MANAGING KNOWLEDGE ASSETS FOR BUSINESS PERFORMANCE IMPROVEMENT

Daniela Carlucci[a]
Giovanni Schiuma[b]

[a]LIEG/DAPIT, University of Basilicata, Italy
carlucci @unibas.it

[b]LIEG/DAPIT, University of Basilicata, Italy &
CBP, Cranfield School of Management,
Cranfield University, UK
schiuma@unibas.it

Session K-5

Abstract

In today's economy more and more organisations are realizing that to acquire and maintain their competitive advantage they must explicitly manage their cognitive resources. For this reason, managers need to understand how they can identify and evaluate existing knowledge assets within the organisation and how to manage these assets in order to achieve the competitive advantage.

The relevant problem is that many organisations frequently embark on knowledge management initiatives without a clear idea of what business benefit they could expect.

In such a prospect, this paper aims to explore a fundamental issue at the basis of the reasons for the implementation of Knowledge Management initiatives within companies, that is business performance improvement. In particular, the research provides a framework which aims to drive management in planning and evaluating a KM initiative focused on the improvement of a specific business performance.

Keywords: Knowledge Management, business performance improvement, Knowledge Assets, Analytic Hierarchy Process method.

Managing knowledge assets for business performance improvement

Daniela Carlucci [a]
Giovanni Schiuma [a,b]

[a] LIEG/DAPIT
University of Basilicata, Italy
[b] CBP, Cranfield School of Management, Cranfield University, UK

{carlucci, schiuma}@unibas.it

Abstract

In today's economy more and more organisations are realizing that to acquire and maintain their competitive advantage they must explicitly manage their cognitive resources. For this reason, managers need to understand how they can identify and evaluate existing knowledge assets within the organisation and how to manage these assets in order to achieve the competitive advantage.

The relevant problem is that many organisations frequently embark on knowledge management initiatives without a clear idea of what business benefit they could expect.

In such a prospect, this paper aims to explore a fundamental issue at the basis of the reasons for the implementation of Knowledge Management initiatives within companies, that is business performance improvement. In particular, the research provides a framework which aims to drive management in planning and evaluating a KM initiative focused on the improvement of a specific business performance.

Keywords: Knowledge Management, business performance improvement, Knowledge Assets, Analytic Hierarchy Process method

Suggested track: A Managing organizational knowledge and competence

1 Introduction

More and more organisations, in today's economy, recognize that intangible assets are the key strategic resources and that tangible assets have become, in most cases, no more than transient commodities. Organisations need to manage explicitly their intellectual resources in order to gain and sustain a competitive advantage. According to Wiig (1997 a) the company's viability depends on: "the competitive quality of its knowledge based intellectual capital and assets and the successful applications of these assets in its operational activities to realize their value to fulfil the company's

objectives" (p. 399). It is critical for organisations to understand whether they are using their intangible resources in an efficient and effective way for creating company value. For this reason, they need to identify and assess their existing intangible assets and manage those intangibles. Over the last decades, an increasing amount of contributions have been produced in this evolving research field, from both academics and practitioners, addressing the assessment of Intellectual Capital (Haanes and Lowendhal, 1997; Petrash, 1996; Roos et al. 1997; Marr and Schiuma, 2001; Sveiby 1997) and the initiatives of Knowledge Management (KM) (Davenport and Prusak, 1998; Grant, 1991, 1994; Leonard-Barton, 1995; Nonaka and Takeuchi, 1995; Ruggles, 1998; Sveiby, 2000, 2001 a; Teece, 2000; Wiig, 1997 b). The assessment of Intellectual Capital (IC) and the implementation of KM initiatives, in our point of view, are two building blocks that should be jointly considered. In fact, if the first subject is focused on the identification and evaluation of knowledge assets, the second subject allows to create, acquire, continually renew, effectively apply knowledge assets and to maximise their value, by their systematic and explicit management. Wiig (1997 a) argues that it is fundamental to determine which KM activities are required to obtain the desired intellectual capital results and capitalize their value for the company's benefits.

This paper introduces a tool "the Knowledge Assets Value Creation Map" that can be used for visualising and assessing the relationships between knowledge assets and company's performance and it is shown how this can drive managers toward the implementation and evaluation of knowledge management initiatives. The "Knowledge Assets Value Creation Map" is presented as a tool of a more general framework, the "Knowledge Assets Value Spiral" which has been defined in order to provide managers with some guidelines to plan and manage KM initiative within an organisation.

In the paper, first, there is provided a concise review of the KM literature in order to ground our interpretation of KM. Then, we explore the literature in terms of contributions concerning the link between KM and company business performance. We derive the components of our framework, the "Knowledge Assets Value Spiral" (KAVS), from this literature analysis and from the results of an action research project. Finally, we report a case example of the application of the KAVS within a world-leading manufacturing company located in Southern Italy. The KAVS, in the reported case example, is applied to the New Product Development (NPD) process of the company. It demonstrates how the KAVS can be applied in order to identify the key knowledge assets at the basis of an organisation's operation/business process and how it can be used for improving process/company performance.

2 Knowledge Management

Today, organizations consider knowledge as a strategic lever for the competitive advantage and their business success seems to depend increasingly on the ability to assess, manage and develop their own knowledge as well as to acquire new knowledge (Davenport and Prusak, 1998). Teece (1998) argues that “the competitive advantage of companies in today’s economy stems not from market position, but from difficult to replicate knowledge assets and the manner in which they are deployed” (p. 62).

In the last decade, the central role of knowledge, and more generally of intangible resources, in the creation of value and competitive advantage has been the subject of several studies which were conducted under different research streams as the Resource Based View (RBV) (Amit and Schoemaker, 1993; Barney, 1991; Grant, 1991; Hall, 1993), the Competence Based View (CBV) (Leonard – Barton, 1995; Prahalad and Hamel, 1990; Rumelt, 1994), the Knowledge Based Theory (KBT) (Grant, 1991; Sveiby, 2001 b). In all of those streams, competencies are seen as the base of a company’s ability to get the competitive advantage. Moreover, company’s competencies are considered to be closely linked to knowledge and its management. In fact, KM is about managing knowledge assets and knowledge processes which are at the basis of development, maintenance and renewing of organisational competencies (Adler, 1989; Leonard-Barton, 1995; Nelson, 1991; Prahalad and Hamel, 1990; Marr and Schiuma, 2001).

