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Organizing Innovation: Do Management Control Systems Contribute to Knowledge Management?

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ABSTRACT

In markets with increasing complexity and intensity of competition, innovation is becoming one of the most relevant means to continuously outperform competitors. The sequence runs from diversifying and adapting to re-positioning and even re-inventing the organization. One important stream of research has emerged that focuses on how enterprises manage the processes of acquiring and sharing new knowledge to sustain the competition challenge. Likewise, literature recognizes that Management Control Systems (MCS) play an important role in supporting the "problem finding" and "problem solving" processes. This establishes a close link between MCS and knowledge production. From these lines of research, the aims of our exploratory paper are to:

- *i. determine which clusters of enterprises correspond to a theoretical framework that describes where and how companies acquire, produce and select knowledge for sustaining innovation strategies, and provide a statistical evidence. The theoretical framework encompasses the origin of knowledge (where) and the knowledge creation process (how);*
- *ii. identify such theoretical and statistically proven clusters that correspond to a description of how companies use their MCS to produce knowledge and sustain innovation strategies;*
- *iii. detect and prove, within these clusters, the existence of a link between MCS and knowledge management processes in terms of coherence between how companies manage the knowledge process and how they use MCS.*

In order to get a wider perspective, the paper analyzes the knowledge management process during innovation. The research is based on a survey conducted on a sample of 40 enterprises working in the North East of Italy that carry out pertinent innovation processes. A structured

questionnaire was delivered to the CEO of each company, to the Financial Manager and to the Innovation Manager (a total amount of 120 questionnaires).
The managerial implications of this paper will be:

- i. *to assist managers in developing strategic, tactical and operative activities related to innovation, and to facilitate the respective knowledge processes;*
- ii. *to offer guidelines for projecting more useful MCS in order to facilitate innovation processes.*

Keywords: Innovation, intellectual capital, knowledge management, Management and Control Systems.

1. CONTEXTUAL FRAMEWORK AND RESEARCH QUESTIONS

Scholars advise that to acquire a sustainable competitive advantage, companies must treat knowledge as a strategic asset (Teece, 2000). Knowledge management (KM) thus becomes a strategic task, and the ability to link KM to strategy and competitive advantage is perceived to be the key for exploiting opportunities to innovate a company's business model (Drew, 1999). Literature on this topic is quite extensive and it is not possible to identify a unique definition of innovation and KM (Bardy, 2010). Some authors (Van de Ven & Engleman, 2004) have outlined that four basic perspectives emerge in studies of innovation strategies: human, contextual, structural and process. The first focuses on making organizations more innovative by exploring new knowledge rather than exploiting existing knowledge. The second emphasizes the creation and management of a context that is appropriate for innovation. The third refers to the structural problem of building an infrastructure across organizational boundaries for absorbing external knowledge. The final perspective focuses on revealing the sequences of activities and transactions that are involved in, and which contribute to, the constitution of new knowledge.

In a similar perspective, the question: "Which internal and external factors influence innovation strategies?" has attracted interest within the academic debate. Internal factors include organizational structures, control and coordination mechanisms, communication channels and organizational cultures. Early studies noted that organic organizations were more effective than bureaucratic or mechanistic organizations in innovation because they had flexible structures and informal communication channels, a fact that was important for sharing knowledge within an organization (Butler, 1981). External factors refer to a set of contextual contingencies that have an effect on KM and innovation activities. Van de Ven (2004), for instance, emphasizes the role of networks in transferring knowledge across organizations, industries and national boundaries, while Cohen and Levinthal (1990) accentuate the importance of "absorptive capacity", i.e. the ability to recognize, assimilate, and apply external knowledge. Others shed light on complementary assets that they think constitute crucial factors for improving the process of learning how to supplement the effect of absorptive capacity (Teece, 1987).

