A NEW KNOWLEDGE MANAGEMENT TOOL FOR PRODUCT DEVELOPMENT IN MICRO-COMPANIES

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Abstract

The main purpose of this paper is to present a new Knowledge Management (KM) tool for product development in micro-companies. To develop this proposal, the first part presents a state of the art about knowledge management and micro-companies specificities and shows the need for them to get, with reduced resources consumption, new and easy-to-use KM tools. The second part presents the new KM tool. The idea is to create information cards to capture knowledge by conducting interviews. To deliver the knowledge in an easy and efficient way, all the information cards specify the job and the step of development related to their contents. The third part presents a case study on a specific micro-company. 16 knowledge cards in an 18-hours work were written and are currently exploited by the micro-company. Future works are ongoing to determine how exhaustive are the cards and to measure qualitatively and quantitatively the performance of this KM tool. We believe it will save time, reduce costs and reduce risks of errors for product development in micro-companies.

Keywords: Knowledge management, New product development, Innovation, Micro-companies

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1 INTRODUCTION

In micro-companies (companies with fewer than 10 employees (EUR-Lex, 2016)) many decisions are taken tacitly and product designers make relevant choices mainly guided by their know-how. But in the event the structures changes, some product design knowledge is very likely to be lost. In fact, very often, knowledge is kept in the minds of the owner and some key employees rather than recorded and shared. To avoid such risks, Knowledge Management (KM) tools should be used. However, existing KM tools seems too difficult to use for micro-companies due to their lack of available time and resources. This article presents a new KM tool easy to use specially designed for product development in micro-companies.

The first part of this article presents a state of the art about KM and specifies the micro-companies challenges with KM. The second part presents the new tool. The third one provides an application case to test this tool and presents the preliminary results.

2 STATE OF THE ART

2.1 Knowledge Management

Before looking at Knowledge Management (KM), it seems essential to define precisely what knowledge is. To do it, we first distinguish between the three following terms: data, information and knowledge (Zins, 2007; Aamodt and Nygård, 1995) :

- *data* is a raw element (letter, number, symbol, word, ...);
- *information* corresponds to one or more data placed in a particular context. It is therefore organized, structured and richer than the data. Finally, its meaning is context-related;
- *knowledge* results from the encounter of an information with an individual. There must therefore be appropriation and interpretation of information by an individual in order to be able to speak of knowledge.

Vinck (1997) uses the image of an iceberg to refer to individuals' level of awareness of their knowledge. He notices how difficult it is for someone to determine clearly his/her actual level of knowledge and lacking knowledge.

Nonaka and Takeuchi (1995) propose a definition of knowledge that is now a reference in this subject (Figure 1).

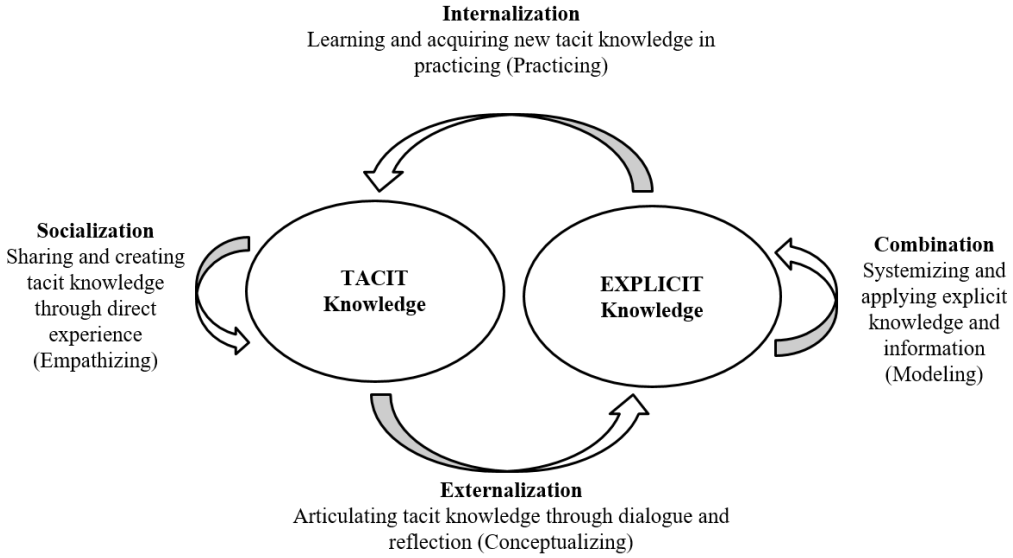


Figure 1. Model of Nonaka and Takeuchi (1995)

Figure 1 presents two types of knowledge: Tacit knowledge and Explicit knowledge. This model is based on a cycle and on a communication between those two types of knowledge. A free flow between those two types of knowledge leads to producing more knowledge. For companies, controlling and using this knowledge is called Knowledge Management (KM).