In the last few years the literature has provided several definitions of KM (Beijerse, 2000; Lee and Yang, 2000; Quintas et al. 1997; Ruggles, 1998; Sveiby, 2000; 2001 a; Teece, 2000; Wiig, 1997 b) from which emerge two main aspects of KM: (1) KM is presented as a set of processes and (2) it aims to create value for the organisation.

The first aspect is concerned with the managerial facet of the KM and it is about how to manage company’s knowledge. It reflects the dynamic view of KM as a set of processes concerned with the usage, development, renewal and value creation of knowledge (Wiig, 1997 b). The second aspect is more concerned with the economic facet of KM and involves a more static notion of knowledge as asset, which can manage and deploy in order to generate value. As regards, the literature provides different methodological tools and models for identifying and assessing the knowledge assets of organisations.

Marr and Schiuma (2001) bring together the different aspects and propose two taxonomies concerning the knowledge assets and the knowledge processes useful to manage knowledge assets.

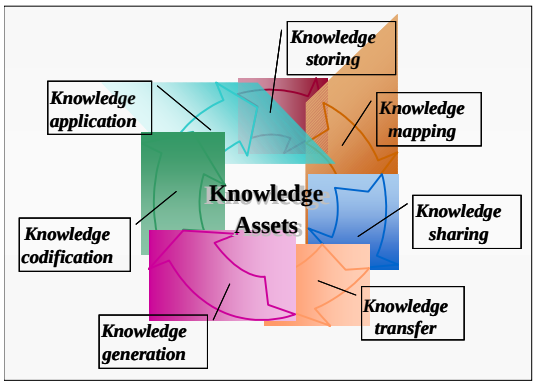

Fig. 1. Knowledge Management Processes

They identify and describe the following seven key knowledge processes: knowledge generation, knowledge codification, knowledge application, knowledge storing, knowledge mapping, knowledge sharing and knowledge transfer, which are tightly interrelated and often overlap (see Figure 1). These processes represent the managerial lever that managers can adopt within an organisation to manage company's knowledge assets.

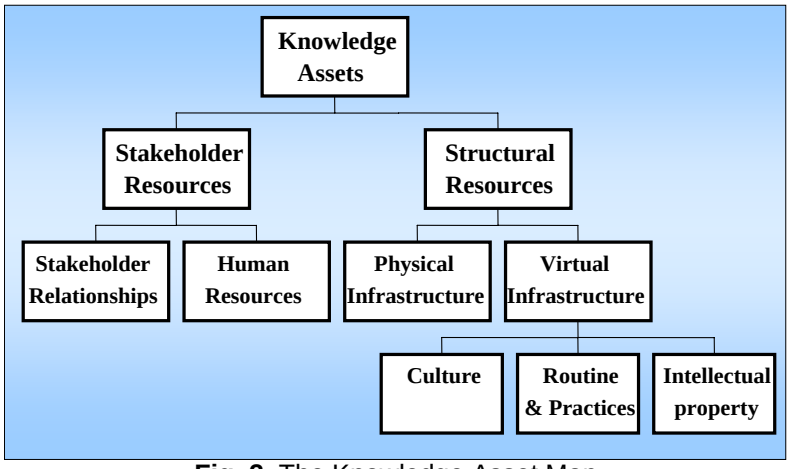

Fig. 2. The Knowledge Asset Map

While a critical review of the literature about the IC classification/assessment models resulted in the definition of the 'Knowledge Asset Map' (Marr and Schiuma, 2001), which proposes a classification of organizational knowledge assets on the distinction between Stakeholders Resources and Structural Resources (see Figure 2). The Knowledge asset map is particularly useful to identify and classify knowledge assets

within an organisation. Moreover it provides a basic framework for both a qualitative and quantitative assessment of organisation knowledge assets.

Moreover, the analysis of the KM literature suggests that the KM can be interpreted in accordance with three main perspectives: strategic, managerial and operational perspective.

The strategic perspective, supported by strategic mainstreams highlighting the strategic importance of the knowledge and its management for company business success (i.e. RBV, CBV and KBT), considers the set of approaches which connect the company's strategy with KM (Bierly and Chakrabarti, 1996; Burns, 2000; Hansen et al. 1999; Zack, 1999).

The managerial perspective includes the set of approaches and methodologies to assess the company's Intellectual Capital, and to implement the KM processes. It includes all models driving managers towards the assessment and management of knowledge processes. The management literature on this interpretative facet provides a wide range of contributions (i.e. the mainstream of IC assessment or numerous definitions and descriptions of KM processes).

The operational perspective of KM includes the set of organizational and managerial activities and projects (e.g. teamwork, meeting, benchmarking of best practices, community of practice, etc.), aimed to the use and development of company cognitive capital. The projects, based on the development and use of the ICT tools (Borghoff and Pareschi 1998) for KM, are included in this dimension (e.g. intranet, yellow pages, knowledge repositories and libraries, groupware, computer – supported cooperative work, etc.).

These are three complementary perspectives. In fact, an effective implementation of KM needs a combination of strategic, managerial and operational aspects. The KM contributes to company's competitiveness insofar as it is aligned to the business strategy. This needs an organisational capability in mapping knowledge resources, categorizing them, analysing them in order to identify possible knowledge gaps linked to strategic objectives. From a managerial point of view, this requires that the organisation is able to asses its knowledge assets by specific approaches or models.

The analysis of the characteristics and of the interpretations of KM allows us to provide the following working definition: *"KM is a managerial paradigm which assumes that knowledge is at the basis of organisational competitiveness and, from the explicit and systematic adoption and implementation of approaches, techniques and tools for*

assessing and managing knowledge assets derive the ability to generate value for company's stakeholders".

3 The link between Knowledge Management and business performance

In the recent years, different studies have addressed the issue of how intangible assets contribute to improve business performance and create value for organisations. These studies have been focused on different aspects of the research issue.