Our study focuses on the role of KM in devising and implementing innovation strategies. Using previous literature, we analyse the role of Management and Control Systems (MCS) as a blend of tools that support KM while innovation processes are executed within and across organizations. The connection between innovation and MCS is sometimes thought to be indeterminate (Bisbe & Otley, 2004), but it is acknowledged that the relation is stronger when encompassing the whole of MCS rather than when merely studying the characteristics of a single tool (Henry, 2006). This relates to the outcome of our literature review which shows that there is more than one definition

of MCS. Many textbooks adopt the narrow definition of control: management activities are categorized separately, as planning, control and decision-making. Emmanuel et al. (1990) reject this approach and adopt a wider definition of control which encompasses both planning and ensuring that plans are implemented. Planning, control and decision-making are inextricably linked within this wider conception of management control. Indeed, literature endorses that MCS has two complementary and interdependent roles (Ahrens & Chapman, 2004; Simons, 1994): i) MCS can be used to extend control over the attainment of organizational goals; ii) MCS can also be used to enable managers and employees to search for opportunities and solve problems. Scholars recognize that this blend of aims requires a combination of multiple control systems that work together (Otley, 1980) and different levers of control (Simons, 1994).
Numerous prior studies have highlighted the importance of achieving a fit between a firm's strategy and its MCS (Chenhall, 2003; Langfield-Smith, 1997, Simons 1990). Traditionally, the relationship between strategy and MCS has been viewed as a passive one, suggesting that the MCS is an outcome of a firm's strategy. However, Hopwood (1987) and Dent (1990) state that the MCS might have a proactive role in influencing strategy. From there, the role of MCS and its impact on innovation processes has emerged as an important research matter (Shields, 1997), but very few empirical studies address the relationship among these variables, especially considering SMEs. Extending the line of research, we investigate the relationships between the KM processes adopted in innovation strategies and the use of MCS. Thus, our research questions are:

- RQ1: How do enterprises manage knowledge in the specific process of innovation strategy?
- RQ2: How do enterprises design and use MCS in the specific process of innovation strategy?
- RQ3: Is there a link between KM processes adopted by the enterprises of the sample in the specific process of innovation strategies and the use of MCS?

2. METHODOLOGY

In order to develop our research sample we contacted the local SME-associations. We contacted the president of the 8 different associations asking for names of companies well-known as innovators. The overall selection criterion for creating the sample was that the firm must have introduced at least one new product in the last two years. The criterion was chosen considering that, according to the Italian Statistic Institute (ISTAT), 30% of companies introduced at least one product/process innovation in the last two years. Moreover in order to limit the selection to a relevant innovation process, we decided to limit the analysis to firms with expected costs for innovation strategies amounting to at least 100,000 Euros. This resulted in selecting companies with a history of innovation and with relevant innovation strategy projects. After this process, a sample of 40 SMEs located in North-Eastern Italy was drawn from a list of 200 manufacturing firms supplied by local SME associations. We contacted all those companies by email and we ended up with 40 SMEs that accepted to participate in the project (response rate 25%).
Our research was conducted under the form of a knowledge audit, where owner-managers were interviewed in their role as "experts" (Ketchen & Shook, 1996). We adopted a multi-method, multi-case field research designed to capture, in depth, the richness needed to investigate patterns of KM and MCS-use with innovation strategies and the link between them. Our multi-method design employs qualitative and quantitative data collected through four main information sources: public data, company reports, one semi-structured interview and a structured questionnaire. The questionnaire was based on the interviews and the other materials and sent to

the CEO, the CFO and the Research and Innovation Manager, asking them to rate their answers on a 1-7 Likert scale.

In order to identify the KM processes involved in innovation strategies, we refer to the knowledge model of Holsapple and Jones (2004). The KM processes taken into consideration were

i. knowledge acquisition: acquiring knowledge from external sources and making it suitable for subsequent use;
ii. knowledge generation: producing knowledge by either discovery or derivation from existing knowledge and making it suitable for subsequent use;
iii. knowledge selection: selecting knowledge that had been generated and making it suitable for subsequent use.