KM is the process of creating, sharing, using and managing the knowledge and information of an organization (Girard and Girard, 2015). It means using a set of tools, methods, and modes of organisation to facilitate conserving and sharing information spread out in the company. According to the standard FD X50-190 (AFNOR, 2000), capitalising consists in purposefully accumulating elements in a well-organised manner in view of later profitable use. According to Balmisse (2005) a knowledge management process can be divided into several stages : spotting, updating, developing and preserving crucial knowledge (Figure 2).

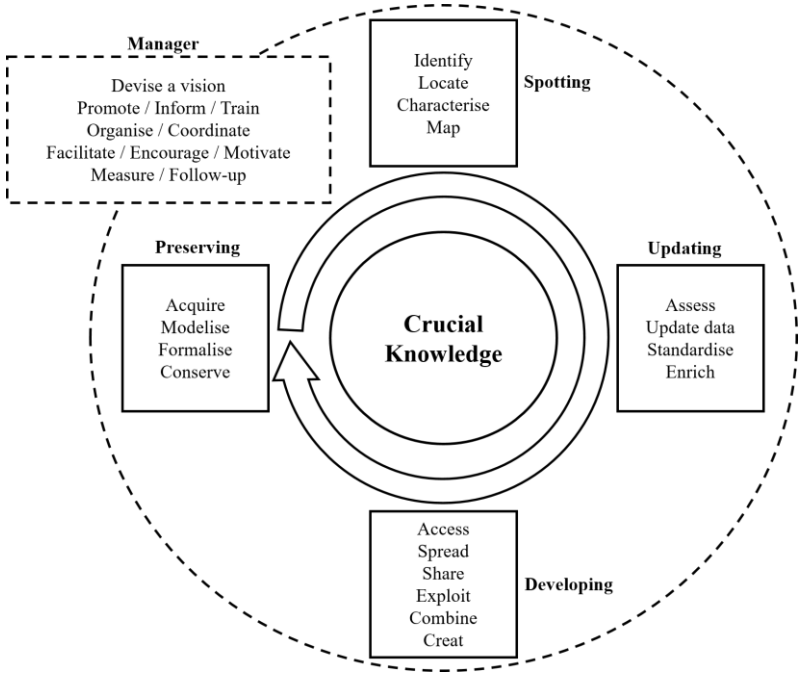


Figure 2. KM process (Balmisse, 2005)

In product development, many methods and tools exist for capitalization of experience feedback (Kaiser et al., 2008). They capture the bulk of knowledge within the company during its activity. Each tool works in a different way but always aims to generate the informal capital of the company. We can quote such tools as CYGMA (Dieng et al., 2000), REX (Malvache and Prieur, 1993), or Componential Framework (Steels, 1993). Based on different categories, the CYGMA method generates knowledge in a database that can be used by deductive reasoning algorithms. REX method uses a terminology network set up to allow requests close to standard language. Componential Framework approach describes models representing the overall activity of an expertise and case models corresponding to descriptions of specific problem-solving situation that are exploited with a specific software.
However, all these methods and tools require a significant amount of time and resources to be understood and be used. The next part presents arguments showing it is difficult for micro-companies to use them.

2.2 Micro-Companies and KM

Small companies face unique KM challenges that are distinct from those of their larger business counterparts (Edvardsson and Durst, 2013) :

- They face resource constraints, and existing resources must consequently be used with care, as erroneous decisions will have more serious complications than they would have in large companies;
- They have a flat structure and an organic, free-floating management style that encourages entrepreneurship and innovation. They tend to be informal, non-bureaucratic and there are few rules.
- Control tends to be based on the owner's personal supervision and formal policies tend to be absent. It is not uncommon that the processes of business planning and decision-making are limited to only one person;

- Very often most knowledge is kept in the minds of the owner and some key employees rather than recorded or shared.