A recent survey by APQC (2001; 2002), for example, has shown when, during the different phases of a KM initiative, the measurement benefits are required; it has suggested some possible measures for the benefits. Other research has been focused on measuring and evaluating the impacts of KM initiative on business performance. Firestone (2001) and Robinson et al. (2001) have provided approaches to facilitate the assessment of the likely impact of KM on performance, respectively by using an abstract pattern of Comprehensive Benefit Estimation (CBE) and the IMPaKT Assessment framework.

McHugh (2002), with reference to practical experiences of Unisys Corporation, has discussed instruments and outputs to measure the business impact of KM within knowledge communities.

Other authors (Anderson 2002; Kingsley, 2002; Perkmann, 2002) have focused their attention on quantitative measures of the impact of KM projects, for example the ROI. Their research finds that ROI can only capture a part of a project's impact. This is because projects always have unintended effects that cannot be easily captured as a financial return.

Some researchers have analysed causal relations between KM initiative implementation and business performance improvement (Armistead 1999; Chong et al. 2000).

From an empirical point of view, a recent survey on KM within companies (Heisig, 2003; KPMG, 2003) has shown different impacts of KM initiatives on organisational performance, i.e. better understanding of customer's needs, improvement of innovation organisational capability, increase of quality, and so on.

Moreover, the managerial literature provides a lot of case studies showing the performance improvement related to KM initiatives.

The review of the literature suggests that there is no straight forward link between KM and business performance but rather a complex relationship based on various theories. However, from the analysis of both the KM literature and the performance measurement and management literature, it seems possible to summarise a cause-effect relationship chain explaining the link between KM initiatives and company's performance (Carlucci et al., 2004). Since knowledge is at the basis of company's capabilities, an organisation can improve its skills and abilities over the time by managing and developing knowledge assets. This involves a continuous improvement of company's processes which are grounded on capabilities. Finally, an organisation is able to generate higher level of value and acquire competitive advantages by improving processes' performance.

The relevant problem for an organisation is not only to measure KM impacts on performance, but to improve its ability to exploit and create knowledge in order to increase the value for its stakeholders. Moreover it is very important to understand what are the benefits related to investments in KM initiatives. In fact, many organisations embark on KM initiatives without a clear idea of what business benefit they could expect. For this reason, it is very important to understand better the link between KM and business performance. Understanding the link supports the validation of KM investment and can contribute to explain what knowledge should be managed and developed within an organisation to achieve performance improvement.

The analysis of the theoretical and empirical contributions concerning the link between KM and performance (Carlucci et al., 2004) highlights that the most important factor for guiding KM is the company's strategy. In accordance with this Zack (1999) states that "an organisation's strategic context helps to identify KM initiatives that support its purpose or mission, strengthen its competitive position and create shareholder value" (pp.5-6). Therefore, the starting point to define a KM initiative should always be the company's strategy, which should be based on the definition of the stakeholders' needs and wants (Neely et al. 2002). Moreover, the literature stresses the importance of measuring the results gained from the implementation of KM initiatives in order to test their effectiveness and efficiency.

Thus finally we believe that the link to the strategy and the relevance of measuring the impact of KM initiatives are two building block of any managerial framework aiming to provides managers with guidelines to design, deploy and manage KM initiatives within an organisation.

4 The Knowledge Assets Value Spiral

In order to drive managers toward the definition and implementation of effective and efficient knowledge management initiatives we introduce a managerial framework based on five managerial stages. The framework derived from both a review of the management literature and from an analysis of a wide range of case examples as well as from the results of an action research project, is mainly aimed to answer to the following fundamental question: *How can an organisation identify and manage its knowledge-based assets to improve its performance?*

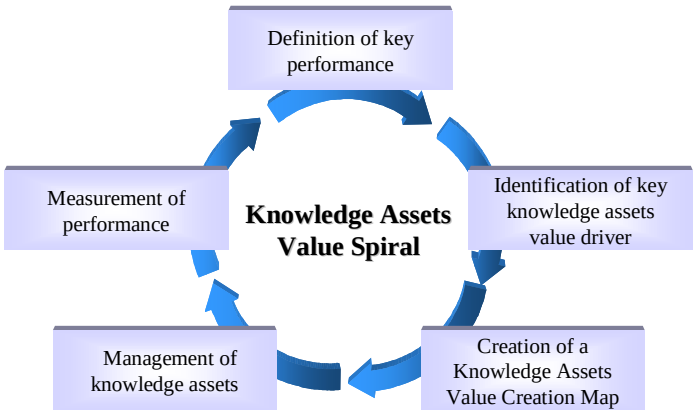

Fig. 3. The Knowledge Assets Value Spiral

In order to answer to the above question we propose the "Knowledge Assets Value Spiral" (see Figure 3). It involves the following managerial stages.

Definition of key performance

The first stage consists in the definition of the company key performance related to the company's strategy. For each defined dimension of performance managers can set up a set of specific performance objectives to be reached.

At the basis of the definition of the company key performance is a clear articulation of the organisation strategy which involves the definition of company's stakeholder needs and wants (Neely et al. 2002). Once the key performance have been translated in performance objectives to be carried out a set of performance indicators should be defined in order to measure performance achievement.

Identification of key knowledge assets value driver

The second stage can be referred to the strategic and managerial perspective of KM. It concerns the identification of the most important knowledge resources - the *key knowledge assets value driver* - required to achieve the performance objectives fixed at

the previous level of analysis. Starting from the performance objectives, the managers have to select a set of critical knowledge assets that helps to achieve those objectives. These knowledge resources can be considered as key value drivers, or in other words, the knowledge resources which are very important for improving organisational performance. In order to identify the knowledge resources, the organisation can use different models or taxonomies. In this paper, we refer to the Knowledge Assets Map, which has been introduced above. It offers a taxonomy of knowledge assets including human resources, stakeholder relationships, physical infrastructure, culture, routines and intellectual property. An organisation can use a *'matrix of direct dependences'* to select its knowledge assets value driver. In this tool, the knowledge assets are listed in rows, classified in accordance with the Knowledge Assets Map, and the specific defined performance objectives are listed in columns. Using the matrix, managers judge, adopting a binomial approach (i.e. filling the cell of the matrix with Yes or Not), if a knowledge asset is important or not for the achievement of each objective.

