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KNOWLEDGE MANAGEMENT FOR REDUCING DESIGN DEVELOPMENT TIME

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Abstract : Knowledge management is currently becoming a standard issue in our society and specifically in our firms. Knowledge management tools enable companies to take more appropriate decisions, to better capitalize their know-how, and to improve co-workers' training. Such tools are also used to enhance companies' performances as well as the quality of their products. It is indeed possible to exploit the possibilities offered by those tools in order to reduce the time needed to develop new products and therefore grab more opportunities of new markets. However complex it may seem for small structures to implement such tools, it is definitely possible to use them.

Key words: Knowledge Management, Project Feedback Management, Design process, Decision Making process.

1 INTRODUCTION

Time is a key issue for successfully introducing any new product on the market. Reducing the time for the development of a new product is essential. Product companies are now able to create new products or new versions of existing ones really quickly, even as regards high technology devices. Many examples testify to this evolution, from smartphones to cars, with upgraded versions every year. Competition is fierce, and consumers have become truly demanding. We as consumers want availability, quality, low prices and the latest technology for every product we buy. And, should we not be satisfied, we can easily spread the word to the entire world. Our generation uses online information for everything and knows where and how to find it in no time. However, if knowledge is readily available, finding the relevant, trustworthy and appropriate information may prove harder and more complicated for product development.

Let's consider the possibility of some knowledge management tool easy to both implement and exploit, and adaptable to all types of structures, including the smaller ones. Whenever a small-sized structure chooses to develop a new product, a number of decisions are taken tacitly. Developers know their field of expertise and they make relevant choices guided by their know-how. But in the event the structures change, some knowledge is very likely to be lost, and all the work has to be started from scratch. To avoid such risks, we propose a tool that enables not only to capitalize the choices but also, and mainly, to justify them.

Let's take driving as an example : it's fairly easy for a driver to determine when he's slipping the clutch, but if he has to explain to another person how to do it, it's a different story. Our tool aims to induce the people wishing to use it to put words on their personal knowledge.

Its second objective is to build an information database with an appropriate size. Every single piece of information must be relevant and one should be able to use it at any given time. The idea is to avoid wasting time in trying to localize the useful information in all the databases available.

To succeed in doing so, we need to consider the various knowledge management tools, to understand how they function, and to single out the one that is likely to be the most efficient after some alterations

2 State of art

2.1. Defining knowledge and the conditions for implementing knowledge management tools.

Nonaka and Takeuchi [1] proposed in 1995 a definition of the knowledge that is now a reference in this subject :

