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**Knowledge Management:
A Strategic Cost Management Perspective**

by

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FIRST DRAFT

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ABSTRACT

La gestione dell'impresa basata sulla conoscenza è da tempo oggetto di attenzione negli studi e nelle prassi di tipo economico-aziendale poiché capace di sviluppare vantaggi competitivi difendibili e duraturi nel tempo (Barney 1986, Collis and Montgomery 1995, Penrose 1959, Spender 1994, Teece, Pisano and Shuen 1997). In questa prospettiva, gli approfondimenti hanno riguardato sia le implicazioni strategiche e organizzative, che quelle tecnologiche, del controllo di gestione e della comunicazione economico-finanziaria. Questo lavoro affronta il tema dell'impatto della conoscenza sulla struttura dei costi e della performance dell'impresa. In particolare, tramite l'impiego dell'apparato concettuale e metodologico dello strategic cost management verranno analizzati l'impatto del tipo di conoscenza implicita nelle attività e nei costi dell'impresa, le relative determinanti, le eventuali relazioni con il valore generato dalle suddette attività e il profitto potenziale dell'impresa. Dopo la premessa teorica che ha motivato questa ricerca, verrà illustrato il modello di ricerca e la sua applicazione a quattro imprese italiane operanti nel settore meccanico. Pur essendo la ricerca ancora in corso, i risultati qui riportati mostrano che l'informazione di costo può aiutare a supportare i processi decisionali collegati allo sviluppo e alla gestione della conoscenza.

Organizational knowledge is receiving increasing attention in the management literature because of its claimed capability to create a competitive advantage. In recent years, notable research efforts have been addressed to strategic, organizational, technological, financial and management reporting issues linked to the knowledge role in organizations.

This paper focuses its attention to the way knowledge affects firms cost structure. Most specifically, by using recent research development in the field of strategic cost management, the paper investigates the activities related to organizational knowledge, their cost and cost drivers, and their impact on firm's profit potential with the aim to provide information for effective strategic decision making and control. After a brief literature review of knowledge management theories and applications, research model and methodology will be elicited. Then the model will be applied to four Italian companies operating in the mechanical industry. While this paper is a work in progress, evidence shows that strategic cost management framework might represent a valuable source for understanding and managing the critical aspects related with knowledge management and measurement (specifically what a firm knows or should know, which activities should a firm perform in order to capture, develop or leverage its knowledge). In the conclusive part theoretical and methodological issues will be reported as well as future research efforts.

1. Introduction

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This paper focuses its attention to the way knowledge affects firms cost structure. Most specifically, by using recent research development in the field of strategic cost management, the paper investigates the activities related to organizational knowledge, their cost and cost drivers, and their impact on firm's profit potential with the aim to provide information for effective strategic decision making and control.

After a brief literature review of knowledge management theories and applications, research model and methodology will be elicited. Then the model will be applied to four Italian companies operating in the mechanical industry. While this paper is a work in progress, evidence shows that strategic cost management framework might represent a valuable source for understanding and managing the critical aspects related with knowledge management and measurement (specifically what a firm knows or should know, which activities should a firm perform in order to capture, develop or leverage its knowledge). In the conclusive part theoretical and methodological issues will be reported as well as future research efforts.

2. Background

In recent years, a plethora of notable research and practice efforts has focused its attention to the basic understanding of which models, systems and dynamics better create, disseminate (Guthrie 2001) and measure knowledge within organizations (Lev 2000). Specifically, these efforts span from strategy to information technology and human resource management, from financial reporting to management accounting, while little work has been focused at the cost management level.

At the strategic management level, for instance, the focus has been addressed to the comprehension of “the what” an organization currently knows, “the what” it needs to know in order to be competitive and “the how” it should align its capabilities to those ones required (Grant 1991, Zack 1999). With the purpose to exploit a knowledge-based strategy knowledge has been codified in several ways. Indeed, it might be tacit or explicit (Nonaka 1994), specific or general, declarative or procedural, or at an individual or collective level (Zack 1999). As a consequence, managers look for models and tools to remove any knowledge barrier or to enhance the existing one in a value creation

pathway. In order to sustain a competitive advantage knowledge has to be dynamic (Teece, Pisano and Shuen 1994): organizations should be able to modify, combine or integrate it with other (Grant 1996), both internal or external the boundaries of the firm (Lorenzoni and Lipparini 1999, Cohen and Levinthal 1990). In this perspective, alliances, partnerships, interfirm relationships have become effective choices for gaining, leveraging, or developing new competencies and resources (Westney 1988, Hagedoorn 1993, Kogut 1988, Mowery et al 1996). In deploying a knowledge-based strategy a key issue is the understanding of which activities, resources and capabilities an organization should address its efforts. Moreover how a firm can effectively accumulate and enhance its knowledge asset stock and how it can accelerate its competitive use (Dierickx and Cool 1989), or how a firm can avoid the risk to have its resources locked into a limited profit potential path. In this perspective strategic management needs not only qualitative models, but also quantitative frameworks capable to capture the effects between their decisions and the impact on their firm's competitive and financial performance.

Information technology usually plays a relevant role in developing a knowledge-based organization. IT applications allow firms to better capture, storage, retrieval and share documented knowledge (Zack 1999 and 1999b). Recent evidence from the field (KPMG 2000) shows that about 68% of the UK, Europe and US organizations has launched knowledge initiatives aimed to improve competitive advantage or customer focus, to reduce cost, to enhance product innovation performance, and so on. Specifically organizations are setting decision support and expert systems, database management, on line document systems repository, internet, intranet and extranet applications in order to enable managers to route, share and distribute information and moreover in codifying knowledge (Zack 1999b). Nevertheless when these large efforts are not connected with strategy they risk to be of limited value (Zack 1999, KPMG 2000), or to create complexity, uncertainty, ambiguity, equivocality (Zack 1999b). Therefore the understanding of which IT projects and initiatives best aligned to the firm's strategy is a critical management issue, as well as their impact on its profit potential.