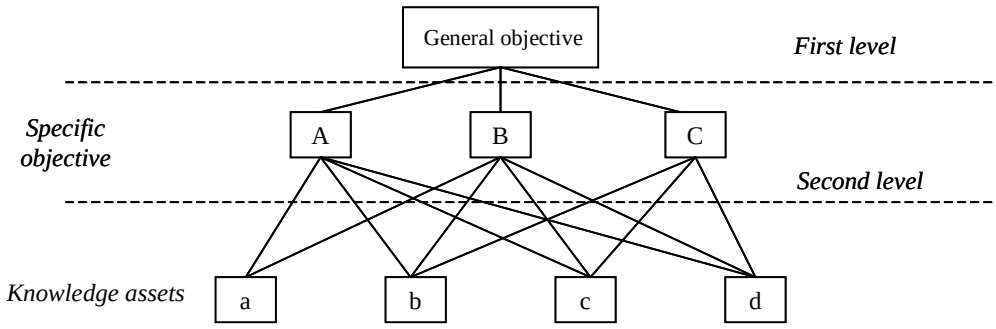

Fig. 4. Hierarchal structure

Finally, the identified *key knowledge assets value driver* and the performance objectives can be represented by a hierarchal structure. The hierarchy could be structured by an hierarchical approach putting at the highest level the general objective to be performed and at the lower levels the specific objectives which are at the end connected to the knowledge assets, which represent the bottom level (see Figure 4).

Creation of a Knowledge Assets Value Creation Map

This stage maps out how the selected knowledge assets will help the organisation to achieve its performance objectives. In particular, managers weigh the importance of *key knowledge assets value driver* in achievement of performance objectives and to choose the knowledge assets to manage with priority. Managers, making such a choice, take into account of both interactions between performance objectives and

between knowledge assets and the results coming from the application of the AHP method on the hierarchical structure.

The above judgements, summarised in the hierarchical structure, identify the importance of the knowledge assets relating to a performance objective in an isolated and static fashion; however, as indicated by various scholars, it is often the dynamic interaction of various knowledge assets that provides a sustainable competitive advantage (Nelson and Winter, 1982). Moreover, it is possible to have some interactions also between the performance objectives of same level in the hierarchical structure.

Managers can take into account of those interactions by the *'matrix of the indirect dependences'.* A *'matrix of the indirect dependences'* is created in a way that both rows and columns contains the identified knowledge assets. It is possible to create a matrix for each performance objective previously stated and for which the *key knowledge assets value drivers* have been defined. The cells of the matrix contain a judgement concerning the relevance of a knowledge asset for performing the performance object. This judgement is expressed by two possible levels of importance: moderate importance and strong importance. Similarly, the '*matrix of the indirect dependences'* has be used to identify and weigh the interactions between performance objectives. As regards, the *'matrix of the indirect dependences'* is created in a way that both rows and columns contain the performance objectives of same level in the hierarchical structure.

Using the data from the *'matrix of direct dependences'*, the manager can choose which knowledge assets to manage with priority in order to achieve a desired performance improvement. Making such a choice, the manager doesn't take into account of the interactions considered in the *'matrix of the indirect dependences'.*

The Analytic Hierarchy Process (AHP) Method is particularly useful in order to facilitate this decision process (Saaty, 1980; Saaty, 1994). The AHP is a comprehensive, logical and structural framework, which allows to improve the understanding of complex decisions by decomposing the problem into a hierarchical structure. It is based on three principles:

1. Decomposition of the decision problem;
2. Comparative judgment of the elements;
3. Synthesis of the priorities.

The first step is to explain the decision problem in a hierarchical structure. The Hierarchical structure is a reticular structure which can have two or more levels. The first level contains the general goal. The second level contains the objectives specifying the general goal contents (specific objectives or criteria). Each specific objective can be further subdivided in more specific objectives (third level), and so on. On the bottom level, there are actions to select in order to achieve an objective. The second step is the comparison of alternatives actions and objectives. They are compared in pairs with respect to each element of the next higher level.

Verbal scale	Numerical values
Equally important	1
Moderately more important	3
Strongly more important	5
Very strongly more important	7
Extremely more important	9
Intermediate values to reflect compromise	2, 4, 6, 8

Table 1. Scale for pairwise comparisons

The scale of Table 1 can be used for this relative comparison. It allows to express the comparisons in verbal terms, which are then translated into corresponding numbers. The judgements of comparison are expressed in the “pairwise comparison matrix”.

The next step is to extract the relative importance involved by the previous comparisons. Here it is necessary to estimate the right principal eigenvector of the previous matrix. On the base of a judgment matrix with pair wise comparisons, the corresponding maximum left eigenvector is approximated by using the geometric mean of each row. Afterwards, the numbers are normalized by dividing them by their sum. Hence, there is calculated the corresponding priority vector ’x’ for the previous matrix.

Therefore, the check of the consistency of the evaluations at every level of hierarchical structure has been carried out for each matrix. In the AHP, the pairwise comparisons in a judgment matrix are considered to be adequately consistent if the corresponding consistency ratio (CR) is less than 10%. The CR coefficient is calculated as follows. First. the consistency index (CI), which is done by adding the columns in the judgment matrix and multiplying the resulting vector by the vector of priorities (i.e. the approximated eigenvector) obtained earlier, needs to be estimated. This yields an approximation of the maximum eigenvalue denoted by λmax. Then, the CI value is

calculated by using the formula: CI = (λmax - n)/(n - 1). Next, the consistency ratio CR is obtained by dividing the CI value by the Random Consistency index (RCI). If the CR value is greater than 0.10, then it is a good idea to study the further problem and re-evaluate the pair wise comparisons. As the last step, the comparisons is carried out to get the priorities of the alternatives actions with respect to each objective and the weights of each objective with respect to the goal. The local priorities are then multiplied by the weights of the respective objective. The results are summed up to get the overall priority of each alternative (Triantaphyllou and Mann, 1995).

