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CONCEPT OF AN INTERNET-BASED PLATFORM FOR AN EFFICIENT TECHNOLOGY ABSORPTION

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1. Introduction

Many companies in industrialized countries react to global competition by offering newer and more innovative products. To achieve this, companies implement short and efficient product design and development processes focussing on a fast translation of customer needs and legal requirements into products. To improve the innovative character of the products they depend heavily on importing innovations created by suppliers and other companies (e.g. OLED-displays for mobile phones). *Cohen and Levinthal* argue that in a setting as described a company's ability to identify, import and apply external technology becomes a critical aspect for the innovative capabilities of a company [1]. This capability is referred to as the absorptive capacity of a company. In their empirical research *Cohen and Levinthal* link absorptive capacity to R&D spending and already existing knowledge in the area where additional knowledge is to be imported. The empirical results prove the suspected link and advice companies to build up knowledge in strategically important areas and use it during the absorption process in order to facilitate a more efficient technology absorption. These findings are supported by other authors, e.g. case studies analyzing the implementation of process technologies [2].
In order to produce more specific results on critical aspects of the absorptive capacity of companies, to identify problems, obstacles and suitable solutions, this paper develops a process model for knowledge absorption. Empirical research is used to assess practices and obstacles in the stages of the knowledge absorption process. Based on these findings a concept for an Internet platform will be proposed that considers practices already in use and reduces the obstacles identified for the knowledge absorption process.

2. Knowledge absorption and knowledge management

Leonard-Barton describes several activities associated with the absorption of technological knowledge including the identification of gaps in technological core capabilities [3]. These gaps may result from deliberately reduced R&D spending of a company, advances in a technology already applied or newly identified technologies. The next step consists of identifying sources of suitable technology and evaluating the sources as well as their technology. Subsequently, the technology has to be imported, adapted to the needs of the company and applied in new products and processes.
The absorption of external technology is associated with knowledge transfer. In order to develop a process model for knowledge absorption the activities described before are integrated into an existing knowledge management process model.
For this purpose we adopt the pragmatic definition of knowledge as "information sufficiently interpreted to enable action" and information as "data that has been structured and represented for the human senses" [4]. This paper focuses on the absorption of external technological knowledge and the

development and examination of the absorption process. Therefore, we use a model of knowledge management that facilitates the process view and allows external sources of knowledge as shown in figure 1.

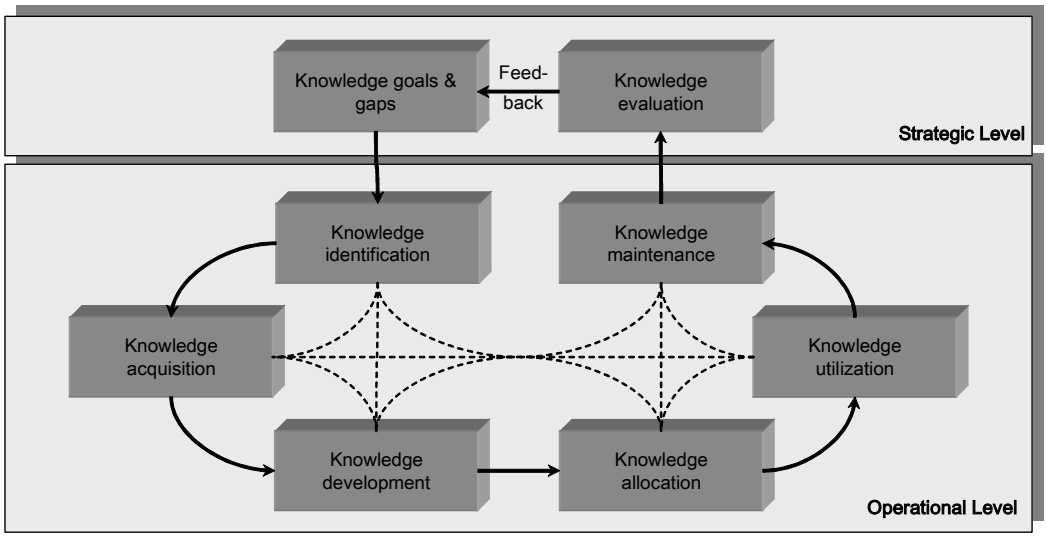

Figure 1. Model of a knowledge management process on a strategic and operational level [5]

On a strategic level the model includes the evaluation of existing knowledge in a company as well as the identification of desirable knowledge. On the operational level suitable means have to be chosen to identify desired knowledge and acquire it. Newly important knowledge is developed to the level desired by the acquiring company. Then the knowledge is allocated and applied. Finally, knowledge should be preserved to allow a reuse in a similar context. Closing the process loop the knowledge management process starts over with strategic considerations.
As compared to other knowledge management models, e.g. *Troxler and Lauche* [6], this model adds a strategic and operational level to those activities presented. Similar to the identification of a technology gap as the starting point of technology absorption this process starts with the assertion of a knowledge gap.