Human resource management mostly aimed to comprehend and to evaluate skills, competencies and capabilities (see Boyatzis 1982 and 1993) can provide a potential tool for the search and the exploit of knowledge, but as its focus is quite often limited to individuals and not to the organization and strategy needs it risks to fail to set "static" valueless initiatives (knowledge key performance indicators, rewards and training tools and systems).

In order to measure and best show where knowledge efforts should be addressed some work has been done in the financial and management reporting areas, while very little from a cost accounting perspective. In the financial accounting and reporting area, the intangible nature of knowledge has

raised relevant questions about how to measure, report and communicate a firm's value. It has been argued that in the existing financial report system only a small part of a firm's market value (1: 6) appears on the balance sheet, while the remaining represents intangible assets (Lev 2000). This deficiency tends to lead to some serious negative consequences for the economic system, such as (Lev 2000) an higher cost of capital that limits investments and growth, an above the average information asymmetry that systematically undervaluates the intangible-intensive companies, potential insider trading gains, deterioration in the usefulness of financial with a potential increasing of a firm's performance volatility and manipulation of financial information through intangibles. With the aim of overcoming the above mentioned deficiencies, new ways to measure and report knowledge are emerging (Guthrie 2001). The common idea of these models is to integrate financial information with some non-financial value generating aspects related with intellectual capital. The Celemi intangible asset monitor (Sveiby 1997), the Skandia value scheme (Edvinsson and Malone 1997), the balanced scorecard (Kaplan and Norton 1992, 1996), or the value chain scoreboard (Lev 2000) are some notable attempts to standardize knowledge reporting and to enhance the investor's capability in comprehending firms value. It has been argued (Mouritsen et al 2001) that reporting intellectual capital (IC) indicators might be problematical because they do not fully describe or prescribe the development of intellectual capital resources, since they tend to focus the attention away from the context the represent. "Measurement and management are related. If measurement does not make management – or intervention – possible there is no need for it" (Mouritsen et al 2001). Therefore these attempts, if standing alone considered, risk to be a simply knowledge or IC indicator library, and fail to be useful for management purposes related with the understanding and management of which activities and competencies are best or accelerate the value creation process. Management accounting studies have so far mostly evolved to multidimensional performance measurement systems. The tableau de bord (Lebas 1996), the balanced scorecard (Kaplan and Norton 1992, 1996), or the Lynch and Cross scheme (1991) are some popular frameworks. These models have largely addressed their attention to non financial measures related with customers focus, time, quality and productivity parameters, at different stages of the organization. Except the Kaplan and Norton framework which explicitly highlights organizational learning and growth as a primary strategic and long term performance measure, little attention has been paid to the knowledge planning and control activity.

At the same level cost accounting and management studies and practices have mainly focused their interest on categorizing the cost of the resources employed with knowledge for reporting purposes. Lev (2000) in his value chain scoreboard suggests, for instance, to give evidence to the cost related with IT, R & D, training, marketing and customer acquisition activities, ... in order to allow the

market to understand where and at what stage of the life time are the intangible projects of a specific firm. As in the case of financial and management reporting the relationship between activity, cost and value is fairly missed and then it provides little guidance on the understanding and management of a company's effective knowledge based strategy.

While cost accounting has so far focused its attention on traditional cost objects and purposes (Lorenzoni, Shank and Silvi 1999, McNair, Polutink and Silvi 2001), a different perspective named as "strategic cost management" (SCM) (Shank and Govindarajan 1993, 1989) has emerged with the aim to use cost information, provided from several and often heterogeneous sources, to create a competitive advantage. In this framework, key issues are where the firm should move in the value chain, which activities should be performed and how cost can be compressed and value enhanced. Specifically, Shank and Govindarajan (1993) argue that cost analysis and cost management must be tackled broadly with explicit focus on the firm's strategic positioning, its overall value chain, and the full set of cost drivers for the firm. Recent strategic cost management developments (McNair, Polutnik and Silvi 2001 and McNair, Polutnik and Silvi 2001b) have further investigated the relationship between the costs of the firm and the value the firm provides to its customers as a primary key to the ability of the firm to reach its profit potential. Specifically, this framework has introduced the value creation model (VCM) where the firms' cost structure in terms of value added, non-value added but required activities, as well as of waste (McNair 1994, Womack and Jones 1996). A firm's cost structure is aligned with value attributes embedded in products and services. The VCM model seeks to understand the trade-off between what the customer is willing to pay for a product/service bundle (value) and the cost the firm bears to provide what the customer desires. Based on these tradeoffs, VCM defines value multipliers, which help the firm to determine which activities managers should best focus on in order to develop a competitive advantage. SCM and VCM investigate areas where it might be strategically convenient to address efforts and investments, but no explicit mention is made with the knowledge-based view of the firm.

3. Research model

Looking at the issues mentioned above, each framework presents some critical aspects in the fully comprehension of where knowledge resides in an organization or where managers should focus their resources for capturing, enhancing or distributing knowledge. Strategic management, information technology, human resource management are mostly qualitative frameworks and there is a potential in providing them models and tools capable to measure and to highlight in an efficient and effective way where their efforts should be addressed. Financial reporting and management accounting have so far given little attention to the deployment of useful model for planning,

managing and controlling a knowledge-based strategy. Strategic cost management recent developments are designed for making relationship between activity, cost and value more visible in order to develop a competitive advantage. Specifically value chain analysis, cost driver analysis and value creation analysis might be of relevant interest for supporting a knowledge-based strategy.