In our case, the construction of "pairwise comparison matrix" involves the hierarchical structure shown in Figure 4. The result of AHP method is a priority order of *key knowledge assets value driver* with reference to the general performance objective.

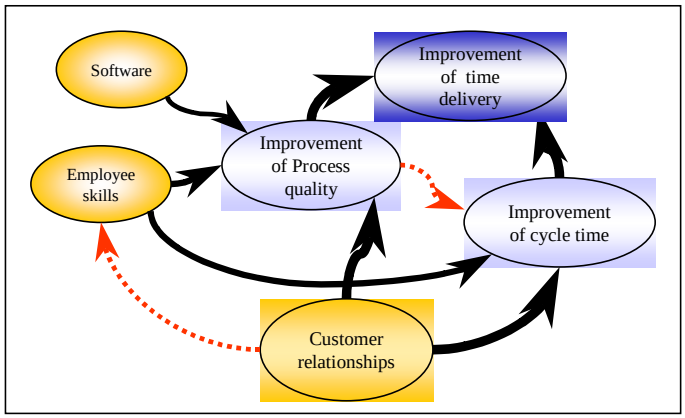

Fig. 5. The Knowledge Assets Value Creation map

The application of the AHP method to the analysis of the knowledge assets at the basis of company's performance results in the "Knowledge Assets Value Creation map" (see Figure 5). It shows how (weight and links of dependence) *key knowledge assets value driver* contribute to improve performance. In particular, the map shows how knowledge resources are linked to performance objectives and how different knowledge assets (and objectives) interact with each other to create value.

The map has nodes and arrows. *Key knowledge assets value driver* and performance objectives are on the nodes. The width of node of knowledge asset (or performance objective) means the importance of the asset (or performance objective) against the performance objective at first level (general objective). The hatched arrows mean the relevant dependences among assets and among performance objectives. The continuous arrows mean the links among elements (assets or performance objectives) of different levels. The width of continuous arrow means the importance (in terms of

global priority) of an asset (or performance objective) in order to achieve the objective in which the arrow ends.

The Knowledge Assets Value Creation Map helps the management to focus its attention on the critical knowledge resources and on their contribution to performance. In fact, the management, on the basis of results of AHP method and the data of *'matrix of indirect dependences'* shown in the map, can choose which knowledge assets manage with priority in order to improve the strategic stated performance objectives.

Management of knowledge assets

This stage could be referred to the managerial and operational perspective of KM.

Once managers have selected the knowledge assets to manage with priority, they can define ways of managing them. In other words, managers have to decide the appropriate knowledge processes to put in place for growing and maintaining the *key knowledge assets value driver*. The literature provides various taxonomies of KM processes; in this paper, we refer to the knowledge process taxonomy identified by Marr and Schiuma (2001) introduced above. An important factor to take into account is to choose KM processes the nature of knowledge, tacit or explicit. Moreover, since KM processes carry out through a KM initiative within an organisation, other factors need to be taken into account as technological, structural and cultural organisational aspects.

Measurement of performance

In this phase, managers monitor, by measuring performance, the results gained by the implementation of knowledge management initiatives. Organisations can actually test, in this level, their strategic assumptions which are codified in the "Knowledge Assets Value Creation Map". On the basis of this analysis, managers can then justify their investments into certain *key knowledge assets value drivers*, or, if their assumptions where wrong and no performance impact can be measured, they might go back to the start and identify different knowledge drivers of success.

5 A case example: the "Knowledge Assets Value Spiral" at Calia Italia

In the following paragraph, we present a case example showing how the "KAVS" was applied in the New Product Development (NPD), department of an world-leading furniture manufacturing company operating in an important industrial district in South Italy. The main aim of this case example is to demonstrate how the theoretical

framework can support managers in choosing KM initiatives focused on the improving of company performance.

5.1 Company's description

The Calia Italia S.p.A. designs, produces, and sells residential upholstered furniture. It is a large furniture manufacturer with the leading market shares in North America and Europe. It counts 600 employees and produces nearly 250 different models each year. The company produced a turnover of 80 million US Dollars in the year 2001. About 90% of its production is designed for the export market in Europe and the US.

5.2 The Knowledge Assets Value Spiral for NPD performance

New Product Development (NPD) is a core process at Calia Italia. Its strategic value is closely related to product features, prevalently directed to the end-customer, greatly determined by customer requests and/or needs, with an high stylistic content and a short life cycle. Such a product characterization explains the needs for a continuous product innovation. Moreover, the production does involve a considerable amount of craftsmanship which gives the company a differentiation advantage, due to the low products imitability. On the other hand, it doesn't allow to take advantage by the modularity of standardized components, which would mean a reduction of the time to market. More generally, the NPD presents the characteristics of a not formalized process and it is greatly based upon know-how and knowledge with tacit nature, creative intuition and craftsmanlike ability of some key individuals operating in different phases of the process. Such characteristics of the process, which appear deeply tacit knowledge based, affect operational performance.

Calia's management decided to implement some KM initiatives in order to improve the performance of the NPD.

Following the "KAVS", the management selected the main performance they wanted to improve in the first stage.

In Calia's case, the general performance objective was an improvement of product design and prototyping performance. The general objective has been further subdivided in two specific objectives: improvement of the conformity of the prototype carried out by prototype builder to the product design carried out by designers; and reduction of product design activity/prototyping time.

As regards the conformity of the prototype it is important to stress that, in the NPD process, the Product Design is an output of the product design activity and an input for

the prototyping. Product design includes ’new product concept‘ and the ’development specifications‘. The new product concept consists of the design in scale 1:10 of the model in the various angles-shot equipped with quotas and specific descriptions. The latter includes the information that identifies the model, technical characteristics, and further characteristics particularly useful for developing the model. Frequently, the final produced prototype is quite dissimilar to the initial product design. The reasons for these differences include:

- know-how gap between the person producing the prototype and the designers;
- low level of technical expertise among designers;
- absence of codified rules for design and prototyping activities;
- highly tacit working practice;
- poor integration between design and prototyping, in terms of transfer and knowledge sharing;
- prototyping input with ambiguous and uncertain little informative content.