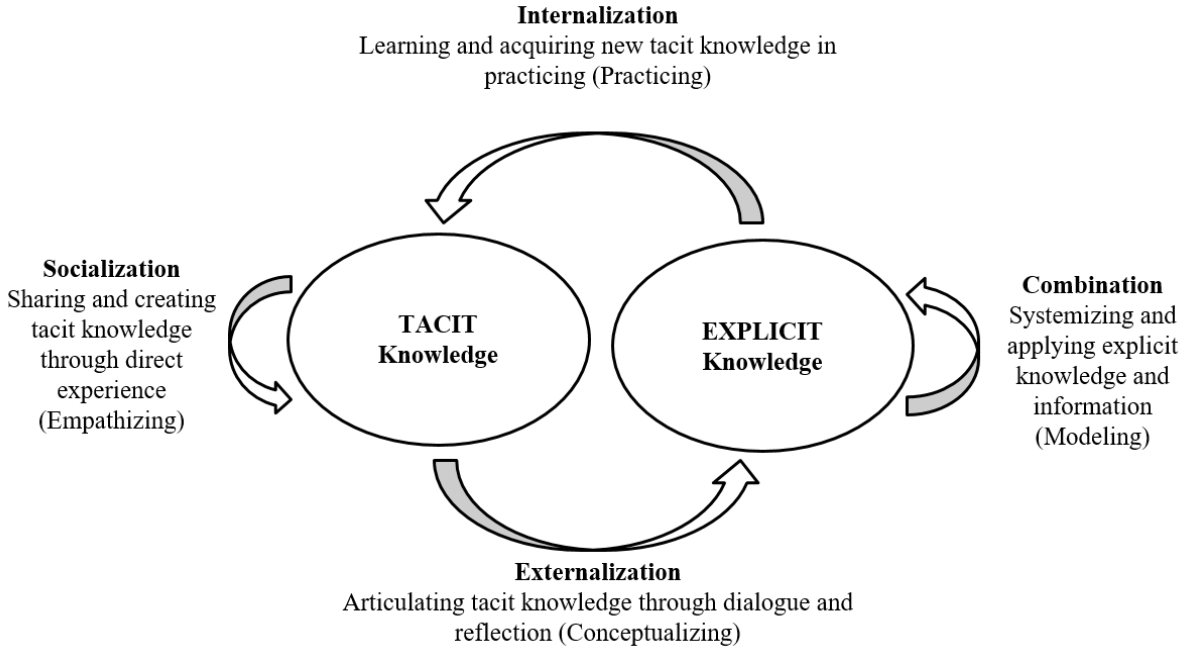

Figure 1 : Nonaka and Takeuchi SECI Model

We can see on this figure that there is two type 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 creating more knowledge. For companies, controlling and using this knowledge is called Knowledge Management.

Succeeding in implementing knowledge management tools requires some strong determination from the company's management. As the benefits delivered by such methods are not immediate, a real commitment is necessary, as well as the governing body's prior validation. The resources necessary for generating capitalization systems are also indispensable. The FD X50-190 [7] standard confirms the necessity for companies to build Knowledge Management systems suited to their specific needs and use. Once the tool has been chosen, it is necessary to have a communication system efficient enough for every co-worker to be able to access it. It is therefore essential to ensure that these people are sensitized to those tools in order to fully exploit the benefits delivered by Knowledge Management. Each tool has its own assets and weak point, which means that choosing the right tool is of prime importance.

2.2. Knowledge Management tools

Many different tools and methods are on the family of Knowledge Management and can be used to capture and then use this existing knowledge in order to avoid doing again something that has already been done. Some research focus on building methods of capitalization while some others are about exploiting this knowledge. Methods such as MASK [2], CYGMA [3] and MEYDIAM [4] have allowed to generate a lot of opportunities to exploit companies' internal or external knowledge. Methods such as REX [5] or Componential Framework [6], that rely on those methods of capitalization to provide considerable help to companies for their performance or strategic orientation.

The table below shows the various tools' differences and capacities :

Methods	Extent of Activity Represented	Type of approach	Type of memory and models of representation	Types of models generated
MASK	Activity + Context	Knowledge engineering	Activities memory Knowledge models	Models of contexts, Work areas activities, Concepts, Tasks
CYGMA	Activity + Context	Continous memory build-up	Job tasks memory Jobs reference document	Glossary, Semantics leaflet, Regulations register, Operating manual
MEYDIAM	Aid to Decision-Making	Mapping	Project memory Decision-making reference document	Decision diagram, Organization graph
REX	Resolution of Problems + Vocabulary	Continous memory build-up	Individual experience memory Experience reference document	Lexicon, Experience cards
Componential Framework	Resolution of Problems + Context (tasks to complete)	Continous memory build-up	Activities memory Knowledge models	Problem-solving models, Work area models, Case models

Figure 2 : Comparison chart of KM Methods

Let us mention that the REX [5] methods use a terminology network also called ' lexical items network' set up to allow requests close to standard language. Such a network is made up of objects that may be words or sentences with vocabulary belonging to the field of the area considered. The network is structured with syntax relations like 'sort-of' and ' about'. An element of experience is considered as a basic item in the memory. It is linked to a collection of objects defined in the viewpoints. This may be an automatic operation. It is based on a lexical recognition of terms identified in the context of the element of experience. But choosing which connection is finally to be set up is left to the Artificial Intelligence specialist. This kind of association allows to have a descriptive view of the area. The text representation of an element of experience can be indexed automatically by relating terms identified in the text to the terminology network defined.