Value chain analysis. SCM focuses analytic attention on the distribution of activities within the system in order to reconstruct the value generated overall by the industry or in an network of firms and to grasp how value is distributed between the various actors that contribute to its formation (Shank and Govindarajan 1989 and 1993). The final outcome of analysis is to identify those phases of transformation that achieve the best return within the value system, towards which financial resources should consequently be addressed. In a growing number of businesses, value is progressively shifting towards activities that are 'intangible', are located further 'downstream', and involve a high degree of interaction with the customer (Slywotzky 1996, Wise & Baumgartner 1999). Both General Electric and Coca Cola have significantly enhanced their performance by focusing managerial and financial resources on these end-stages (Slywotzky & Morrison 1997). Electrolux has recently sold off its components plants (manufacturing electric motor compressors) in order to concentrate on commercial activities. Embracing this philosophy, a small Italian clothing manufacturer has identified its profit zone (Slywotzky & Morrison 1997) in brand reinforcement and distribution activities. Since this firm's strengths are not in manufacturing but rather in designing collections and monitoring the distribution network, the investment of financial resources in improved cutting systems or in new sewing machinery would achieve returns smaller than those likely to accrue from investing in marketing and design activities. In the US automobile industry, car marketing services like finance, insurance, maintenance and servicing are all highly profitable, whereas manufacturing and sales remain far less so (Gadiesh & Gilbert 1998). As in many other sectors, the ratio between the total number of products (cars) in circulation and the number of products (cars) yearly manufactured has been rising steeply from 1, in the 1950s, to 13 today (Wise & Baumgartner 1999). This situation has focused the attention on an increasingly broad user base, rather than on stable production volumes. Hence the 'downstream' shift in managerial focus. The trend towards concentrating energies on core competencies has been gathering for several years, even if it is not always easy to pinpoint just what is 'core' and what is not.

Cost driver analysis. In SCM's framework, competitive advantage and effective supply chain management presume a good understanding of the causal factors which drive cost incurrence. Costs, indeed, are caused by many interrelated factors. Some factors are implicit in the firm's choices about its underlying economic structure (structural cost drivers). They include strategic choices concerning: scale (size of investment to be made in manufacturing, R&D, marketing

areas), scope (degree of vertical integration), experience (number of times the firm has already done what it is doing again), technology (type of process technologies used at each step of the firm's value chain) and complexity (product or service line breadth). Structural cost components can be managed (up or down), but only by changing the fundamental economic elements of how the business competes. Such changes are far from easy to implement. Also, in general, structural factors are not monotonically scaled. That is, one can have too much scale, or complexity, as well as too little. This makes optimization very tricky. Costs also are driven by the firm's ability to execute successfully within its given structure (executional drivers). In particular, executional cost drivers include work force involvement (commitment to improvement), total quality management (Kaizen and zero defects), capacity utilization, plant layout, product configuration, and linkages with customers and suppliers. In general, executional cost drivers are monotonically scaled, so that more is always better (Riley, 1987). Lower costs can be achieved either through redesigning the firm's value chain, reassessing the coherence of current activities compared with the customers' business requirements, reconfiguring the structural business model, or better executing within that model.

Value creation analysis. The VCM model (McNair, Polutnik and Silvi 2001) seeks to understand the trade-off between *what* the customer is willing to pay for a product/service bundle (value) and the cost the firm bears to provide what the customer desires. Specifically, VCM defines the firms' cost structure in terms of value added (i.e. one directly related to the reason why the customer purchases the product), non value added but required (i.e. an essential support activity whether in relation to administration, personnel management, maintenance, etc.), and waste activities (i.e. those activities resulting from mistakes, duplications, reminders, etc.). Evidence from the field (McNair, Polutnik and Silvi 2001) shows that a large proportion (over 50%) of total activities cost are non value added but required and waste, with several implications for reaching or improving firms profit potential. In the VCM model, a firm's cost structure is then aligned with value attributes embedded in products and services as defined by the *market*. Table 1 shows an example (McNair, Polutnik and Silvi, 2001b) of the activity costs a firm incurred to deliver the value attributes desired most by their customers. This table highlights significant differences between the market weightings of attributes and the total expenditures for service reliability and technical performance, or between what the firm's customers are willing to pay for and VA expenditures reveals that this firm is currently overspending for the delivery of technical reliability and price. Moreover, it shows that this firm is currently under-spending for technical assistance and technical performance and VA expenditures in these categories are severely misaligned with market weight.

Table: 1 Firm's Attribute Cost and Customer and Management Requirement

Value Attributes	VA	VA %	NVA	NVA %	W	W %	Total	Total Cost %	Market Weight
Technical Reliability	645	31%	201	18%	253	23%	1,099	26%	21%
Price	579	28%	218	19%	160	15%	957	22%	19%
Service Reliability	390	19%	507	44%	405	37%	1,302	30%	19%
Life Cycle	293	14%	79	7%	92	8%	464	11%	15%
Customer Assistance	113	5%	141	12%	165	15%	419	10%	14%
Technical Performance	35	2%	0	0%	12	1%	47	1%	12%
TOTAL	2,055	100%	1,146	100%	1,087	100%	4,288	100%	100%
AVERAGE		48%		27%		25%	100%		

Source: McNair, Polutnik and Silvi (2001)

VCM enables the firm to develop a better understanding of the market and its position in the market through the alignment of activities and attributes. Based on these relationships, VCM defines value multipliers (revenues per attribute divided per value added cost per attribute), which might support managers of which activities the firm should focus on in order to develop a competitive advantage. Table 2 shows the value multipliers calculated for the above mentioned firm. While the average multiplier is at 12.7, value multipliers pertaining to customer assistance and technical performance are significantly higher and value multipliers for technical reliability and price are significantly lower than the average multiplier. Without getting specifically into the implications related with this model (see McNair, Polutnik and Silvi 2001 and McNair, Polutnik and Silvi 2001b), the usage of value multipliers can support a firm in analyzing and debating about what is value creating and what is not (i.e. R & D or customer service, low cost or design, timeliness or reliability, ...) and where it should focus its efforts, resources and competencies.

Even though knowledge is not part of the SCM and VCM glossary, it seems to be highly embedded in the phenomena they study and suggest. For instance, value chain analysis might indicate where are our competencies and where they should address or develop. Cost driver analysis can make visible lacks or potentials in knowledge, as well as VCM that allows managers to understand where and for what are the resources employed.