The inconsistency of prototype production and product design causes a frequent ’trial and error‘ approach and leads to an increase of prototyping time, and, therefore, time-to-market. Two main performance indicators have been identified in order to assess performance improvement: (1) time to design/prototype a new model of sofa and (2) the ratio: number of prototypes with different stylistic/dimensional features compared to product design/number of prototypes (reference time: one month). Once the management has identified the performance objectives, it can select the *key knowledge assets value driver*, using the *’matrix of the direct dependences’*.

In Calia’s case, the selected knowledge assets (*key knowledge assets value driver*), according to taxonomy of Knowledge Asset Map, were:

- technical expertise of the designers;
- problem solving capability of the designers and the prototypists;
- software for design;
- working practices;
- manuals with codified procedures.

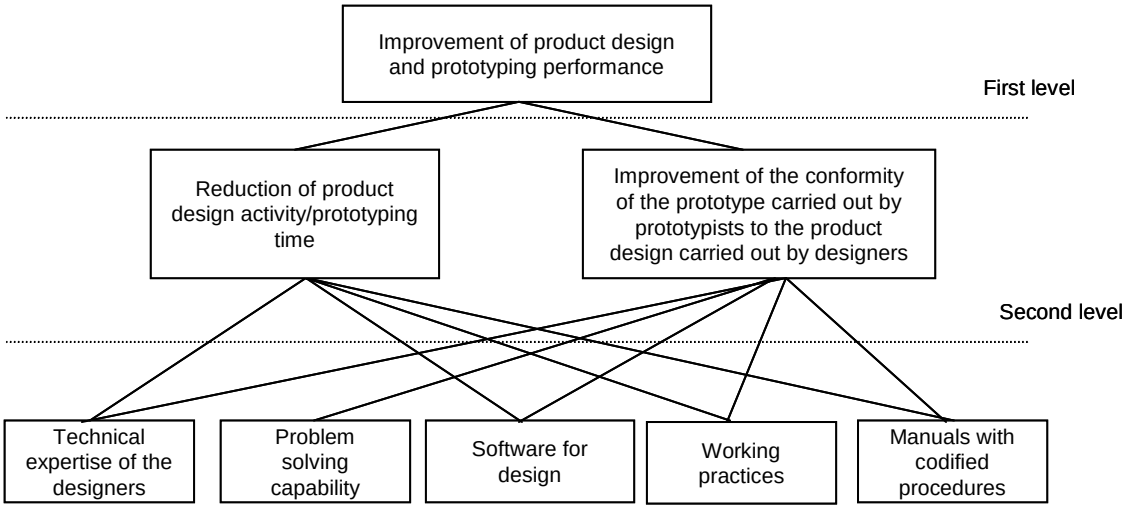

Fig. 6. Calia's Hierarchal structure

The identified *key knowledge assets value driver* with the related performance objectives defined by Calia's managers have been depicted in the hierarchical structure (see Figure 6). The next step has been focused on the generation of the "Knowledge Assets Value Creation Map". The *'matrix of the indirect dependences'* have been filled.

The "pairwise comparison matrix" were completed using the data of hierarchal structure, according to the AHP method. The priority vector "x" and the maximum eigenvalue λmax have been calculated from the matrix. CI and CR have been calculated. According to the AHP method, there was no problem with model inconsistency is (CR=0,03<0,1).

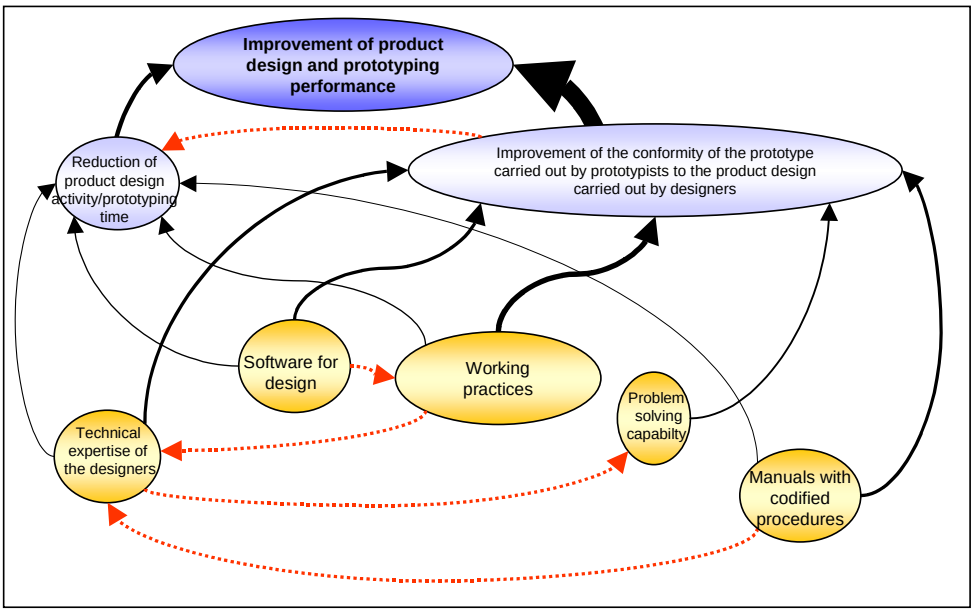

Fig. 7. Calia' s Knowledge Assets Value Creation map

On the basis of results from AHP method and from the data of '*matrix of the indirect dependences*', there has been generated the "Knowledge Assets Value Creation Map" (see Figure 7). On the base of the map's results, the managers have chosen to focus primarily their attention on the working practices, software for design and the manuals with codified procedures.

According the "KAVS", the next step was the choice of KM processes. The company, according to knowledge process taxonomy discussed earlier, selected knowledge sharing and knowledge codification as primary processes to manage the selected knowledge assets. These KM processes have been involved in two KM initiatives:

Design in a 1:1 scale and inter-functional teamwork of designer and prototypists

The teamwork was proposed, involving designer and prototypists, to improve working practice and technical expertise of designers.