3. Development of a process model for knowledge absorption

The activities associated with the absorption of technology can be integrated into the knowledge management process. The result is a process model for the absorption of external technological knowledge as presented in figure 2. With this process model empirical findings about obstacles and practices used during knowledge absorption can be associated with the different process stages and allow a better understanding of problems and potential solutions.
Starting point of the absorption process is the identification of technological gaps based on a comparison of existing capabilities to the strategic needs of a company. Potential sources for the desired knowledge as well as the technology they offer must be identified and evaluated. Suitable means for the acquisition of knowledge must be chosen. The gap between acquired and desired technology is closed by developing the technology. The process ends when newly acquired technology is applied which closes technology gap identified at the very beginning. From a knowledge management point of view the process goes on with preserving the knowledge for reuse. To close the loop a comparison of the achieved knowledge level with the original target level or a revised target level has to take place. This evaluation might result in the identification of a new technology gap.

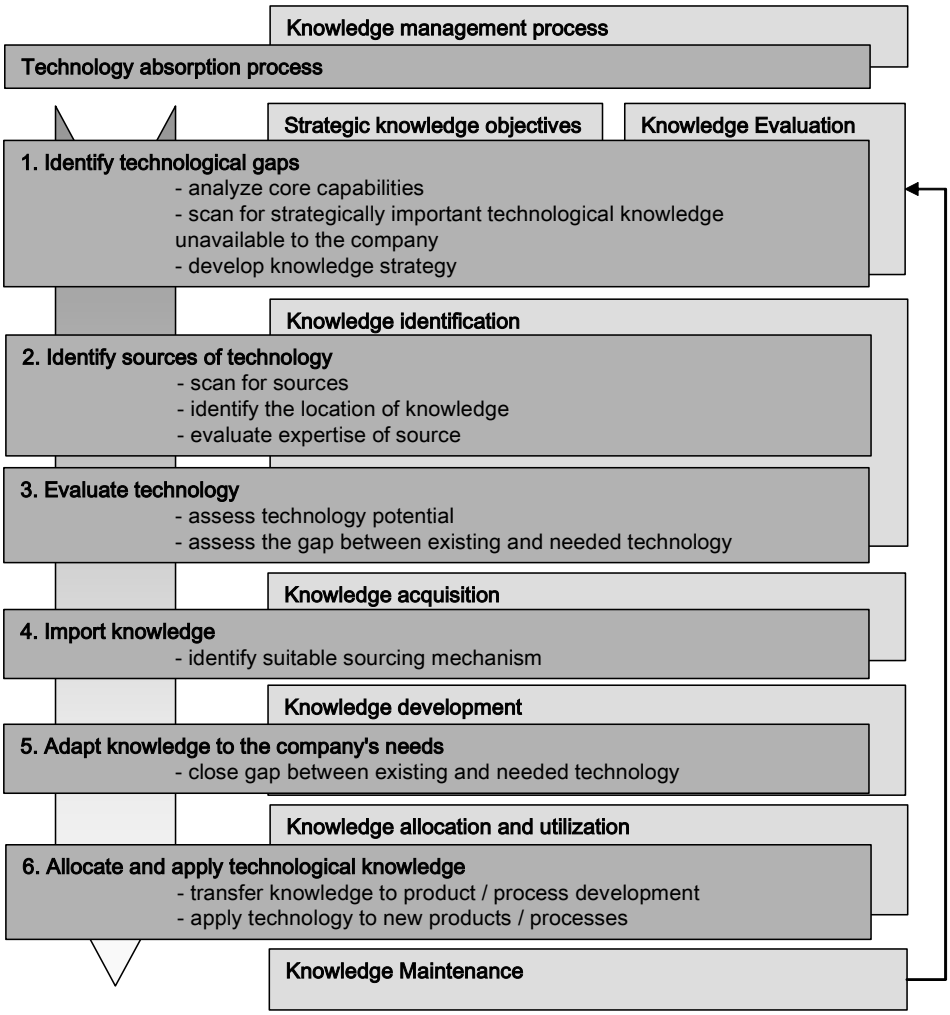

Figure 2. Process model for the absorption of external technological knowledge

Practices and obstacles of the absorption of external technological knowledge were part of a study asking 497 German companies about general knowledge management practices [7]. The study differentiated between the non-innovators and innovative companies, defined as those companies that have realized at least 10% of their revenue from new products during the last three years Some questions and the corresponding data can be directly related to the introduced absorption process:

i. overall importance of the knowledge absorption process,
ii. importance of an strategic approach to knowledge absorption,
iii. means of scanning for sources of knowledge and their relevance,
iv. usage of different sourcing mechanisms and their relevance as well as
v. obstacles in the stages 1 to 4 of the absorption process.