Table 2: Revenue Multipliers for a Firm

	Market Weight	Revenues	Value Added Cost	Revenue Multipliers
Technical Reliability	21%	5,502	645	8.5
Price	19%	4,978	579	8.6
Service Reliability	19%	4,978	390	12.8
Life Cycle	15%	3,930	293	13.4
Customer Assistance	14%	3,668	113	32.5
Technical Performance	12%	3,144	35	89.8
TOTAL	100%	26,200	2,055	12.7

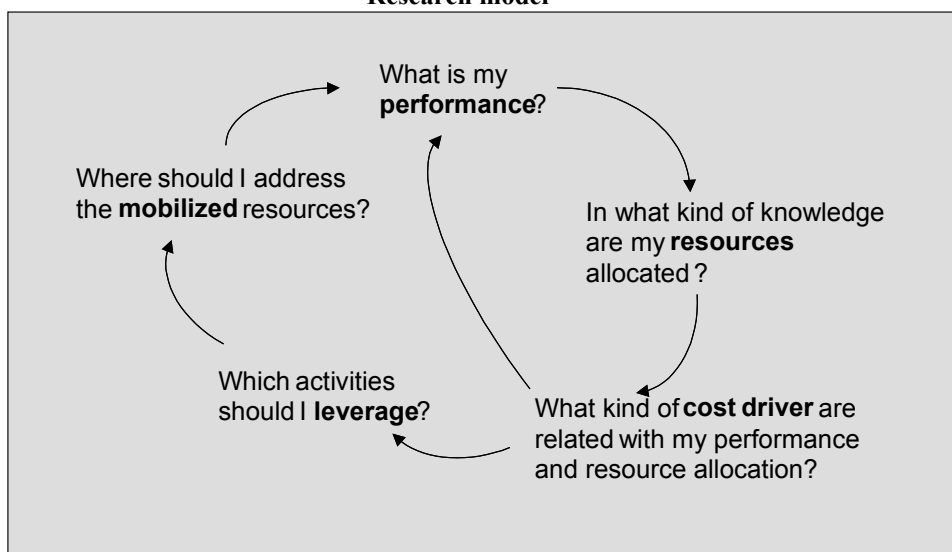
Source: McNair, Polutnik and Silvi (2001b)

In general terms a correct alignment between activity, cost and value reduces NVA and W might reduce slacks, mobilize resources and therefore enhance the value created by VA activities (McNair, Polutnik and Silvi 2001, Macri, Silvi and Zanoni 2000, Lorenzoni, Shank and Silvi 1999). These considerations show a potential benefit for developing an approach that uses SCM and VCM framework for supporting the management of knowledge within an organization. In particular, the research approach is then developed around the primary question related with the possibility that strategic cost management frameworks might represent a valuable source for understanding and managing the critical aspects related with knowledge management and measurement (specifically what a firm knows or should know, which activities should a firm perform in order to capture, develop or leverage its knowledge).

Figure 1 elicits this research model.

Fig. 1

Research model



It starts with a firm's performance appraisal where profitability, value chain positioning and cost structure (in terms of VA, NVA and W) are evaluated, then the model analyses what kind of knowledge is embedded in the activities and related cost. Specifically, at this stage of the research, the purpose is to understand:

1. how important is knowledge in carrying out an activity in an effective way;
2. what kind of knowledge is incorporated in the activity.

Importance of knowledge. Using Stewart (1997) concept where skills are defined as “commodity skills” (abilities that are not specific to any particular business and readily obtained), “leveraged skills” (knowledge that is not specific but valuable to a particular company) and “proprietary skills” (company's specific and distinctive skills), two dimensions are then defined: low relevance (commodity skills) and high relevance (leveraged and proprietary skills). Low relevance includes activities like filling orders, dispatching, delivery time checking, material handling, some production phases, payroll management, expeditation, High relevance category includes activities like market demand development, R & D, customer assistance, production scheduling and so on: in other words activities where knowledge and competence play a critical role for sustaining a firm's competitive advantage. This classification might help the research in the understanding of where resources (cost) are allocated and how important is the activity for the firm's competitive edge.

Kind of knowledge. While several ways of categorizing knowledge have emerged (Zack 1999b), in this early part of the research Nonaka's (1994) framework, where knowledge is codified as tacit or explicit, has been followed. Tacit knowledge (Zack 1999b) “is subconsciously understood and applied, difficult to articulate, developed from direct experience and action, and usually shared through highly interactive conversation, story telling and shared conversation. Explicit knowledge, in contrast, can be more precisely and formally articulated”. Tacit knowledge includes individual activity or routines. Specific examples of individual and routine activities (tacit) are customer dealing, technical problem solving, public relations, marketing initiative, new product developments, delivery time checking, supplier expeditation, human resource management and so on. On the other hand explicit knowledge is related with activities that are executed by using technologies and formal procedures. Explicit activities are considered order filling, inbound logistic, supply ordering, material and product checking, quality control, production, production scheduling, CAD.

The third step of the research model is related with the understanding of the activity cost drivers. Specifically, by using the above mentioned Shank and Govindarajan (1993) cost driver framework in this phase we try to answer to the basic question of what is the cause of cost arising and if this

effect is due to the way knowledge is managed or embedded in the activities. Cost drivers might affect firm's cost structure or performance and for this reason they are also related with firm's cost structure and performance assessment (step 1).

After having performed these first three steps an assessment about relationship between performance, type knowledge embedded in activity cost and related cost drivers might be elicited. At this level there might be the opportunity to identify some key actions in driving a firm towards its profit potential (step 4). Figure 2 reports an example of what a firm might do with the information provided by the assessment.