The variables we chose to characterize KM were: (i) knowledge origin or “where”, i.e. repositories of acquired, generated and selected knowledge; (ii) knowledge creation process or “how”, i. e. ways of knowledge acquisition, generation and selection. “Where” and ”How” were then connected to acquisition, generation and selection for determining our clusters. “Where” and ”How” were also used to categorize the answers from the interviews as follows: (i) 15 different ways of acquiring knowledge (7 “where” + 8 “how”); (ii) 8 different ways of generating knowledge (3 “where” + 5 “how”); (iii) 8 different ways of selecting knowledge (3 “where” + 5 “how”). To identify the use of MCS we refer to classifications suggested by previous research (Vandenbosch, 1999, Davila et al, 2009). The variable chosen to characterize the use of the management control process was information use or how ways of information were drawn from MCS in the specific process of strategic decision-making related to innovation. The open answers supplied by the owner-managers that we interviewed were categorized by overlapping these classifications, which established 9 different uses of MCS.

Cluster analyses have been used in earlier studies to classify firms into different groups based on their KM processes and MCS-use. The techniques used were based on agglomeration coefficients: dendrogram analysis; average silhouette index analysis; Tukey’s pair wise comparison analysis. These approaches have been adopted in management control and in strategic management field research (Ketchen & Shook, 1996; Gerdin & Greve, 2004; Henri, 2008). We subsequently tested our results using k-means approaches and p.a.m. approaches (Kaufman & Rousseeuw, 1990). We used a Chi-Square Test (χ^2) to investigate the existence of a “coherent” link between KM processes and the use of MCS. To provide reassurance that the observed associations were statistically robust, some control variables were used. In particular, we compared our results considering: (i) environment uncertainties; (ii) technology uncertainties; (iii) organization structure; (iv) organization size; (v) strategy characteristics. Those variables were selected because they represent common factors used in contingency-based management accounting research (Chenhall, 2003). In order to carry out these tests, One-Way-ANOVA-models were employed for each control variable.

3. RESULTS

Our cluster analysis led us to the identification of distinct groups at the levels of KM processes and of MCS-use, and the semi-structured interviews showed that distinct sources of knowledge and ways of applying the knowledge are employed. The results of our analysis are presented as follows:

3.1. Knowledge Acquisition

We determined two groups of enterprises that reflect the dimensions of the knowledge acquisition model discussed by Jordan and Jones (1997), appropriately adapted to our sample companies. The groups are labelled as follows:

- Cluster 1 "Focused": Enterprises of this cluster use structured approaches as their knowledge acquisition process. Great importance is given to professional providers of knowledge such as research centres and consultants which are the main sources of knowledge acquisition. Suppliers of goods and services are also important, even though less importance is given to them than by the other cluster. Preference is given to collaborative approaches, temporary management and access to existing knowledge databases.
- Cluster 2 "Opportunist": Enterprises of this cluster mainly use the economic actors of their value chain (mostly suppliers, customers and sales network) in their knowledge acquisition process. Techniques used to acquire knowledge are sparsely structured. A fair number of enterprises recognize the importance of the information given by competitors and gained from exhibitions, fairs, meetings, etc. Ample importance is given to access to existing information available in markets.

Table 1. Knowledge acquisition clusters

Variables	Centroids		Tukey's Comparison	Average Silhouette Width
	Cluster 1	Cluster 2	1-2	
Where (1-7)				
Research centres	6.35	3.71	***(see Note below)	Cluster 1: 0.475
Consultants	6.39	4.95	***	Cluster 2: 0.500
Districts organizations	3.42	2.49	***	Median: 0.496
Competitors	2.81	4.49	***	
Customers	4.72	5.92	***	
Suppliers	4.42	6.08	***	
Sales networks	3.54	5.57	***	
How (1-7)				
Benchmarking	5.14	2.54	***	
Collaborative learning	6.49	4.83	***	
Temporary managers and Job mobility	6.49	4.40	***	
Direct access to Knowledge databases	5.54	6.40	***	
External training	5.04	2.52	***	
Meetings and conventions	4.54	5.44	***	
Exhibitions and fairs	4.89	6.44	***	
Technical papers	3.53	5.00	***	

Note: *p<0,05;** p<0,01;***p<0,001

3.2. Knowledge Generation

Our results represent the presence of two groups that could be related to the KM strategies first identified by Zack (1999), adequately adapted to our sample companies. They are labelled as follows:

- Cluster 1 "Aggressive Planners": Enterprises of this cluster create specific cross-functional groups to develop their research projects. A few of them also feature an R&D group, which is usually not exclusive (researchers are usually assigned other tasks, too) but permanent and they use cooperative methods and target experimentations.
- Cluster 2 "Conservative Searchers": Enterprises of this cluster deploy a top-down approach, setting out from the top managers (who are mainly the owners), using methods such as

learning by doing, brainstorming and sometimes also self-intuitive generation. The key variable is the interaction between doing and learning, and research projects are not organized in advance.

