRMA, 1999).

Within the intellectual capital framework, measurement focuses on the value of knowledge-related assets. More generally, measurement is

planned observation, and it is used to improve understanding of a specific system or to control its behavior. The system of measurement articulates major assumptions about the purpose and structure of an organization, and therefore the system of measurement is also one of the main statements of the priorities of an organization. In theory, a mission statement may try to crystallize the overall intent and identity of an organization; in practice, the measurement system makes such a mission statement either meaningless words or everyday organizational reality. As a consequence, the measurement system is also one of the main tools by which an organization can change itself.

For example, if an organization starts to measure the effectiveness of its knowledge sharing processes and enablers for knowledge creation and organizational learning, it becomes able to monitor and improve these aspects of the organization. Only those aspects of organizational action that can be observed, i.e., measured, can be used to control the organizational action. In practice this happens, for example, by providing incentives and goals that signal organizational priorities.

The system of measurement, therefore, needs to be derived from the strategic vision of the organization. It also needs to be distinguished from accounting measures (Johnson & Kaplan, 1987). As Quinn argues:

> With few exceptions, standard accounting practices have not only been of little value in evaluating intellect but have often had a significant negative influence. Rather than regarding expenditures on intellectual or service developments as being investments in assets of enduring value on which one expects returns and then systematically quantifying these returns, accounting practices have classified them as "expenses" to be written off—and minimized if possible. (Quinn, 1992:248)

R&D, for example, can be measured as a generator of "opportunities to exploit." According to Quinn, this is much like evaluating a gold mine. Using the best available techniques, one estimates the likely cash flows one could achieve from exploitation and discounts these based on the probabilities and risks involved. The company can also determine what it actually did with these potential values. Based on this, one can calculate an "exploitation ratio," which may lead to insights on the effectiveness of R&D activity (Quinn, 1992:247).

As was pointed out above, there is no single way to measure intellectual assets or knowledge-related processes. In many practical

cases, there are several correlating phenomena in an organization that can be measured and it is not clear which indicators would be the most useful. Instead of looking for the single right measurement system, one should, therefore, look for one that enables the management to know whether the organization is moving toward the overall strategic vision.

Quinn proposes that an organization should try to put value to its intellectual assets using several complementary approaches. The organization can estimate the price the company would be willing to sell off the entire activity; estimate how much it would cost to rebuild from scratch the portions of the R&D unit the company would like to keep; assess how much it would have cost the company to buy from outside sources the "opportunities to exploit" R&D created; estimate the asset value of a continuing stream of created "opportunities to exploit." In addition, the organization should measure the quality and productivity of knowledge processes as well as their outputs (Quinn, 1992:249).

The measures that are used should also be relevant. They need to give feedback on the development of the organization in strategically important dimensions, and therefore the measures should be able to distinguish change in those dimensions. For example, if rapid deployment of best practices is important for a company, the measurement system should be able to tell something about the speed and extension of the deployment of best practices. More generally, specific measures should reflect the critical factors that have to be in shape for the organization to succeed. In addition, the measurement system should have adequate coverage, so that there are no important gaps in the measurement system. As the measurement system can not be complete or final, it also needs to be revised regularly so that it reflects the current priorities of the organization in question.

In summary, then, the criteria for a measurement system can be stated as follows. It has to be based on measures or indicators that are related to strategy. Moreover, the indicators have to be relevant, complementary, dynamic, and cover those areas that are important for the organization.

13.3.1 Types of measurement

In general, measurement can focus on three different types of issues. First, it is possible to measure results or outputs. Second, it is possible to measure the quality, efficiency and stability of the process that

produces these results. Third, it is possible to measure inputs, tasks, and other enablers that are needed to generate the results. These are schematically depicted in Figure 46.