Each tool is suited for a specific need ; it is therefore important to assess one’s needs before opting for one of these tools.

We believe it is possible to generate a new tool specifically adapted to the initial design and offering opportunities in terms of reduction of development time.

2.2. MEREX

Let's focus on the family of REX [5] tools, and more particularly on the MEREX [8] tool. The working basis of REX [5] tools consists in a process of exploitation of experienced situations.

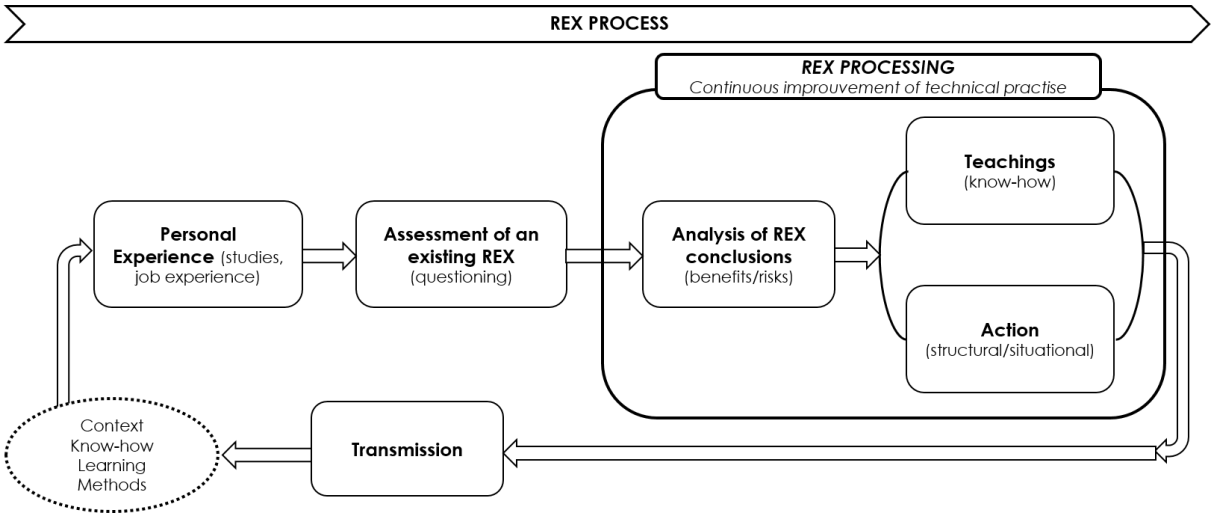

Figure 3 : REX Process

The purpose of the MEREX [8] method, developed by Renaud in 1997, is to use their knowledge and expertise in a better way, to avoid making mistakes during the design process. The process starts at production level ; operators are faced with a problem and capture it. Renault technical experts concerned by the problem analyse it and attempt to find solutions. Together, they set up a rule to prevent the problem from happening again. The rule is then forwarded to the research department for developers to be informed. They create short files to hold experiences they are willing to save for the future. The MEREX [8] information card defines elements of experience through :

- Context of a problem or of a problem-solving situation
- Description/body
- List of references

The body itself is made up of three parts :

- Sheer description of a fact
- Personal opinion and commentaries
- Recommendations

This card is purposefully streamlined and presents easily readable information, though stating extremely relevant elements of context, reference, and follow-up. It allows its readers to fully understand the issue as well as the ways and means to solve it.

3 METHODOLOGY

In this article, we propose to use and adapt the MEREX [8] tool to shorten the time allotted to product development. Based on this method, we propose to (1) capture all the work already delivered - especially about the technical aspect-, (2) classify all the information gathered in relation to its nature and (3) diffuse only the information each trades need at each step of their design process methods. Our improvement consists in adding on each information captured, new parameters like nature, trade and design process step. The work carried out before the beginning of the design process of the last prototype may save us a lot of time because the information is yet classified.