All those challenges are reinforced in micro-companies due to their even smaller size. In the case of turbulence (for example: when a team member leave), volatile knowledge is likely to be lost. To avoid such predicaments that may have considerable consequences on this type of structure, tools and methods to pool knowledge offer real opportunities (Cerchione and Esposito, 2017).
However, the existing KM tools seems too difficult to use for micro-companies due to their lack of available time and resources. As Baptista Nunes et al. (2006) says, most large organisations have already adopted KM principles but small companies have difficulties to afford investment and to establish a credible business value to KM. Therefore, studies in this field should be reinforced.
The next part presents our contribution with the creation of a new KM tool for product development in micro-companies that will meet their specificities.

3 PRESENTATION OF THE NEW KM TOOL

Our new KM tool for product development is presented in Figure 3. By carrying interviews, elementary knowledge is reported on information cards that are each one used for a specific design process step and a specific job.

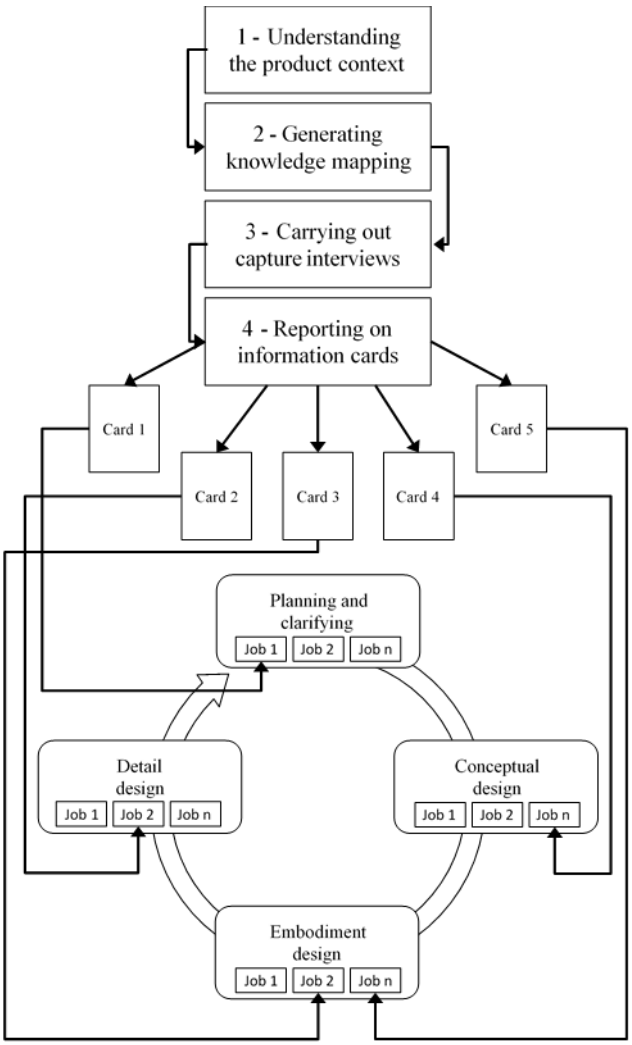
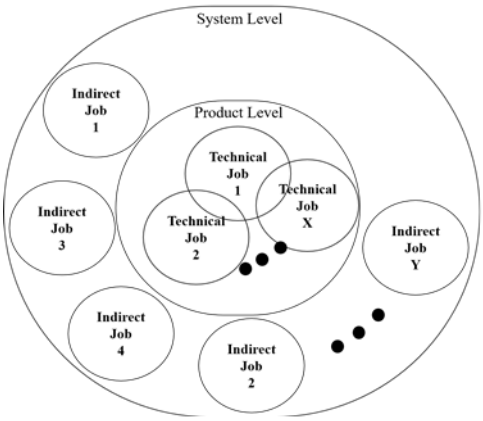


