Stakeholder analysis for development of knowledge management system in micro- and nanoelectronics

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Abstract: *Knowledge management relates to the vast majority of business-processes at enterprises in knowledge-intensive sectors, such as nanoindustry. In particular, all stages of the new products' creation, i.e., research, development, launch of the production line, manufacturing and operation, are associated with the new knowledge generation. However, one can find numerous inefficiencies in the existing business-processes due to a lack of communication and poor data handling. Although the financial consequences of ignoring these problems are significant for the enterprises, the absence of step-by-step solution plan and human resource overload make it necessary to look for different ways to solve the issues related to this topic. In order to successfully solve the detected problems and thus ensure support for the further development of the knowledge management system, five key directions were formulated based on the interviews with stakeholders.*

Keywords*: KNOWLEDGE, KNOWLEDGE MANAGEMENT, NANOINDUSTRY, STAKEHOLDERS*

1. Introduction

Being one of the essential spheres of Industry 4.0, nanoindustry is among the most knowledge-intensive sectors. Indeed, the organizations linked to micro- and nanotechnology are constantly generating and consuming data, information, and knowledge. Analyzing the other companies' attempts to improve the corresponding business-processes in order to achieve higher productivity, one of the most promising ways is the development of knowledge management system.

This system is applicable at least in three key aspects of innovative organization, particularly in the social, commercial, and scientific-technical activities. For example, after establishing the direct communication between the fundamental research groups and development departments, the problems can be formulated and solved faster. This, in turn, allows to allocate the precious highly-qualified specialists to the new projects. Stronger project teams stimulate the advances in the fundamental and applied research as well as provide the opportunity to create new products. Thus, the organization does not only faster gains intellectual capital, but also increases its revenue. Similar chain effects set the ground to develop and run a knowledge management system in organization.

The fastest way to launch such a system would be to integrate one of the ready-to-use knowledge management tools or adjust one of the multiple knowledge management models developed by several research groups who studied the innovation process in companies since 1970-s. Unfortunately, none of these instruments are task-specific enough, i.e. they do not account for the dynamics and variability of technology development, so there is no straightforward recipe for implementing an information system at microelectronics enterprises using one of them. This implies that specific organizations are involved in different types of knowledge generation activities. Moreover, one can denote these groups as knowledge sources and classify them by their roles and functions.

2. Knowledge sources

Table 1 illustrates the attempt to match the stages of technology life cycle as exemplified by the field of micro- and nanoelectronics to the types of activities which are related to the knowledge generation [1]. One can observe that the transition to the next level of technology's development shall trigger both the new sources of knowledge and some new streams of information that must be carefully gathered and analyzed.

It shall also be stated that due to the complexity of the field, there are multiple branches in microelectronics, which go through the same steps during their evolution. In case all the obstacles to the development of such a branch which make it incompatible with the core technology, are resolved, then the technology itself becomes part of the micro- and nanotechnology.

Table 1: *Suggested matching between the stages of micro- and nanoelectronics technology life cycle, specific types of technology development activities, and the key groups of stakeholders participating in these activities.*

Life cycle stage	Activity	Agents
Initial research	Fundamental research	Universities and academic institutes
Inflated expectations	Applied research	Industrial institutes
Trough of disillusionment	Study of requirements	Customers
Slope of enlightenment	Implementation in production	Manufacturers
Plateau of productivity	Analysis of operation	Consumers

More than 60 years of progress in microelectronics allows to certainly locate its position at the life cycle curve, and it is at the productive stage. That means that in order to develop an advanced knowledge management system, one requires to account for the needs of all types of participants in knowledge-generation processes.

3. Stakeholders demands

Based on results of the initial round of interviews with the agents both within and outside the research organization, five topics were formulated as the issues where lack of either communication or information analysis lead to some form of inefficiency, e.g., loss of revenue or irrational resource consumption. We will now work through each task and consider the opportunities to address the stakeholders' requests.

3.1. Accessing the lessons learned

The experience gained while working on projects is extremely valuable because it can help you avoid making similar mistakes in the future. After being analyzed, the accumulated knowledge provides the project leaders an opportunity to manage time and money more cost effectively. Besides that, the obtained results might help to assess the organization's capabilities in terms of research and development speed, holders of expertise, and opportunities within the collaboration partner network.

Currently the company does not have even an electronic database of stored project documents. Their scans are stored in the individual folders of various department employees who have been assigned the processing of specific project after its completion.

3.2. Assembling a project team

One of the biggest challenges for launching the new projects is the staffing. It is quite frequent when the assigned project leader needs to find several researchers or developers with relevant experience as well as new unqualified members with the right motivation.

The current common practice in this regard is escalation to the management level for further search of staff among different departments. However, the project leader could conduct the primary search for candidates based on their activity in previous projects and provide the suggestions or even conduct one-on-one interviews before that.

3.3. Customer development

The surest way to bring in more revenue is to make a product that is in demand. In turn, in order to ensure demand, it is necessary to involve the customer in the development of the product. By consistently testing hypotheses, project teams will be able to identify true needs and develop exactly the solution systems that will meet them.

Currently, this information is transmitted through several levels of institutions via the terms of reference, which may have very little in common with the true voice of customer due to the written document format restrictions and time delays.

3.4. Innovation and technological intelligence

In order to improve the enterprise positioning, one shall continuously perform a detailed analysis of commercially available products and technologies, as well as scientific achievements. These measures, also known as technological scouting, allow to make a more accurate picture of available microelectronic technologies on the market [2].

This type of market and scientific research is not carried out on a regular and centralized way, but rather delegated to the technical leaders of the relevant fields. They get this information when they attend events, study the publications, and communicate with colleagues.

3.5. Root-cause analysis of defects

Defects are random nanoscale imperfections that characterize the nonideality of real devices. These defects impact simultaneously not only the performance of single devices, but also the yield of the whole production line.

The statistical process control which is currently the primary tool of quality management in nanofabrication, does not provide sufficient information on the source of the problem.

Digital twins will allow to perform the complex analysis and localize the source of the issue minimizing the time spent on experimental testing of hypotheses suggested by the board of experts.

4. Results and Discussion

We have found five issues which can be tackled using the elements of prospective knowledge management system. These points are considered as the candidates for the “quick wins”, where the members of associated business functions will notice the positive impact of initial steps of knowledge management system development. This will also facilitate the integration of this system into organization’s business processes related to knowledge creation.

5. Conclusion

Developing a knowledge management system for the enterprise in nanoindustry involves identifying the internal and external stakeholders, their roles and functions. In order to successfully implement and anchor the solution, we identified the issues with highest impact on the revenue and employee productivity, which could be solved using certain elements of the prospective knowledge management system.

6. References

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