3.1. Stages of the project

To develop and implement our Knowledge Management tool, we have chosen to go through the following process :

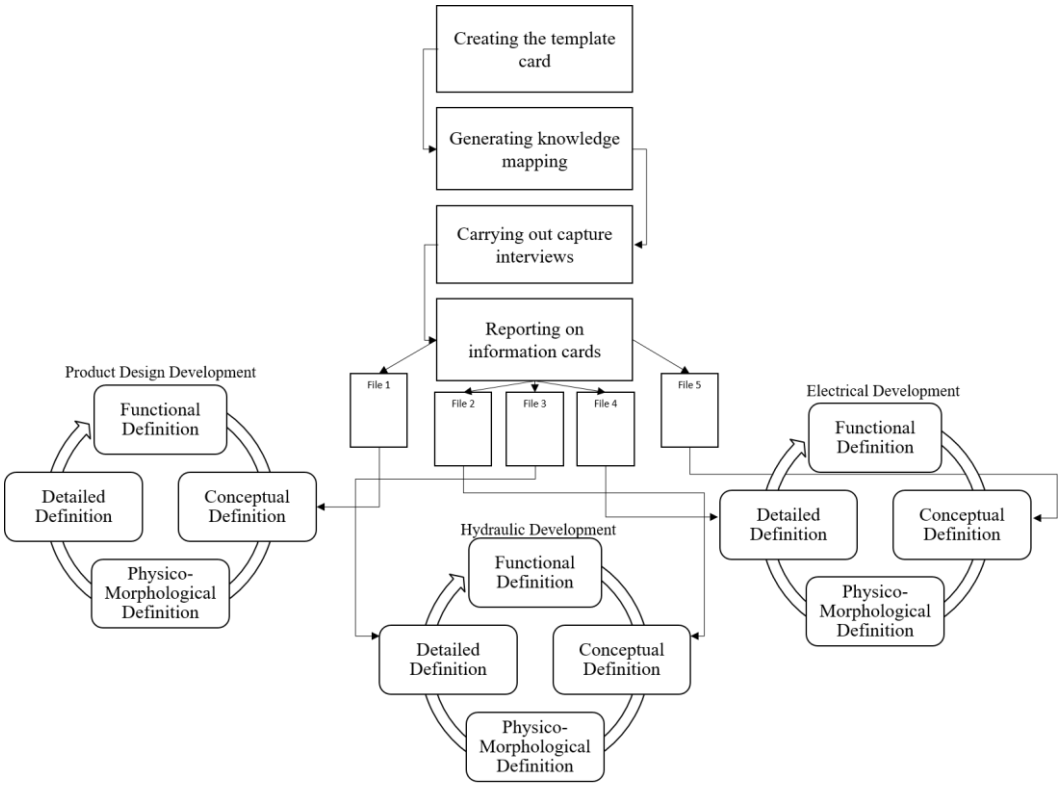

Figure 4 : Process development and implementation

The process is split into 5 parts. Stage one is about how to adjust the traditional MEREX [8] card to design a card better adapted to the uses of our tool. Then we need to think about how to organize the cards generated so that the tool captures all the necessary data. As soon as this work is completed we can move on to capitalization in the way of an interview. This stage allows to write out the information cards with the data harvested in the interviews. Finally, the persons who need these cards for development can proceed to using them.

3.2. Standard card and knowledge mapping

To move from the MEREX [8] knowledge card to the one used by this tool, the notion of issue should first be eliminated. Our method aims to capture all the information generated by previous work and not only the problems met. The notions linked to the commercial impact of the problems are also removed. As regards the part entitled « consequence of the issue » the notion of problem is also removed so as to keep only the consequence of the information. Besides, our purpose is not to define general rules or ready-made solutions to solve the issue captured. Our tool captures information without imposing or enforcing any solutions.
Whatever deals with following up the card consultation has also been removed since this tool does not aim to set up use statistics. The goal is to obtain a simple card that can be read quickly.