Figure 3. KM Tool

The process is split into 4 steps. The first one consists in understanding the product context and to determine the key persons that keep the knowledge. The second step aims to generate the knowledge mapping of the product. The third step consists of a series of interviews of those key persons to gather information held on the product. The final step aims to transcribe this information on knowledge cards to make them as easy to read as possible. We can then proceed to exploiting all this bulk of knowledge

efficiently for each job throughout the product development, for example throughout the four steps of the Pahl and Beitz (1977) design process: Planning and Clarifying, Conceptual Design, Embodiment Design, Detail Design.
Concerning the second step, the mapping, users should spot and find the information required quickly and easily. Consequently, we have decided to create two levels (macro and micro). The micro level is called Product, in which the technical cards related to the solution can be found. In the macro level called System, more global cards can be found, related to the whole solution and its environment. At both the Product and the System levels, each card will display which jobs or positions are likely to be concerned. This will make it possible to divide the cards efficiently because everyone involved in development will be able to find the cards relevant to his domains (Figure 3 - left).
After having defined the mapping of the product, we generated the capital of knowledge and report it on cards. A blank knowledge card is presented in Figure 4 right. We get inspired by the REX knowledge card (Malvache and Prieur, 1993) and simplified them. Our goal is to obtain a simple card that can be found and be find and read quickly.



Company Name Date of creation of the card	Card Title Marking System	Card Code
Information context : Statement and/or Graph : Effects of the information : Lessons from the information : Reference elements :		
Written by :	Source of information and context of capture :	Step of development :

Figure 4. Blank Knowledge Mapping and Blank Knowledge Card

The next chapter presents a case study of the implementation of the tool in a micro-company.

4 CASE STUDY

4.1 Presentation and Protocol

We worked with a micro-company specialized in the development of new smart eco-solutions to clean up water pollution. One of these solutions is an innovative product for farms water treatment. Three prototypes have been designed so far. A new prototype is currently in development to boost its performance.
To pilot the experimentation, a questionnaire was drawn about each of the last three prototypes. The goal was to capture all the technical specifications staff has determined; and also, to identify what was positive in those prototypes and what was inadequate. The reasons why they made such choices are also of prime importance.
4 interviews were carried out with the people who had the information:

- The manager allowed us to gather a large amount of information about the Product level as well as the System level, and to create 10 cards;
- The system's designer enabled us to create 2 cards of System level about process and experimentations;
- An expert in the system's commercial positioning allowed us to create 1 card at the System level about the commercial segment;
- A company's former engineer allowed us to create and/or complete 6 cards at both levels.

We thus obtained 16 knowledge cards after an 18-hour work. Once the cards have been written out they can be exploited by all the parties involved in developing new solutions. The database will be available to all of them and a sorting system will allow each user to find quickly the information sought.

4.2 Preliminary Results

4.2.1 Setting up the Mapping and the Cards

We first set up the information map and thus made out 4 types of job areas per level. The Product level includes the following job areas: Hydraulics; Electrical; Shape Design and Mechanics. The System level includes: Process; Commercial segment; Experimentation and Legislation. 16 cards were produced. An example of product level card is presented in Figure 5.