Table 2. Knowledge generation clusters

Variables	Centroids		Tukey's Comparison	Average Silhouette Width
	Cluster 1	Cluster2	1-2	
Where (1-7)				
R&D unit/function	5.39	2.96	***(see Note below)	Cluster 1: 0.538
Specific cross-functional group	5.91	4.13	***	Cluster 2: 0.598
TOP managers	3.44	6.07	***	Median: 0.582
How (1-7)			***	
Emergent, occasional, intuitive knowl. generation	2.94	5.00	***	
Learning by doing/using	3.45	6.48	***	
Internal and external brainstorming	3.42	6.44	***	
Systematic, targeted, focused experiments	5.85	3.30	***	
Cooperative research and development	6.50	3.48	***	

Note: *p<0,05;** p<0,01;***p<0,001

3.3. Knowledge Selection

We identified two groups that show the characteristics of the KM strategies first identified by Hansen et al. (1999), adequately adapted to our sample companies. They are labelled as follows:

- Cluster 1 “Entrepreneurs”: Enterprises belonging to this cluster restrict knowledge selection to top managers, who choose what information they need and then search for knowledge bases. The approaches they use are less formalized; brainstorming and informal identification are among the most used tools.
- Cluster 2 “Team Workers”: Enterprises belonging to this cluster feature specific R&D groups inside the organization. These groups, as in knowledge generation, may temporarily be cross-functional, formed especially for overseeing the research projects, or they may be stable R&D groups which enjoy considerable autonomy. These groups apply formalized approaches in selecting the relevant information, using both cooperative analysis approaches and experimental control.

Table 3. Knowledge selection clusters

Variables	Centroids		Tukey's Comparison	Average Silhouette Width
	Cluster 1	Cluster2	1-2	
Where (1-7)				
R&D unit/ function	4.57	2.51	***(see Note below)	Cluster 1: 0.547
Specific cross-functional groups	5.86	4.09	***	Cluster 2: 0.544
TOP manager	3.38	6.09	***	Median: 0.558
How (1-7)				
Informal, intuitive selection	3.17	4.90	***	
Internal and external brainstorming	4.45	6.47	***	
Standardization in knowledge repositories	5.50	4.00	***	
Systematic, in-depth and focused analysis	5.93	3.78	***	
Cooperative analysis	6.57	4.53	***	

Note: *p<0,05;** p<0,01;***p<0,001

3.4. MCS-Use

Our results show three groups that correspond to the MCS taxonomy identified by Henri (2008). They are labelled as follows:

- Cluster 1 "Learning Machine": Enterprises belonging to this cluster use MCS to support innovation processes, but above all to support KM, including debate development inside research groups and problem focusing.
- Cluster 2 "Problem Solving Machine": Enterprises belonging to this cluster use MCS to manage complexity linked to innovation processes, to reduce decision time and increase their problem focusing attitude.
- Cluster 3 "Surveillance Machine": Enterprises of this cluster use MCS mainly as surveillance tools, in order to focus the organization on critical factors which may lead to success, and to understand promptly all the opportunities given by innovation processes.