Consequently the card will include the following elements :

- The name of the company concerned by the card and the date of creation of the card
- The card title
- The card code
- A memo stating which jobs or positions are likely to be concerned by the card

- The context in which the information has been previously learnt
- Text and/or graph giving the information
- The consequences of the information captured
- What can be learnt from the information captured
- Reference elements
- The name of the card's writer
- The source of information and the context of capture
- The step in development where the card can be used

This architecture is very similar to that of the MEREX [8] card but it makes it possible to adapt to a capture less specific than the original one.

It is also essential to define how these cards are arranged so as to classify them in the best possible way.
Knowledge mapping must enable users to spot and find the information wanted quickly and easily. Consequently, we have decided to divide an x solution into 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 an indication about which jobs or positions are likely to be concerned.
This will make it possible to divide the cards efficiently because every party involved in development will be able to find the cards relevant to their domains.

3.3. Interviewing, writing and exploiting cards

Once the design phase of our tool has been completed, we can move on to the phase devoted to capturing knowledge. Several options are available :

- Telephone interview
- Face-to-face interview
- Skyping
- Any other form of exchange

To succeed in capturing all the relevant information, the person in charge of the interviews should, on the one hand, master how the tool actually works and on the other hand, have a comprehensive knowledge – both global and transversal- of the whole system.
This will enable this person to ask questions that are really to the point and to write faithful, reliable information on the cards.
Synthesizing is an indispensable task to write out the cards efficiently.
One must choose how to import onto the cards and deal with all the information retrieved through the interviews. Indeed, the way the information is laid out on the map and the cards will have a direct impact on how relevant and efficient the tool will be.

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 CASE STUDY

Innogur Technologies is a micro company specialized in the development of new smart eco-friendly solutions to clean up water pollution. For a period of six months, we are in charge of developing the latest prototype of one of its green products, namely a performance booster for sewage systems called GreenBoost. The project began in 2009 and three prototypes have been designed so far. Innogur Technologies now wishes to launch this product on the market.

To pilot the experimentation, our first step will be to draw a questionnaire about each of the last three prototypes. The goal is to capture all the technical specifications which Innogur Technologies staff have opted for ; 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. For this purpose, face or telephone interviews will be used with all the persons who worked on those prototypes. We need to do the same interviews for each person involved because the point of view is a key element. Afterwards, and by using the Knowledge Management tools, we will classify all the knowledge gathered.

The results will be assessed by a questionnaire at the end of the process for the suppliers to let us know if the information provided helped them. Finally, to set into relief the time-saving aspect, we will set the time needed for this development against the time of development spent over the former three prototypes.

5 RESULTS

The aim of this research is to show that Knowledge Management can be used in design development simply and that the method can be adapted to all product development types. Making better use of whatever worked or failed to work in the past will help design new products faster and better.

5.1. Setting up the GreenBoost database

When dealing with the development of GreenBoost, we followed the process presented in Figure 4.
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
- Design
- Mechanics

As to the System level, it includes :

- Process
- Commercial segment
- Experimentation
- Regulation

We have therefore represented the knowledge map as follows :