The teamwork requires that the designer and prototype builders have to work as a team before the product design is passed on to prototyping. In particular, they have to discuss the product design and identify the problems concerning the production of the prototype. On the basis of the advice from the prototype builder, the designer could change the product design and draw main technical aspects of product into design much earlier in the process to avoid increasing interactions between two teams or a prototype inconsistent with product design. Moreover, the inter-functional team, allowing face-to-face interactions between designer and prototype builder, could facilitate knowledge sharing. The process could contribute to improve the level of technical understanding and planning knowledge among designers and prototype builders.

Till today, the teamwork is not systematically implemented for different reasons: lack of time; cultural rigidities of prototype builders; control and management of top manager of product design activity and prototyping by procedures hamping the change in working practice; lack of proper tools and working spaces.

There has been introduced a design software to support the teamwork. It allows to increase and improve the informative content of the product design. The software allows to produce easily drawings in a 1:1 scale, which forces designer to specify better details and dimensions of the product. The software is daily used today.

Codification of main design and prototyping rules

A design manual has been produced to improve the level of codification of working practices. The manual was built on the basis of an externalisation process of knowledge, as a lot of the working practices were highly tacit in nature, rooted in the actions of designers and prototype builders. The knowledge externalisation was conducted by a team of analysts who, first of all, watched the expert designer and prototype builders and described their operational abilities, and, second, discussed with experts their description of their activities, bringing about corrections and enrichments. In this last phase, open and semi-structured questionnaires were used as support instruments. The tools used in the codification process included hand-written documents, reporting statements in natural language, cause effects diagrams, as well as photographs.

Today, the manual is the codified cognitive property of the company, outlining the design and prototyping activity. It will be used by designers and prototype builders in order to: standardize working practices; improve problem solving capability; facilitate easier access to technical knowledge for designers.

Today, it is possible to point out the following impacts on the performance concerning the Design in a 1:1 scale.

- reduction of time to draw up technical forms of the new product;
- reduction of time to dimension the draws;
- reduction of time to develop all models of the new product;
- reduction of uncertainty of informative content of the draw, i.e. more defined details of the draw; measurements more detailed;
- creation of a database of shapes and models, helping designers in the design activity of the new products;
- reduction of time to correct or modify the draws.

From the performance objectives point of view, the above mentioned benefits have provided: reduction of 30% of the product design activity time; an improvement of the stylistic/functional conformity of the prototype to the product design; reduction of 20% of the time to carry out the wooden structure.

On the basis of the above highlighted difficulties in implementing KM initiatives, the next phase will be focused on a change of some procedures and routines adopted by top and middle management in daily activities of control and management of new product development process.

Final remarks

Knowledge management is a managerial approach facilitating the development and application of organisational knowledge in order to create value and to increase the competitive advantage. But how can an organisation plan and evaluate a KM initiatives designed for improving business performance? How can an organisation collect information about how knowledge drives value and affects business performance? We intended to shed further light on this issue, with this paper, by providing the "KAVS" as a framework to facilitate the design and evaluation of an effective KM. The identification of the *key knowledge assets value drivers* and the visualisation of their interactions allow companies to define managerial priorities and to select the appropriate KM process to put in place. The paper introduces the application of the AHP method to support the above mentioned planning.

The application of theoretical framework has been shown in a case example. The empirical evidences, gathered from the analysis of the case study, support the model as well as provide managerial guidelines about how to implement KM projects within the company. Moreover, the case highlighted the relevance of some organisational and cultural facets (e.g. in particular the board involvement and the cultural openness to the knowledge sharing) for a successful implementation of knowledge management projects.

The proposed theoretical framework aims to: identify intellectual capital value drivers; visualise how intellectual capital value drivers contribute to organisational performance; assist in identifying and evaluating appropriate knowledge management initiatives to grow and maintain the value contribution of such knowledge based assets; adopt a push strategy approach to plan KM initiatives focused on improvement of specific performance objectives consistent with company's strategy; that means to adopt a strategic approach which, selecting and managing knowledge, push knowledge into performance; drive company's strategy and its related knowledge strategy on the basis of the performance results achieved by KM initiatives, according to a pull strategy approach (i.e. lessons learned from KM initiatives could orient performance objectives and then knowledge strategy).

Future developments of the research will be directed towards a depth analysis of the proposed framework. In particular, it is necessary to apply the framework to several cases in order to test and deepen the various phases of the model. Particular attention will be paid to the efficiency measures of KM initiatives. In fact, we have evaluated two

KM initiatives using the measure of effectiveness. The measure of effectiveness represents an assessment of the achievement level of the defined performance objectives. However, these measures do not take account of the cost of implementation of KM initiatives.

Instead, measures of efficiency are process –based measures which take account of the cost of implementation of KM initiatives and consider a ratio of the expected benefit or the utility per unit of KM investment (Robinson et al., 2002)

References

Adler, P.S. (1989): When Knowledge is the critical resource, Knowledge Management is the critical task, IEEE Transactions on Engineering Management, 36, 2.

Amit, R. Schoemaker, P.J.H. (1993): Strategic assets and organisational rent, Strategic Management Journal, 14.

Anderson, M. (2002): Measuring Intangible Value: The ROI of Knowledge Management, [online],http://www1.astd.org/news_letter/november/Links/anderson.html.

APQC, (2001; 2002): Measurement for Knowledge Management, [online],http://old.apqc.org/free/articles.

Armistead, C. (1999) "Knowledge management and process performance" Journal of Knowledge Management,3, 2, 143-154.

Barney, J.B. (1991): Firm resources and sustained competitive advantage, Journal of Management, 17, 1, 99-120.

Beijerse, R.P. (2000): Knowledge management in small and medium – sized companies: knowledge management for entrepreneurs, Journal of Knowledge Management, 4., 2, 162-179.

Bierly, P. Chakrabarti A., (1996): Generic Knowledge Strategies in the US Pharmaceutical Industry, Strategic Management Journal, 17, Winter Special,123-135.