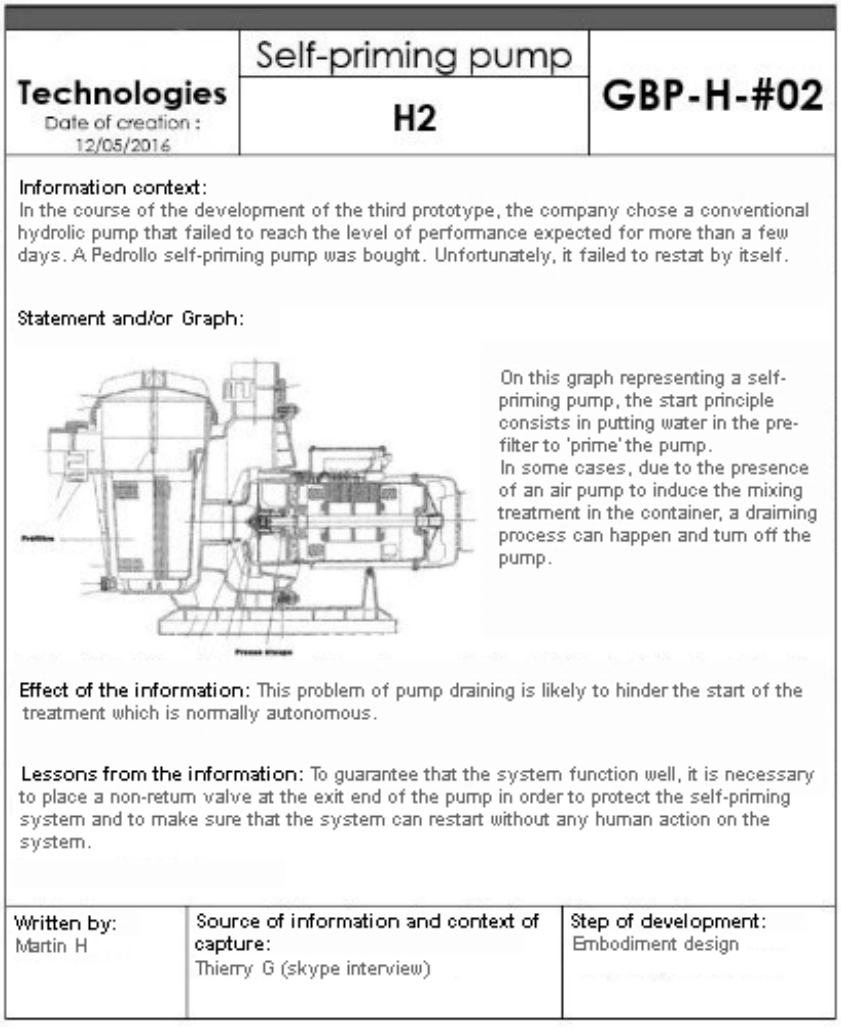


Figure 5. Knowledge card example

4.2.2 Analysis of the preliminary results and future works

We analyse all the cards obtained in their distribution by level and their distribution by job. Figure 6 summarizes the results.

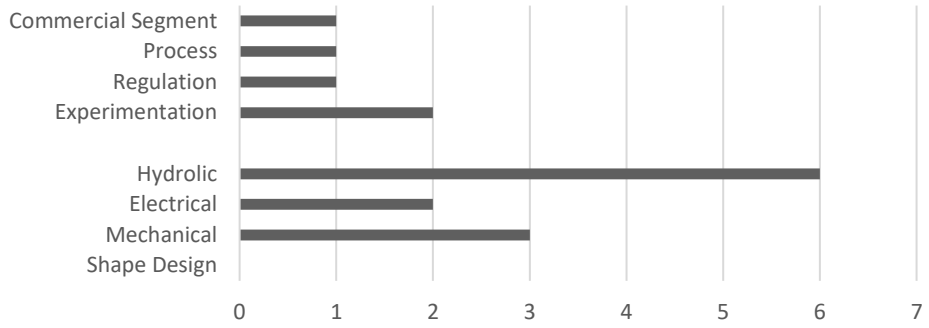


Figure 6. Number of Cards per category

Figure 6 shows the number of cards for each category. All of them have at least one card except the Shape Design job. Pinpointing this lack of knowledge allows us to validate how necessary it is for the company to carry out a work on that subject.

Two main future works should be done. The first one is to determine how exhaustive are the cards and how to measure it. The second one is to measure qualitatively and quantitatively the performance of this KM tool. At that time, the new prototype is currently under construction, we are not yet able to give any data. But we plan to measure if it saves time, reduce costs and reduce risks of errors. We also plan to conduct interviews to ask users how helpful are the cards. With this data, we will enrich this KM tool and test it in new experimentations.

A limitation of this case is that interviews are conducted by an external of the company. Another work to be done is therefore to check if performing interviews by an internal of the company also provide satisfactory results regarding the resources involved.

5 CONCLUSION

Knowledge management tools and methods can help companies to reduce the time needed to develop new products and therefore grab more opportunities of new markets. However, the existing KM methods and tools require a significant amount of time and resources to be understood and be used for micro-companies for product development.

The idea of the presented new tool is to create information cards to capture knowledge by conducting interviews and to deliver the knowledge in an easy and efficient way as they can be found quickly: all the information cards specify the step of development and the job related to their contents.

A case study on a specific micro-company was realised to test the tool. 16 knowledge cards in an 18-hours work were written and are now exploited by the micro-company. Future works are ongoing to determine how exhaustive are the cards and to measure qualitatively and quantitatively the performance of this KM tool. We believe it will save time, reduce costs and reduce risks of errors for product development in micro-companies.

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