Figure 2
High vs low relevance and tacit vs. explicit knowledge: possible initiative

High relevance	leverage	defend
Low relevance	automate	outsource
	Tacit	Explicit

Specifically, a large presence of tacit activities related with low importance (relevance) of knowledge might highlight opportunities of efficiency recovery through an automation of these activities (Stewart 1997) with a possible containment of NVA and W cost. While tacit activities related with high relevance of knowledge (i.e. design, sales capabilities, ...) might explain a firm's specific advantage where making them explicit might be dangerous for a long term profitability. At the same time this situation can hid a firm's specific risk if these resources fail. Low relevance related with explicit knowledge activities might highlight opportunities of outsourcing (Stewart 1997), while for a sustainable competitive advantage the last combination between high relevance and explicit knowledge activities should be defended by proprietary tools (i.e. patents, trademarks) difficult to imitate or replicate. Leveraging the right activities should address a firm towards its profit potential and specifically, through a correct alignment between cost and value, might contain NVA and W and mobilize "stuck" resources to be employed in a value creation process (step 5), capable to increase the firm's performance.

Therefore, this framework can increase the effectiveness of knowledge management: linking SCM and VCM frameworks to the knowledge-based view of the firm might have the potential to fill the existing gap between strategy and measurement. Strategic management, IT decisions, human resource management, as well as knowledge measurement and reporting might enjoy the support of strategic cost management frameworks.

4. Research methodology

As already said, the research approach was developed around the primary question related with the possibility that strategic cost management frameworks could represent a valuable source for understanding and managing the critical aspects related with knowledge management and measurement.

At this stage of the research specific research questions were posed as follow:

- i. Can knowledge be measured in order to understand how it impacts on a firm's cost structure and on its performance?
- ii. In which activities is knowledge embedded?
- iii. What is the effect of knowledge on a firm's cost performance?
- iv. Can the cost drivers of the activity be related with knowledge?
- v. Does the understanding of the cost of knowledge provide any management implication?

Due to the complexity of this kind of analysis a case-study methodology has then been used. Case study research method is indeed particularly suited to the characteristics of the data analysed and to the wide variety of sources used (Hartley 1994, Yin 1989). In particular, the present work has used case studies as "instrumental cases" (Stake 1998), where the case itself is of secondary interest, while it simply facilitates the understanding of some more general issues.

Taking these research questions as a starting point, the investigation methodology was articulated in the following steps:

1. focus on a sample of firms operating in the same sector or macro-industry
2. mapping the firm's organizational units;
3. identification and analysis of activities performed by each organizational unit;
4. attribution of costs to individual activities;
5. definition of the activity cost driver
6. plotting the activities in terms of:
 - a. relevance of activities with regard to value: value activities (VA), 'non-value but required' activities (NVA), and 'waste' (W);

- b. relevance of the role of knowledge in performing the activity (low vs. high);
- c. nature of the knowledge embedded into the activity (tacit vs. explicit).

7. data analysis.

Steps 1 to 6a have been performed using our strategic cost management data set which contains cost information data of a certain number of Italian firms operating in a variety of industry (manufacturing and service organizations). This data set was built following a research protocol aimed to understand activities and related cost, cost drivers and the value provided by them and represents a primary source for cost management studies.

Concerning the relevance of the role of knowledge in performing the activity (step 6b) the purpose was to understand how important was knowledge in carrying out the specific activity in an effective way. Specifically, two dimensions were defined: low relevance (commodity skills) and high relevance (leveraged and proprietary skills). While low relevance included activities like filling orders, dispatching, delivery time checking, material handling, some production phases, payroll management, high relevance category included activities like market demand development, R & D, customer assistance, production scheduling and so on: in other words activities where knowledge and competence played a critical role for sustaining a firm's competitive advantage. This step was conducted by discussing with managers around the basic question if the individual in charge of the activity might be easily and in a short time be substitute with no great impact on the firm's efficiency and effectiveness performance.

While this category has not presented any specific problem in the definition, more problematical has been the issue related with step 6c. Following Nonaka's (1994) framework the nature of the activity has been split in tacit when it included individual activity or routines and in explicit when the activity was executed by using technologies and formal procedures. Specific research questions at this step were for instance:

- "is this activity placed within a inter-organizational routine? Is it a shared and/or customary activity?"
- "is this activity carried out following a formal procedure (i.e. ISO 9001)?"
- "is the activity derived by the usage of specific technologies and software?"
- "is the output of the activity strictly connected with the individual that performs it?"

Specific examples of individual and routine activities (tacit) were customer dealing, technical problem solving, public relations, marketing initiative, new product developments, delivery time checking, supplier expeditation, human resource management and so on. Explicit activities were considered order filling, inbound logistic, supply ordering, material and product checking, quality control, production, production scheduling, CAD, ... In this part of the research the case study

methodology was particularly suited as some activities might be at a border line level. As well argued (Lev 2000), intangibles are frequently embedded in physical assets and in labour, leading to a considerable interaction between tangible and intangible assets in the creation of value. In our research when in a specific activity (i.e. design which uses a specific but not unique software) was more relevant the tacit nature than the explicit one we classified the activity as tacit. In other word we tried to understand which of the two were mostly necessary in carrying out a specific activity or result.

At step 7 cost data were aggregated and sorted out in order to understand in which activities (both relevant and non relevant, tacit and explicit) resources were allocated and with which value and cost driver profile.

7. Evidence¹

At this early stage the research has been conducted on four Italian firms² operating in the mechanical macro-industry. Furthermore, it has not investigated the relationship between knowledge management and value chain positioning and value multipliers.

Firms facts

Table 3 shows some details of the firms we surveyed. Even though these firms operate in different business with different level of competition and size they present some typical and similar activities of a mechanical organization like R&D, job order production and scheduling, customer assistance, high level of suppliers utilization, or material handling and storage.