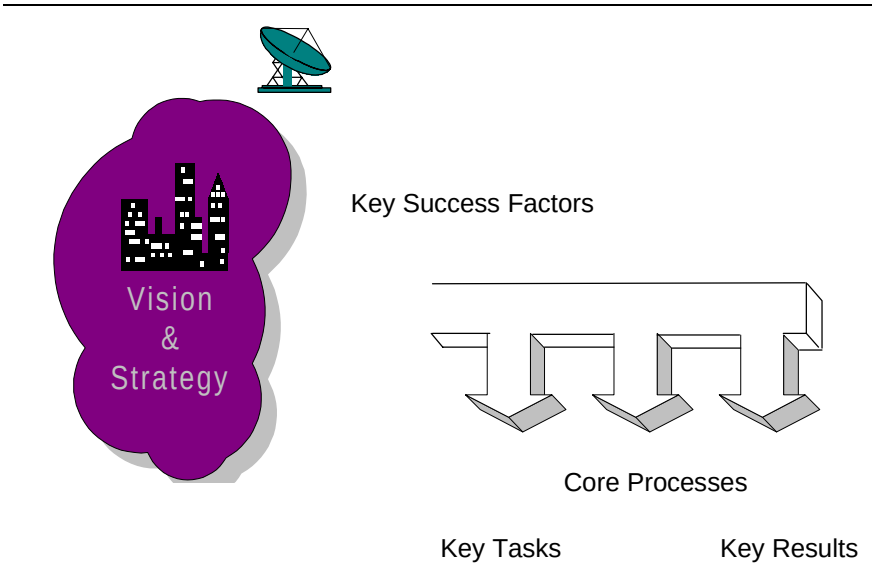

Figure 46. Three areas of measurement.

There are several different types of measurement that provide information on the working of an intelligent organization. Traditionally, knowledge has been measured at the macro-economic level by R&D inputs and estimated rate of return (Stoneman, 1995). At the organizational level, the focus has been of R&D effectiveness and human capital. According to a recent survey on over 100 publications on measuring R&D performance, both quantitative and qualitative metrics have commonly been used to assess R&D (Werner & Souder, 1997).

Any organization both tries to run an effective machine and to renew itself. Therefore it needs to operate in several modes simultaneously, and these modes require different measurement systems. For some organizations, innovation is the key to success, for others it may be marketing or production. These need different measurement systems. Often, production focuses on efficiency, whereas R&D focuses on effectiveness.

Hansen, Nohria, and Tierney (1999) proposed that there are two generic knowledge management strategies. The knowledge codification strategy focuses on codification of information. This strategy seems to be most appropriate for companies that are able to invest in developing a knowledge asset that can be efficiently reused. Another strategy, knowledge personalization strategy, is appropriate for companies that rely extensively on tacit knowledge, or which offer customized products that can not easily be standardized. An extension of the model proposed by Hansen et al. might include a third strategy, which is appropriate for companies that compete by creating new knowledge, and products that define a novel product category. These three types of knowledge management strategies are shown in Figure 47. For companies that emphasize the codification strategy, an appropriate measurement system would focus on measuring knowledge products and knowledge packaging processes. For companies that emphasize knowledge personalization strategy, the appropriate measurement system would focus on communication and knowledge adaptation processes. For companies that emphasize knowledge creation, the measurement system could include components that diagnose factors of organizational culture that are critical for knowledge creation, dynamics of its ba's, or social interactions that facilitate innovation.