Borghoff, U.M. Pareschi, R. (1998): Information Technology for Knowledge Management, Springer – Verlag Berlin Heidelberg, New York

Burns, J. (2000): Strategies for E-Business in a Global Economy – A Framework for Managing Change. Paper presented at the ACIS, Australia

Carlucci, D. Marr, B., Schiuma, G. (2004): The Knowledge value chain – How Intellectual Capital Impacts Business Performance, International Journal of Technology Management, (forthcoming)

Chong, C. W. Holden, T. Wilhelmij, P. Schimdt, R.A. (2000): Where does knowledge management add value?, Journal of Intellectual Capital, 1, 4, 366-380.

Davenport, T. H. Prusak, L. (1998): Working knowledge: How organizations manage what they know, Boston, Harvard Business School Press.

Firestone, J. M. (2001): Estimating Benefits of Knowledge Management Initiatives: Concepts, Methodology, and Tools, Journal of the KMCI, Vol. 1, No. 3.

Grant, R.M. (1991): The Resource – Based View of Competitive Advantage: Implication for Strategy Formulation, California Management Journal, 33, Spring.

Grant, R. M. (1994): L'analisi strategica nella gestione aziendale, Il Mulino, Bologna.

Haanes, K. Lowendhal, B. (1997) The unit of activity: towards an alternative to the theories of the firm. Strategy, culture and style, John Wiley & Sons, London.

Hall, R. (1993): A framework linking intangibles resources and capabilities to sustainable competitive advantage, Strategic Management Journal, 14, 607-618.

Hansen, M. T. Nohtria, N. Tierney, T. (1999): What's Your Strategy for Managing Knowledge?, Harvard Business Review, March-April.

Heisig, P. (2003): Il Knowledge Management sincronizzazione tra persone, processi e tecnologie dell'informazione, in: Bartezzaghi, Raffa, Romano (Eds): Konwledge management e competitività, Napoli: Edizioni Scientifiche Italiane, 19-38

Kingsley, M. (2003): Measuring the Return on Knowledge Management, [online], http://www.llrx.com/features/kmroi.htm

KPMG, (2003): Etude Européenne KPMG sur la Gestion des Connaissances, Enquête 2002/2003 sur la Gestion des Connaissances, KPMG Knowledge Advisory Services, Amstelveen, Pays Bas.

Lee, C. C. Yang, J. (2000): Knowledge value chain, Journal of Management Development, 19, 9, 783-793.

Leonard-Barton, D. (1995): Wellsprings of Knowledge, Boston Massachusetts: Harvard Business School Press.

Marr, B. Schiuma, G. (2001): Measuring and Managing Intellectual Capital and Knowledge Assets in New Economy Organisations, in Bourne, M. (ed.), Handbook of Performance Measurement, Gee, London.

McHugh, M. W. (2002): Measuring the business Impact of KM in Practice, Proceedings of 3rd European Conference on Knowledge Management, ECKM2, 24-25 September, Dublin.

Neely, A. Adams, C. Kennerley, M. (2002): The Performance Prism: The Scorecard for Measuring and Managing Business Success, Financial Times Prentice Hall, London.

Nelson, R. (1991): Why Do Firms Differ and How Does It Matter?, Strategic management Journal, 12, 61-74.

Nelson, R. Winter, S.G., (1982): An Evolutionary Theory of Economic Change, Harvard University Press, Cambridge

Nonaka, I. Takeuchi, H. (1995): The Knowledge-creating Company: How Japanese Companies Create the Dynamics of Innovation, Oxford University Press, New York.

Perkmann, M. (2002): Evaluating the impact of knowledge projects, Measuring knowledge value, july 24-25, ArkGroup [online] http://www.destination.com/articles

Petrash, G. (1996): Dow's journey to a knowledge value management culture, European Management Journal, 14, 365-373.

Prahalad, C.K. Hamel, G. (1990): The core competence of the corporation, Harvard Business Review, 68, 3, 79-91.

Quintas, P. Lefrere, P. Jones, G. (1997): Knowledge Management: a Strategic Agenda, Long Range Planning, 30, 3, 385-391.

Robinson et al. (2002): Evaluating Knowledge Management Strategies: an IMPaKT Assessment, Proceedings of 3rd European Conference on Knowledge Management (ECKM2, 24-25 September, Dublin.

Roos, J. Roos, G. Dragonetti, N.C., Edvinsson L. (1997): Intellectual Capital: Navigating in the New Business Landscape, Macmillan, London.

Ruggles, R. (1998): The State of the Notion: Knowledge Management in Practice, California Management Review, 40, 3, 80-89.

Rumelt, R.P. (1994): Foreword in Competence Based Competition, The Strategic Management Series, Hame G. and Heene A. (Eds.), John Wiley & Sons, Chichester (UK).

Saaty, T.L. (1980): The Analytic Hierarchy Process, McGraw-Hill International, New York, NY, U.S.A.

Saaty, T.L. (1994): Fundamentals of Decision Making and Priority Theory with the AHP, RWS Publications, Pittsburgh, PA, U.S.A.

Savage, C.M. (1990): Fifth Generation Management: Co-creating Through Virtual Enterprising, Dynamic Teaching, and Knowledge Networking. Butterworth-Heinemann, Newton, MA.

Sveiby, K. E. (1997, 2000, 2001 a), [online], http://sveiby.com

Sveiby, K.E. (2001 b): A knowledge based Theory of the firm To guide strategy formulation, Journal of Intellectual Capital, Vol.2, No.4, pp 344-358.

Teece, D.J. (1998): Capturing value from kassets: the new economy, market, and intangible assets, California Management Review, 40, 3, spring, 55-79.

Teece, D.J. (2000) “Strategies for Managing Knowledge Assets: the Role of Firm Structure and Industrial Context”, Long Range Planning, 33, 35-54.

Triantaphyllou, E. Mann, S. (1995): Using the analytic hierarchy process for decision making in engineering applications: some challenges, Journal of Industrial Engineering: Applications and Practice, 2, 1, 35-44.

Wiig, K.M. (1997 a): Knowledge Management: An Introduction and Perspective, The Journal of Knowledge Management, 1, 1, September, 6-14.

Wiig, K.M. (1997 b): Integrating Intellectual Capital and Knowledge Management, Long Range planning, 30, June, 399-405.

Zack, M. (1999) “Developing a Knowledge Strategy”, California Management Review, 41, 3, 125-145.