Table 3
Field Data Summary

Company	Revenues (\$Mil)	Year	Number of Employees	Profitability (ROS)	Industry	Stage in Business Life Cycle
Icecream Co.	\$58.0	98	350	23%	Ice cream equipment	Mature
Woodwork Co.	\$32	98	n.a.	12%	Wood working machines	Expansion
Frangor Co.	\$12	99	80	4%	Agricultural equipment	Decline
Motorbike Co.	\$275	99	n.a.	9%	High CC Motorbikes	Expansion

¹ The author would like to thank Dr. Franco Visani, of University of Bologna, Forli Campus, Italy, for his help with data collection.

² For discretionary reasons the names of the firms and some figures are disguised.

Specifically, Icecream Co. deals with the icecream equipment industry. It operates on a worldwide scale with 350 employees. Icecream Co philosophy is to make its customers (icecream shops) profitable and in this perspective it offers them high performance products as well as service such as training, customer care and assistance. It manages effectively its supply chain and a part of its suppliers operates on a “free pass” basis. High ROS profitability highlights a competitive advantage. Woodwork Co. with more than \$380 million revenues and about 2,000 employees is a worldwide leader in the wood working machines industry. Innovation, brand awareness and a customer focus are its main competitive advantage. It performs a large part of the value chain activities (from foundries to assembly) and it has been involved in an important total quality management program. The analysis was performed in a selected high growth business unit (panel and sizing and squaring machines). In 1998, its revenues amount to 32 million of US\$ with a 12% return on sales. Frangor Co. operates in the agricultural machines industry (rotary tillers, spading machines, harrows, etc.) and employs 80 people. The industry is facing a critical moment, due to a declining demand in the agricultural machines’ industry. Revenues in 1999 amount to approximately 12 million US\$ and profitability in terms of ROS is about 4 percent. Frangor’s most important activities are R & D, customer care, assembly and marketing and sales, while its value chain shows that 80 percent of the value created along the pipeline from the suppliers of components to the end users is captured by the distributors and a great part of the value is created by those activities valued most by the customers. Finally Motorbike Co operates in the High CC motorbike growing industry. Its revenues are increasing at a double-digit yearly rate. Motorbike focuses its attention on the R & D and marketing activities, while most of the components and parts are provided by its suppliers. In the last three years Motorbike Co. has been involved in a lean management program that spans from its internal processes to the reengineering of its first and second tier suppliers.

As already mentioned, cost data were already available through our “strategic cost management data set”. Table 4 shows the firms cost structure in terms of value added activities (VA), non value added but required (NVA) activities and waste (W) as a percentage of total activity cost and of revenues. In general this table highlights that a large amount of cost are related with non value added and waste activities, and they reduce significantly firms profit potential³. Specifically, waste are mostly due to redundancies, sign of inappropriate processes, delays, poor quality, lack of information and of adequate capabilities or workforce involvement. NVA activities are mainly related with those ones performed by support departments. In recent years many ways of containing this cost category have emerged. IT development (intranet, extranet, ASP, ERP and extended ERP),

outsourcing or network of firms-based strategies (Lorenzoni and Baden Fuller 1995, Lorenzoni, Shank and Silvi 1999) have led firms to contain NVA or W cost.

Table 4
Firms cost structure

Activity cost	Icecream Co		Woodwork Co		Frangor Co		Motorbike Co	
	% of total activity cost	% of revenue	% of total activity cost	% of revenue	% of total activity cost	% of revenue	% of total activity cost	% of revenue
Value added	44%	18%	48%	14%	47%	17%	43%	17%
Non value added but required	32%	13%	40%	12%	32%	12%	38%	15%
Waste	24%	10%	12%	4%	21%	8%	19%	7%

At a superficial level knowledge seems to affect both these activity cost. Typical example might be the case of how a specific product is configured or managed along its overall life cycle time, or how information are shared or reach different departments. Supply chain management, or customer dealing, or assistance sometime entail redundancies, lacks of comprehension and so on.

The Cost of knowledge

This part of the research concerned the possibility to measure the cost of knowledge. Using the above-mentioned activity based approach (see Kaplan and Cooper 1998) cost (resources) were related with the type of knowledge (low vs. high relevance, tacit vs. explicit). This approach might help the understanding of what kind of knowledge was embedded in the activities performed by a firm and what was its related cost, or in other words in which “knowledge level” activities were a firm’s resources allocated. Table 5 shows for each firm surveyed where their cost are allocated. Specifically Icecream Co, Motorbike Co and Woodwork - firms with a general higher ROS performance compared with Frangor Co – report an amount of resources mainly embedded in high knowledge based activities. Because of the small number of firms considered, evidence cannot clearly support that a relationship between these cost categories (VA, NVA and W) and performance. Nevertheless it shows what kind of impact has knowledge on a firm’s cost structure. A significant presence of low resources employed in commodity skills might lead a firm to a decrease in its competitive advantage. Moreover if we compare very similar firm in terms of specific industry this kind of analysis might support the understanding of a different level of sustainable competitive advantage. From an internal point of view, by mapping this performance

³ The result supports earlier work by McNair (1994) and McNair and Vangermeersch (1998), McNair, Polutink and Silvi 2001.

along an extended period, a firm can assess an increase (if high relevance activities scale up) or a decrease (if low relevance activities scale up) of its level of knowledge.

Table 5

Firms cost structure in terms of high vs low relevance and tacit vs. explicit knowledge and performance

	<i>Low relevance % of total act. Cost</i>	<i>High relevance % of total act. Cost</i>	<i>Tacit % of total act. Cost</i>	<i>Explicit % of total act. Cost</i>	<i>ROS</i>	<i>VA % of revenue</i>	<i>NVA % of revenue</i>	<i>W % of revenue</i>
Frangor Co	50%	50%	72%	28%	4%	17%	12%	8%
Icecream Co	30%	70%	61%	39%	23%	18%	13%	10%
Motorbike Co	25%	75%	49%	51%	9%	17%	15%	7%
Woodwork Co	24%	76%	52%	48%	13%	14%	12%	4%