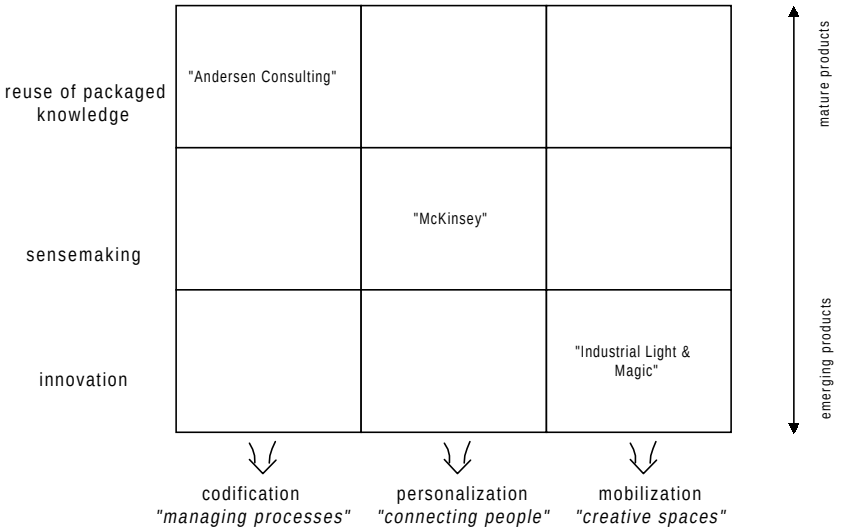

Figure 47. Three knowledge management strategies.

Different views on the organization lead to different measurement systems. If we consider the organization to be a machine that produces outputs from given inputs, a natural approach is to focus on efficiency. In a closed system, we can measure and manage the functioning of the system by getting feedback from the system, and by intervening when necessary. However, only when we have pre-defined goals, we can measure efficiency, and its complement, waste. This may be rather straightforward in those parts of an organization where production is the main objective, and where repetitive tasks and processes make it easy to improve performance through reduction of waste and "non-value adding" activities.

If we, however, consider the organization to be an adaptive system that evolves across time, organizational learning, flexibility and value creation may be natural aspects to measure. Then we may focus on measurement of effectiveness and impact, but also on strategic options that enable these in the future. Instead of waste we then measure the actual value added.

In actual practice, one key task for the management is to define the priorities for different areas of activity within the organization, and implement a measurement system that reflects the strategic

requirements of the organization in question. Some parts of the organization may need to implement a measurement system that emphasizes renewal and innovation, other parts may need a measurement system that gives feedback on knowledge reuse.

In Table 15 three different types of measurement are listed. A complete system of measurement needs to cover all these aspects of measurement, in a way that reflects the organizational strategy.

- Results
  - Effectiveness (value)
- Diagnostics
  - Efficiency (waste)
  - Flows & Stocks
  - Enablers (e.g., culture, values, behavior, organization)
- Process maturity
  - Defined core processes ("what we do...")
  - Quality of approach ("...and how we do it...")
  - Scope of best practice use ("...compared to world-class")

Table 15. Three types of measurement.

Given the discussion above, one could also see that a too strong emphasis on the production dimension and business processes may easily lead to excessive focus on efficiency measures. In practice, efficiency measures tend to overflow also to those parts of the organization where they don't fit well. This happens because it is relatively simple to measure processes where inputs and outputs are defined, and also because the traditional industrial organization was focused on efficient production in relatively slowly changing product-market environments. In many important cases the situation, however, is more complex. Instead of a set of well-defined processes the organization may sometimes better be described as controlled chaos (Cheng & Van de Ven, 1996; Volberda, 1996). Measurement systems that focus on efficiency are relatively common in unsuccessful R&D organizations (Brown & Eisenhardt, 1997). Organizational innovation and learning often occurs outside any defined processes and it is, for example, known that most of the benefits of information technology in organizations are unintended. A measurement system that is able to observe the value of such unintended benefits or chaotic and creative

activities should have a broader coverage than a measurement system that focuses on efficiency.

13.3.2 Measuring knowledge processes

When we define measures for knowledge-related processes it becomes clear that these processes are difficult to define. We don't have a clear input-output model of what happens when a new insight is generated, for example. In such cases we can evaluate the result after it exists, but it may be difficult to tell what were the inputs, or how efficient the process of generating the result was.