Table 4. Knowledge selection clusters

Variables	Centroids			Tukey's Compar			Average Silhouette Width
	Cluster 1	Cluster 2	Cluster 3	1-2	1-3	2-3	
How (1-7)							
Enabling discussion, face-to-face dialogue and debate across all levels of organization	6.58	4.97	3.13	***	***	***	Cluster 1: 0.532 Cluster 2: 0.522
Focusing attention on strategic uncertainties	6.67	5.18	2.91	***	***	***	Cluster 3: 0.530
Supporting creativity	6.50	4.74	3.07	***	***	***	Median: 0.540
Reducing complexity of strategy decision-making	4.97	6.51	3.09	***	***	***	
Reducing strategy-decision time	3.03	6.59	5.09	***	***	***	
Supporting problem-solving and finding	3.22	6.49	5.02	***	***	***	
Tracking innovation processes towards goals	2.78	4.77	6.40	***	***	***	
Focusing the organization on critical factors	4.06	5.05	6.56	***	***	**	
Confirming understanding of the business	2.86	5.13	6.53	***	***	***	

Note: *p<0,05;** p<0,01;***p<0,001

3.5. Link between KM and MCS

To investigate the existence of a "coherent" link between our KM processes and the use of MCS, we used a Chi-Square Test ($\chi 2$) and a Fisher Exact Test. We obtained a strong relationship (p-value <0,001), which confirmed the idea that there is definitely a link between MCS-use and KM processes in our sample. As shown in table 5, when comparing the observed and expected frequencies, we may make the following considerations:

- Regarding the *knowledge acquisition process*, companies which are more focused apply a learning-machine-approach in terms of MCS-use, and the opportunists use a surveillance-machine-approach. This empirical evidence comes close to what Miller (1996) said about the process of learning. Miller exhibits six different ways of learning by categorizing into autonomy of actors and structure of process. Using these variables, we may infer that opportunists do not require an interaction process and that their learning process is less structured. This seems to justify a major propensity of opportunists to use a surveillance-machine-approach: by deploying a more emergent approach on learning, the opportunists use MCS for focusing on critical factors and mostly not for enabling discussion. On the other hand, focused enterprises, which have a more structured approach, develop a double-loop process in order to facilitate debates inside internal and external groups, and to increase the problem-focusing attitude.

- Regarding the *knowledge generation process*, companies which belong to the cluster of aggressive planners use a learning-machine-approach on MCS, and conservative searchers use a surveillance-machine-approach. This empirical evidence comes close to what Henri (2006) said about innovativeness. He has demonstrated that a more interactive use of MCS for fostering dialogues among employees could develop a more fluent information-sharing process. This approach seems to be related to the need to create an internal stimulus to break out of narrow search routines, stimulating opportunity-seeking and generation of ideas. Other approaches which are more conservative with regard to relating the generation process to a self-intuitive approach seem to emphasize the need of focusing actions on critical factors (Simons, 1994). Companies of this cluster deploy a less structured way to verify the opportunities they acquire and they autonomously develop the means to organize their transition to operative plans.
- Regarding the *knowledge selection process*, the "entrepreneurs" cluster is more inclined to a problem-solving approach, and the "team-workers" cluster is more inclined to a surveillance-machine approach. This empirical evidence seems to be related to earlier findings on the process of cognition. A fair and balanced account of the various alternative approaches to cognition is not on the agenda of this paper as there is a considerable overlap between them (Patokorpi, 2009). But we can argue that, considering cognition as an activity in which information is processed, the small number of people involved inside the entrepreneurs' clusters usually adopt tools that could help managers to clarify doubts but not to create a dialogue. Having a more structured approach on knowledge selection, the "team-worker" cluster also uses a more structured approach to control the selection process focusing on critical factors.

Table 5. MCS and KM relationships. Expected and Observed Frequency

Variable	**Cluster**	**MCS-Use**		
		Learning Machine	**Problem-solving Machine**	**Surveillance Machine**
Knowledge acquisition	Focused	14.63 (68%)		
	Opportunist		3.53 (17%)	11.1 (59%)
Knowledge generation	Aggressive Planner	11.25 (45%)	2.55 (12%)	
	Conservative search			13.8 (85%)
Knowledge selection	Team Workers			9.6 (41%)
	Entrepreneurs	2.25 (14%)	7.35 (54%)	

The table only shows the positive difference between expected and observed frequency. The numbers in brackets show the percentage rapport between the difference among expected and observed frequency and observed frequency.