Thus, the study includes questions concerning the practices used in the stages 1 to 4 of the absorption process.

4. Practices and obstacles for knowledge absorption

The study proved the importance of external knowledge absorption (i) revealing that the group of companies that sources external knowledge contains a significantly higher portion of innovative firms than in the overall sample. The same is true for the group of companies that have an explicit innovation and knowledge management strategy, which underlines the importance of a strategic approach (ii) to technology absorption (significance at 1 % level). The most important reason for sourcing external knowledge is the need for fast technological adoption to customer demands or suppliers.

In the stage of knowledge identification (iii) most companies use printed material, Internet research as well as expert networks for monitoring and scanning of technological knowledge. Most widely used is the investigation in printed and electronic sources (used by 97%). Innovative companies rate databases and the Internet as more important than non-innovators. Small and medium sized companies especially rely on codified knowledge such as literature, Internet and databases.
As practices for acquiring and importing external knowledge (iv) participating companies use investigations in printed and electronic sources as well as external experts most frequently.
Among the most important obstacles for the absorption of knowledge (v) is the fear of giving away sensitive knowledge, which is associated with the sourcing mechanism. This problem has also been described by other authors asserting that companies does not stop them from extending their networking activities [8]. There are also indications that this fear is a result of a lack of experience in the sourcing of external knowledge in certain companies. Problems with the identification of knowledge in terms of lacking procedures and high cost of search were especially highlighted by small and medium-sized firms as well as problems with the identification of suitable sources. On the level of single product developers time consuming and therefore expensive information gathering and organizing activities have been identified as problems by several authors [9, 10] supporting the significance of this obstacle.
From the presented results it can be asserted that the most important and most widely used means for scanning as well as sourcing external knowledge is codified knowledge retrieved from literature, databases and the Internet. This is especially true for small and medium-sized companies. Most important obstacles for the absorption of knowledge mentioned by the study can be localized in the stage of knowledge identification and knowledge acquisition. However, it is necessary to note that the study only examined obstacles within the stages 1 to 4 of the absorption process.

5. Concept for an efficient technology absorption

In order to ensure a good user acceptance a concept for a support of the knowledge absorption process should consider the practices already in use and increase their efficiency by lowering the obstacles identified. Thus, the concept especially needs to facilitate the absorption of codified knowledge. As the Internet has been identified as one of the most widely used means for knowledge absorption an Internet platform proves to be a suitable way to present technological knowledge. It is capable of establishing a cost-efficient link between companies that have identified technological gaps and providers of suitable technologies [11].
The development and implementation of an Internet platform linking companies searching for new technologies and providers of technology is the goal of the joint research project E2Pro. The project is a publicly funded cooperation between the Technical University Braunschweig and five industry partners. The screenshot of a first version of this platform presenting an OLED display can be seen in figure 3.
General requirements for the Internet platform can be derived from the stages of knowledge absorption. Additional requirements have been specified in workshops with product designers from the partner companies.
The Internet platform needs to facilitate the identification of sources as well as the evaluation of technologies. For an efficient scanning and identification a combination of search and browsing functions is necessary. For browsing a clear structure consisting of different modules for different kinds of technology groups (e.g. materials, processes and components) as well as a tree structure for browsing within a technology group has been requested.
For the evaluation of technologies it is necessary to develop a comprehensive structure for a brief technology description and present important technology properties. In order to enable a comparison of different technologies the structure has to be consistent. Case studies with the partner companies have revealed the need for an evaluation considering innovative aspects of technologies as well as technical, economical and ecological properties. In addition, developers argued that they want to easily identify properties that are of outstanding importance for them, for example because they are closely related to the technological gap that started the absorption process.

The assessment of the gap between the technology as it exists at the source and as it is needed at the user can be supported, by providing a stage of development for the technology (in development, prototype, market available) and already existing applications (e.g. OLEDs are already available as displays of handheld computers). This enables the user to estimate the transferability of the technology to the product the user is developing (e.g. a mobile phone).
Finally, the source of the technological knowledge needs to be characterized (e.g. research institute, other company) allowing the user to evaluate expertise of the source and to contact the source if desired.