Table 5 shows also the amount of resources employed in tacit or explicit activities. Using the framework presented in figure 1, in order to achieve a superior performance firms should move from the lower to the upper part of the matrix. In other words by making explicit some low knowledge content activities or leveraging the specific higher ones these organizations might mobilize their resources and capabilities in a more effective way. Woodwork Co, for instance, largely invested in total quality programs aimed to make less tacit and more automate its activities and therefore to reduce NVA and W costs. While Frangor Co – a firm with a high presence of low knowledge relevance activities – should automate its supplier order processing or outsource some activities related with the pre-assembly, or leverage its selling and R & D products (in the figure 1 words should move from the lower left quadrant to the right or to the upper level quadrants)⁴. At the same time Motorbike Co is trying to outsource and automate its supply chain processes by leveraging its capabilities in supporting their first and second tier suppliers. They are reaching their profit potential by leveraging their suppliers efficiency (see Norman and Ramirez 1994). Icecream Co decided to enhance its efforts in the marketing and customer “intimacy” activities by investing in R & D and at the same time by acquiring patents and trademarks in order to better defend its competitive position.

Table 6 shows the amount of VA, NVA and W activities embedded in commodity (low relevance) and high knowledge content activities. It clearly shows that low knowledge content activities entail a superior level in NVA and W cost. High leveraged and proprietary skills seem therefore lead to a superior performance. Focusing on a specific knowledge might contain waste and non value added

⁴ These considerations are supported by early works (McNair, Polutink and Silvi 2001b).

activities and drive a firm to a superior performance or to a better value creation process. By using knowledge management initiative a firm can contain the negative impacts of NVA and waste activities. Intangible reporting effectiveness might be enhanced if it communicates where resources are employed.

Table 6
Firms cost structure in terms of high vs low relevance and VA, NVA and W cost

	<i>Low relevance</i>	<i>VA % of total act. Cost</i>	<i>NVA % of total act. Cost</i>	<i>W % of total act. Cost</i>	<i>High relevance</i>	<i>VA % of total act. Cost</i>	<i>NVA % of total act. Cost</i>	<i>W % of total act. Cost</i>
<i>Frangor Co</i>	50%	36%	38%	26%	50%	57%	26%	17%
<i>Icecream Co</i>	30%	11%	41%	48%	70%	58%	28%	14%
<i>Motorbike Co</i>	25%	26%	47%	27%	75%	48%	36%	16%
<i>Woodwork Co</i>	24%	34%	52%	24%	76%	52%	40%	8%

Knowledge cost drivers

Table 7 reports the amount of cost of activity related with executional (or operational) and structural cost drivers (Shank and Govindarajan 1993). It shows that a large proportion of cost is determined by the way the firm executes its activities within a given structure and therefore this cost category might be more easy to manage in the short run, while structural cost drivers entail an overall review of a firm’s strategic choices. A large proportion of cost related with operational cost drivers highlights good opportunity for a short run profit recovery.

Table 7
Firms cost drivers

	<i>Executional Cost Driver</i>	<i>Structural Cost Driver</i>
<i>Frangor Co</i>	66%	34%
<i>Icecream Co</i>	57%	43%
<i>Motorbike Co</i>	85%	15%
<i>Woodwork Co</i>	57%	43%

A research question was to apply the cost driver analysis framework (Shank e Govindarajan 1993) to the knowledge view of the firm. Specifically, the attempt was to try to define the cost driver related with the activity and its relation with the level of knowledge required for the activity. Table 8 shows that in general low and high knowledge relevance activities are mainly determined by

executional cost drivers. In two cases (Icecream Co and Woodwork Co) high relevance was more driven by structural cost drivers. Knowledge management programs and initiatives might benefit from this information because the comprehension of which cost drivers affect a firm's cost performance allows managers to better focus their efforts and resources.

Table 8
Firms cost drivers vs low/high knowledge content activity cost

	<i>Executional Cost Driver Low relevance</i>	<i>Structural Cost Driver Low relevance</i>	<i>Executional Cost Driver High relevance</i>	<i>Structural Cost Driver High relevance</i>
Frangor Co	57%	43%	75%	25%
Icecream Co	84%	16%	45%	55%
Motorbike Co	80%	20%	87%	13%
Woodwork Co	70%	30%	52%	48%

Table 9 reports for each firm and for each knowledge content activity the first two important cost drivers. Specifically for Frangor Co complexity and product configuration globally affect about 48% of its cost of activities with a low importance of knowledge, while total quality management (TQM) and again product configuration are the main cost drivers for high knowledge content activity. Frangor Co should increase its competencies in the management of product development and understand how to decrease its level of complexity and improve its process efficiency. Similarly, Icecream Co shows TQM and plant layout affect respectively 53% and 25% of their resources embedded in commodity skills activity, while experience and level of integration with suppliers and customers are respectively at 31% and 19%. TQM is a recurrent cost driver also for Motorbike Co and Woodwork Co. In general, this analysis completes the above one related with the cost performance where high knowledge relevance activities entail an inferior level of NVA and W cost. TQM, experience and effective level of integration with upstream and downstream agents are areas where knowledge management should focus its attention in the search of these firms profit potential.

Table 9
Firms specific cost drivers vs low/high knowledge content activity cost

	<i>Low relevance</i>	<i>High relevance</i>
Frangor Co	Complexity 27% Product configuration 21%	Total quality management 30% Product configuration 27%
Icecream Co	Total quality management 53% Lay-out 25%	Experience 31% Supplier/Customers integration 19%
Motorbike Co	Total quality management 36% Capacity 33%	Total quality management 34% Capacity 39%
Woodwork Co	Supplier/Customers integration 24% Total quality management 28%	Total quality management 22% Experience 20%