3.6. Control variables analysis

To provide reassurance that the observed associations were statistically robust, some control variables were used. In particular we analyzed an ANOVA index considering:

- environment uncertainties asking the interviewee to respond in a scale of 1 (low = uncertain) to 7 (high = certain);
- technology uncertainties asking the interviewee to respond in the same 1-7 scale;
- organization structure considering the age of companies as a proxy of structure characteristics;
- size of the organization considering number of employees;
- strategy characteristics as dummy variables: 0 for cost reduction and 1 for differentiation leadership.

Table 6 shows our statistical results. They indicate that there is correlation among the control variables and the observed variables in just a few cases. No correlation is verified for all observed variables.

Table 6. Variables of control

	Knowledge Acquisition	Knowledge Generation	Knowledge Selection	MCS Use
Environment uncertainties	0.786	0.413	0.086	0.589
Technology uncertainties	0.059	0.732	0.905	0.155
Organization	0.752	0.208	0.0076 **	0.099
Size	0.647	0.0041 **	0.000***	0.446
Content of strategy	0.005 **	0.990	0.255	0.496

Note: *p<0,05;** p<0,01;***p<0,001

5. DISCUSSION

Along the lines of previous studies, this research is focused on the role of MCS and of KM Systems in innovation strategy processes. The first contribution of this research derives from the results of an exploratory empirical test. As shown in tables 1, 2, 3, 4, we found that the companies included in our sample apply several approaches to KM and MCS-use when they execute innovation strategies. This seems to be coherent with previous theoretical literature. We think that our paper offers a clearer comprehension of the knowledge process within the deployment of innovation strategies.

Focusing on the relationship between MCS-use and KM, we adopted an approach where MCS were no longer seen as mere information providers, but were considered as active players in the strategic management process. Analyzing MCS literature, we observe that previous contributions in the field of contingency theory applied to MCS analyze how companies use and design their MCS. Chennal (2003) found several variables that influence the MCS-design and MCS-use such as: (i) External environment; (ii) Technology; (iii) Organizational structure; (iv) Organizational size; (v) Organizational strategy; (vi) National culture. Focusing on organizational structure, Chennai denominates several characteristics that could influence MCS-use, such as: the size of an organization, levels of decentralization on strategic decision and leadership style. Our paper enlarges this vision by considering the importance of the KM process encompassed in MCS-use.

Our empirical evidence seems to confirm that different approaches to KM drive a different usage of MCS which offers a new perspective on the contingency theory applied to MCS and KM.
The operative applications of our study could be several. Firstly, enterprises could review their use of MCS tools by adapting them in a manner which facilitates the processes of knowledge acquisition, knowledge generation and knowledge selection. Secondly, as knowledge actors, company controllers could work together with other units of their organization to produce information that could aid the innovation process.
Despite displaying corroborated empirical evidence, the study is not without limitations. The geographical limitation of the sample and the relatively small number of enterprises may have influenced the statistical analyses. Several factors like national culture and relatively similar perception recorded from enterprises could have had an influence on our statistical evidence. Indeed, we are conscious that KM processes do not necessary lend themselves to knowledge creation because we need to understand the ecology of the system, which has been coined the "Ba" by Nonaka and Konno (1998). Moreover, although the Chi-Square Test exhibits a strong relationship between MCS-use and KM-approach clusters, we are not able to identify the direction. Our statistics have not indicated whether the KM approaches influence MCS-use or vice-versa. Regarding this, we did not consider any variable indicating performance. These limitations could be dealt with by further studies in this research field.

6. CONCLUSION

Based on the above arguments, the main findings of this research are, as per our three research questions: a verification of how the companies included in our sample deploy their KM process considering the phases of

- knowledge acquisition (where we find two main approaches: focused approaches and opportunist approaches);
- knowledge generation (where we find two main approaches: aggressive planners and conservative searchers);
- knowledge selection (where we find two main approaches: entrepreneurs and team workers).

We verified how the sample companies use their MCS and we found three different approaches: learning-machine, problem-solving-machine, surveillance-machine.
Finally, we verified how the companies of our sample link MCS-use and KM approaches. Our results indicated a statistically relevant relationship between the approaches. Our analyses seem to offer a way for a more extensive application of the contingency theory applied to the MCS-use.
The operative application of these researches in the field could help managers to facilitate the innovation strategies' process and to create a more fluent information sharing practice.

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