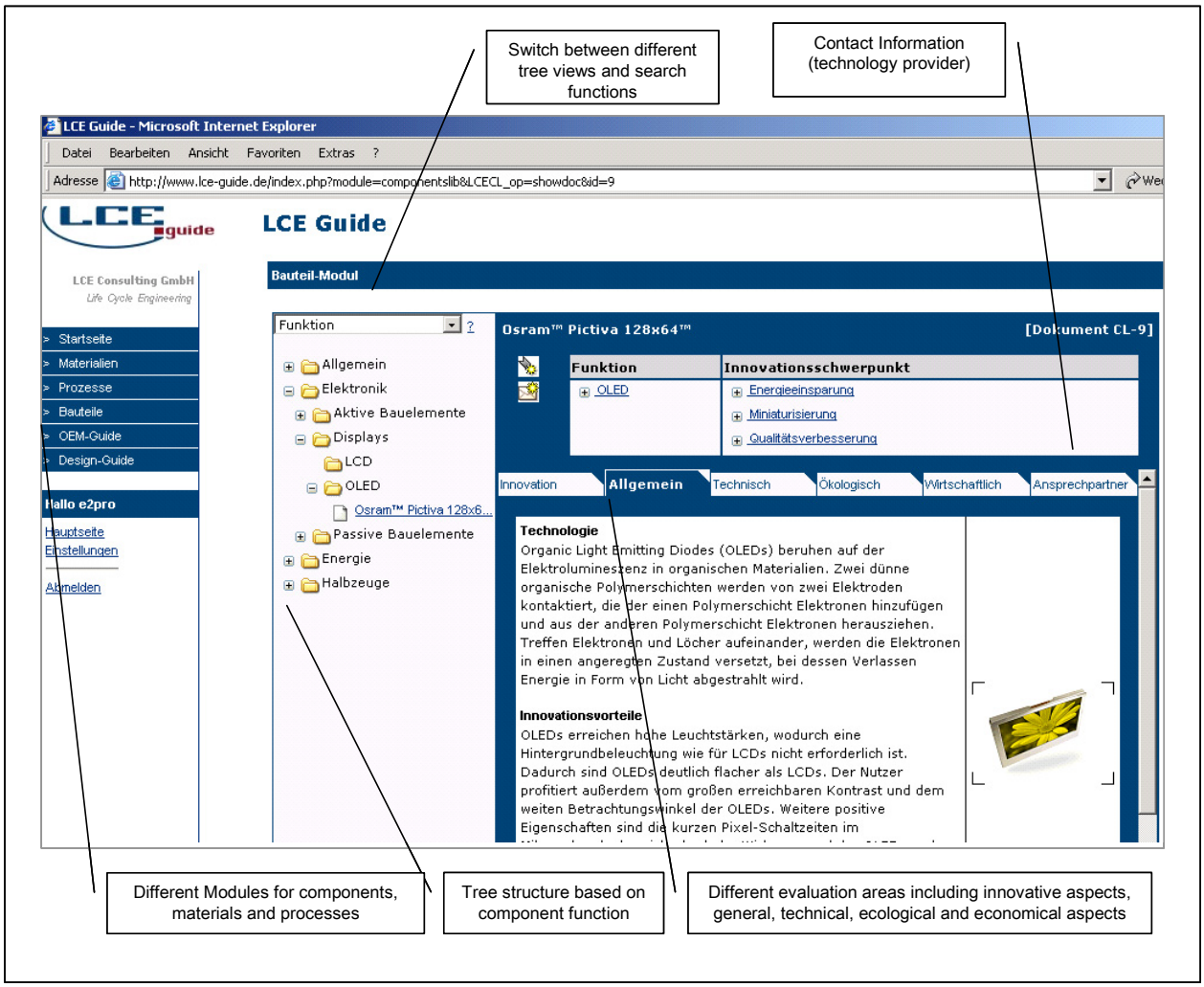

Figure 3. Screenshot of the platform prototype

6. Conclusions and Outlook

Increasing competition forces many companies to speed up their product development processes and offer newer and more innovative products. Shortening product development times companies rely more and more on external sources of technology in order to apply innovations to their products. Thus, the absorptive capacity of companies, defined as the ability to identify, import and apply new technology, becomes even more critical to a company's innovative capabilities. Based on existing literature on knowledge absorption and knowledge management a process model for the absorption of external technologies is developed in order to create a better understanding of the different stages of technology absorption. Obstacles and practices of this process are taken from an empirical study and linked to the different stages of the process in order to structure the problems and practices. Finally, a

concept is developed and briefly introduced to reduce the obstacles and therefore facilitate a more efficient absorption of external knowledge.
The prototype of the platform already comprises most of the functions that have been derived from the requirements. However, test runs at the partner companies of this research project will result in further improvements. In area of technology evaluation surveys have been started to analyse which technical, economical and ecological properties are most important to designers and how recent environmental legislation is influencing these requirements.

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