In general, it may be easier to have some idea about those activities that do not add value. Even when we can not tell what is the "process" that generates the result, we may be able to tell that some activities do not contribute in its creation. Therefore, we may heuristically categorize some activities as waste. For example, we can leave open the question how to model and specify the processes that underlie insight and creativity, and at the same time we can eliminate some forms of activity that do not improve creativity or produce insight.

If our understanding of knowledge processes is wrong, however, we easily make wrong judgments about the nature of different organizational activities. A random discussion in the company cafeteria may be extremely valuable, and yet be commonly categorized as inefficient use of time. Similarly, if we don't realize how critical well managed slack is in the organization, we may think that slack should, by definition, be minimized. This is a rather generic problem as our abstract models of organizational activity rarely take into account that social activity that underlies knowledge creation and development. Measurement systems that try to measure efficiency of knowledge processes, or their inputs, run the risk of destroying them.

As Quinn suggested, we can also try to measure the exploitation ratio of opportunities. This can be done, for example, by estimating the potential value of generated new ideas and compare this with the expected value generated from these ideas. This would reveal underutilized opportunities, and provide some understanding of the appropriateness of allocation of knowledge generation resources.

It is, however, not obvious that a high exploitation ratio is always optimal. We can, for example, measure how many of the patents generated in a company will be utilized in its business, or count how many R&D project proposals lead to projects. It is, however, known

that when a business firm competes in rapidly changing product-markets, its flexibility in re-allocating its competencies may be a major competitive advantage (Volberda, 1996; Teece, Pisano, & Shuen, 1997; Brown & Eisenhardt, 1998). Renewal often means that an organization does something that it didn't do before. Exploitation of new knowledge is not always similar to that of making risky investments in a gold mine, as Quinn (1992:249) suggested. Sometimes it is more like sitting on top of an oil-field, before there are any known economic uses for that sticky black substance.

When we try to measure knowledge creation processes themselves, the main problem is that there has not been theoretically robust models of knowledge processes in an organization. Researchers working with the idea of intellectual capital have mainly focused on the static aspects of intangible assets. Roos et al. (Roos, Roos, Dragonetti, & Edvinsson, 1997:52) try to correct this by proposing measures for the flows between different forms of intellectual capital. Others have tried to describe "the knowledge process" as a sequence of phases where knowledge is created, codified, disseminated, adapted, and used. Such models, however, are not theoretically well founded, and the measurement systems built using them have, for example, problems in making distinctions between the various levels of analysis.

Using the 5-A model of knowledge creation, it is, however, possible to show some key knowledge processes that can be measured. The conventional view on intellectual capital focused mainly on knowledge accumulation. In Figure 48, two types of accumulation are distinguished. First, knowledge can accumulate as knowledge products, i.e., tools, designs, and documents. It is, for example, possible to measure the generation of new design proposals at individual, community, and organizational levels. Second, knowledge can accumulate as expertise. Similarly, appropriation may me measured, for example, by reuse of knowledge, time devoted to mentoring, or use of training. Anticipation, in turn, can, for example, be measured by the number of lessons learned in situations where the world didn't meet our expectations.

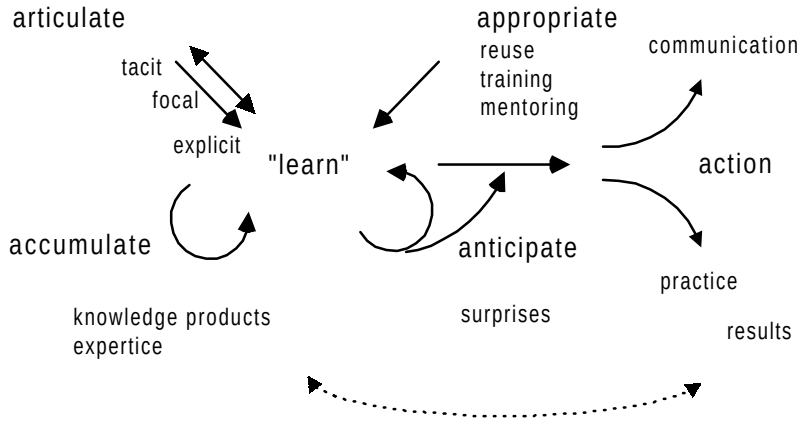

Figure 48. Some example areas of measurement in the 5-A model.