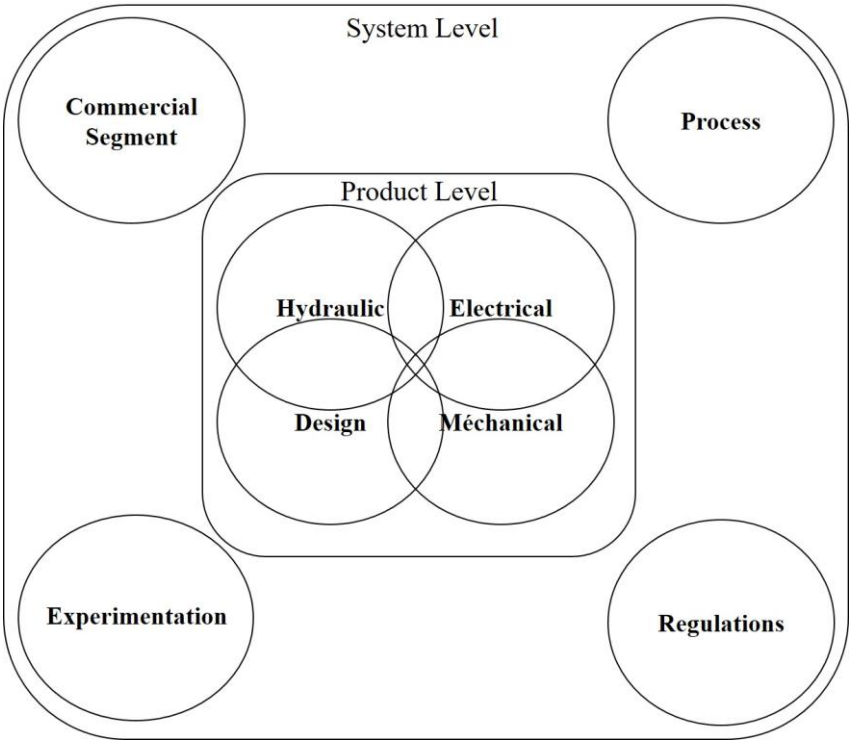

Figure 5 : GreenBoost Knowledge Mapping

Following the definition of mapping we could proceed to interviews in order to generate the information cards.
We carried out 4 interviews with the people who had the information needed :

- Interviewing Innogur Technologies' manager allowed us to gather a large amount of information about the Product level as well as the System level, and to create 7 cards
- Interviewing the system's designer enabled us to create 2 cards of System level about process and experimentations,
- Interviewing an expert in the system's commercial positioning allowed us to create a card at the System level about the commercial segment
- Interviewing the company's former engineer allowed us to create and/or complete 6 cards at both levels

All the information collected provided us with a genuine and thorough view of all the previous works. We could thus exploit them to go further in the development of the product.

5.2. Saving time in selecting components and speeding up product design of the final prototype

One of the main objectives of the project is to carry out an experimentation in order to prove that our system succeeds in reducing water pollution.
We had to build several prototypes of version 3 of the system.
The detailed information about each component which we obtained through the interviews and reported on the cards enabled us to speed up research on those components ; it also confirmed how pertinent they were.

There is no way we could have made our choice so quickly if we had not had a complete view of the system and of the major details thanks to the cards. The prototypes are currently under construction ; as soon as they are finalized we will be able to calculate formally how long it took us to complete the task. The objective is to set these results against the previous experimentations.

In parallel with the work on the experimentation of prototypes of version 3, we are going to carry out some work on product development so as to generate the final version of GreenBoost.
This work, done in partnership with a design company, will enable us to define all the uses of this final version.

To this purpose, using the information cards will be utterly helpful since they will provide us with immediate overview of all the general aspects and all the technical points of the system.
This tool will therefore allow us to make the right choices. Once the project is completed, we will have the possibility to ask users how helpful our cards have proved in the course of their work.

If the results are conclusive, we will be in a position to infer that, in many design cases, the assistance provided by our tool is likely to deliver solutions as regards :

- Saving time
- Reducing costs
- Reducing risks of errors

6 CONCLUSIONS

Developing this tool for pooling knowledge makes it possible for any type of structure to enjoy the benefits of such knowledge tools.
Many tasks are still to be carried out as to how the database for those information cards functions.
Our work concerns one single product of a small-sized structure ; connections haven’t yet been set up with how it could be used transversally for several products. But benefits as regards creativity are already pinpointed. And since our tool provides an overview of a system, it could help spot more quickly how to improve or upgrade it.

Knowledge Management helps companies to innovate and to standardize their practices. Thanks to those methods, we can induce engineers and developers to go slowly at the beginning of a project. They can thus avoid making mistakes as well as wasting time and money. Knowledge management is complex and can be risky for companies' safety. But the benefits are enormous and countless other applications can be found to increase company quality, performance and strategic orientation.

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