The research model in a specific firm

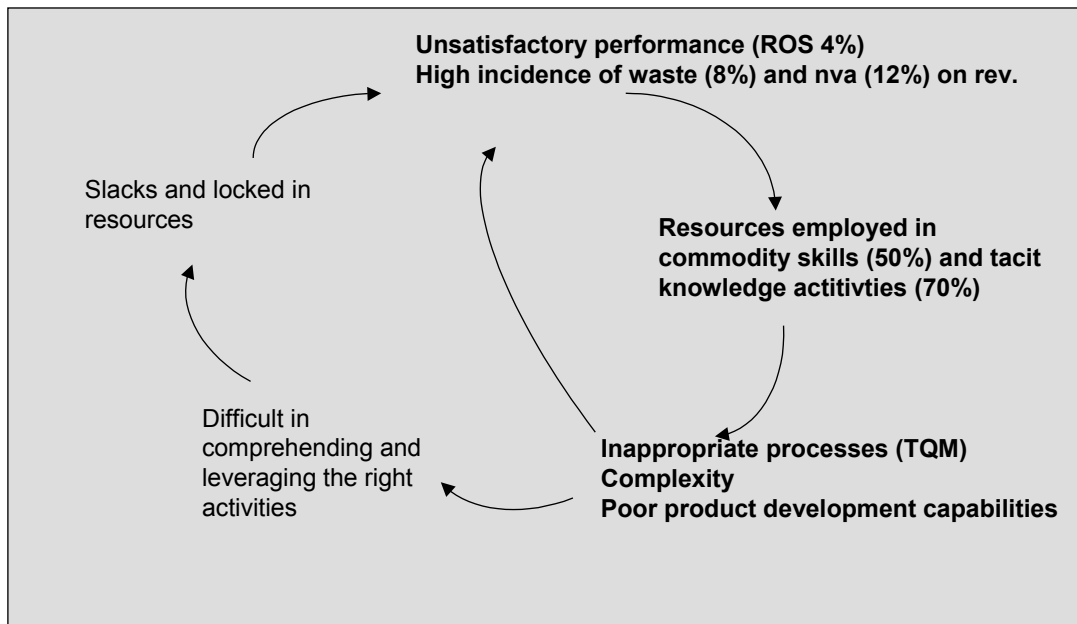
The model here discussed can at this point also be useful for interpreting a specific firm's performance. The Frangor Co case, for instance (fig. 3), indicates that a large part of its resources were employed both in low knowledge content and tacit activities. Individual and not codified activities related with commodity skills originated and/or were originated by complexity, ambiguity and uncertainty and in particular by inappropriate processes and a lack in product development capabilities (Frangor Co main cost drivers). As a result, this contributed to Frangor Co's unsatisfactory profitability (ROS 4%) and to a significantly high relevance on revenues of waste and non value adding activity cost, due to the management of these deficiencies. A locked in resources situation resulted and managers were not able to leverage firm's profit potential towards a product configuration redesign and business process re-engineering.

8. Conclusions

The purpose of this paper was to verify if knowledge costing might be performed and presented any meaningful for management and measurement issues. More specifically this research project was developed around the primary question related with the possibility that strategic cost management frameworks could represent a valuable source for understanding the critical aspects related with knowledge management and measurement. Even though this study is at an early stage and has to be considered as a work-in-progress it provides theoretical and methodological contributions.

At the theoretical level this research extends the SCM field of application at the knowledge theory of the firm. Evidence from the field suggests that SCM framework (firm's value chain analysis and cost driver analysis) can be applied for supporting the comprehension of where knowledge is embedded and what is its impact on a firm's cost structure in terms of value added, non value added but required and waste activity.

Figure 3
Frangor Co vicious cost and effect knowledge pattern



Even though there is the awareness that cost does not fully represent a firm's knowledge potential, linking knowledge management to the cost analysis increases the understanding of cost arising and provides further insights for cost management and the resource allocation decision making process. Because of this linking, this study contributes also to make more effective knowledge management theory. The proposed framework enhances the quality of a firm's competencies and skills assessment and allows a better understanding of the "what" it should do in order to sustain or acquire a competitive advantage. It might allow managers to make more visible where their resources are employed and therefore to better evaluate their "asset stock" and moreover to convey them in a more effective "flow" (Dierickx and Cool 1989). In other words it might contribute to shorten the time frame of the resource "employ ---> performance ----> resource employ" circle and to improve the effectiveness of knowledge management initiatives both at the strategic, information technology and organizational level. A contribution of this paper might be also addressed to management accounting and multidimensional performance measurement system studies. The cost

of knowledge (importance and tacit or explicit) adds another dimension to manage and report in the balanced scorecard approaches. Financial reporting might also enjoy the benefits of presenting and explaining intellectual capital stock with the amount of resources allocated or invested in whether or not relevant or explicit activities.

At the methodological level, the contribution is to “operationalise” the collecting data process to analyse the effects of knowledge on companies cost structure and performance. This approach can also be employed to indicate the impact of cost of other knowledge categories (i.e. general vs. specific, individual vs. collective). In addition it might be used for management control purposes and to improve knowledge information in financial and management reporting.

As with any exploratory study, there are many weaknesses in the work that has been presented here. The lack of comparability across firms limits the statistical analysis and the reliability of the reported relationships. One of the major improvements that could be made, then, would be to compare firms within one specific industry. A second improvement would come from tracking one firm over time, to understand the dynamics of improved alignment between knowledge spending and impact on the firm’s cost structure, performance and competitive position. In addition, some work has to be done in order to better establish when an activity is tacit or explicit. The research highlights some border-line activities which require a better control and investigation.

As already mentioned this paper is in a work in progress phase. Next step will consider the extended value chain mapping and the value multipliers analysis at the assessment and leveraging level. Moreover a detailed discussion of the findings with managers will follow. Future research will be also addressed to the understanding of which cost and value drivers are closely related with knowledge and which are not. A further investigation will be addressed to the analysis of the cost of knowledge embedded in each functional or competence area (technological, marketing, management), or in the main processes in order to comprehend what is its impact on cost and performance and to increase the leverage and mobilize steps of the model.

Despite these limitations and the research work that has still to be done, findings highlight a potential in linking economics - specifically strategic cost analysis – to the knowledge theory of the firm.

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