A simple aggregation of the measured factors is not possible, as the value of knowledge depends on the underlying system of activity. For example, expertise is always related to a specific community of practice, and tools may be used in different ways in the activity systems of different practices. It is however, possible to develop meta-level measures that, for example, count the number of people in different levels of expertise within the organization. For example, Linder and Davenport proposed that engagement is a critical factor when information is shared in a company (Davenport, 1997:92). According to Davenport, engagement has five levels: read/view, act on/discuss, argue/defend, present/teach, and simulate/live. Similarly, Dreyfus and Dreyfus (1986:30) proposed a five level model of the development of expertise.

When we analyze the information engagement model from the Vygotskian point of view, we can say that the different levels of engagement require different forms of advanced thinking. Reading of a document requires only peripheral participation in the community. Discussion, in turn, requires commitment in addition to the capability to read a document. To discuss, one has to have a position concerning the topic at hand. Argumentation requires that, in addition to one's own position, one has to be able at least partially to understand another position and interpretation: that of the opponent. Teaching and

presentation further require that the presentator not only knows another point of view—that of the student—but is able to actively manage the differences and movement within the zone of proximal development. An effective teacher, therefore not only understands the position of the student, but also understands what are the student's capabilities in changing this position. On the fifth level of the engagement model, an expert is able to creatively transcend the current world view, and produce new realities.

Combining the expertise development model and the information engagement model, we could then use it as a practical definition of levels of expertise. Indeed, we can argue that if the levels proposed by Dreyfus and Dreyfus are discontinuous, there probably exists a similar structure also in the social sphere. This means that it should be empirically possible to find five different "cognitive classes" of people in all fully formed communities of practice. As the level of expertise is a key structuring factor in a community, we should also be able to detect corresponding initiation rites, signs of class membership, and sub-practices, that could be used to categorize people in the different levels. The modified engagement model is depicted in Figure 49. The use of the modified engagement model within the context of communities of practice is discussed in more detail in (Tuomi, 1998b).

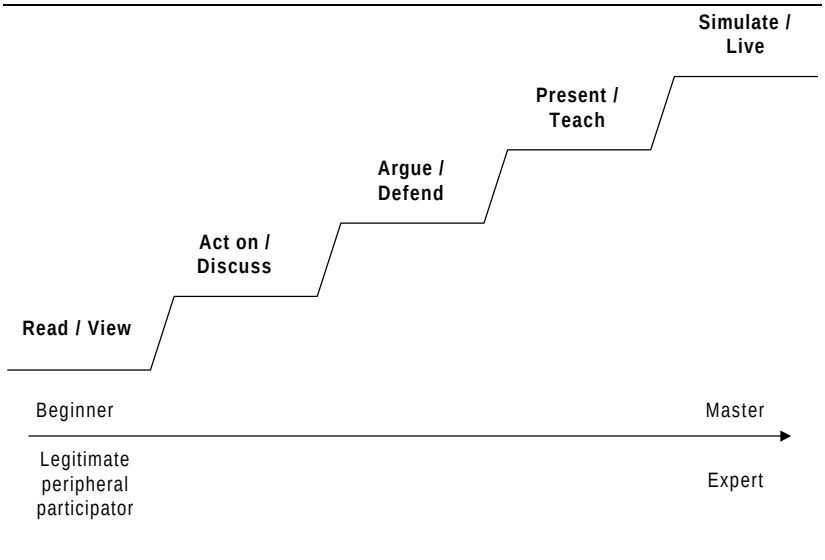

Figure 49. Levels of engagement and the development of expertise.