Abstract
Due to the electrification of the power train, automobile manufacturers and suppliers need a methodology to decide on how know-how or skills have to be developed for new production techniques. The WZL of the RWTH would like to provide a systematically structured method to help companies in taking decisions in an objective way, while reducing costs and time.

Keywords: Technology sourcing, innovation, electric power train, e-mobility

Introduction
Currently, one of the most important technological changes is taking place within the automobile industry by the electrification of power trains. For vehicle manufacturers and suppliers, this shift in technology brings about the need to produce components often completely unknown to them: e.g. combustion engines are replaced by electric motors as traction motors and batteries, which are considered to be crucial components in electric vehicles, have to be developed. Although it can be argued that electric motors and batteries have been produced for decades, but their application in electric vehicles imposes new requirements on them. For instance, the power level required by traction motors is relatively high compared to electric engines for robotics or machine tools. These new requirements lead to new production techniques and processes for which no know-how and expertise is existing in some companies of the automotive industry at the moment.

Today, companies are faced with a fast changing environment that they have to react to (Christensen, 2011). Producing companies in general are more than ever challenged by the pace of technological change which causes them to realign themselves with regard to their product knowledge and technological expertise (Prahalad and Krishnan, 2008). Telling examples can be found in other industries: Nokia (The economist, 2010) lost their market leading positions due to their inability to adjust new innovations within the mobile phone sector. Kodak (The economist, 1012), once a leading company in the camera industry,
declared bankruptcy in early 2012. The replacement of film cameras by digital ones and the cannibalization of cameras by smartphones brought the ruin for this company.

At the moment companies of the automobile industry are confronted with a similar technological change - in this case caused by the electrification of the power train. To spare companies this “fate”, there is a need for a holistic guideline concerning the acquisition of new technologies. This guideline shall include two steps in general (Hümmer, 2001):

- Firstly, a company has to identify the technologies which has to be developed
- Secondly, the company has to develop the technology (in terms of building-up)

Mastering these two steps turns out to be crucial for a company as new core competences are built and its competitive advantage is strengthened. An extensive literature research has been conducted with regard to a definition of core competences as well as approaches concerning the first step of identification (Kampker, 2004) and the second step of the actual developing process of core competences.

**Definition of core competences**

The theory of core competence is widely regarded as an independent part of strategic management. Before using the term “core competence”, it has to be properly defined and distinguished from non-core competences. The first basic and most often quoted definition of the term was published by (Prahalad and Hamel, 1990). The definition has been extended in their book “Competing for the Future” (Prahalad and Hamel, 1996). Since then, building on the basic definition of Prahalad and Hamel many authors have added further characteristics/criteria and changed the terminology to “Core Capabilities“, “Distinctive Competences“ or „Strategic Assets“. Nevertheless, there is a common understanding that companies create products and services by using skills, know-how and resources (Hungenberg, 2011). We will distinguish core competences from non-core competences as follows: Core competences

- cannot be substituted,
- are hard to imitate for competitors,
- contributes a customer value,
- significantly contributes to a competitive differentiation.

**Identification of core competences**

There are existing approaches concerning the identification of core competences in the literature, f.e. portfolio-method, VRIO-analysis, skill-cluster-method etc. (Hoefer, 2012). In general the procedure most often used in practice is done in three-steps. Firstly, there is a product analysis in which key components are chosen. Secondly, there is a process analysis with regard to the production of these key components. And thirdly, the decision process to define which process is considered as strategically important and shall be build-up as core competence.

As already mentioned that there are existing approaches concerning the identification of core competences in the literature. This will not be focused any further in this paper.

**Development of core competences**

The literature research that was conducted revealed that only little work has been done to address the second step of actually developing the technologies (Homp, 2000). Therefore, it is concentrated on this step. In order to avoid the same fate as Kodak, the main objective is to elaborate a methodology that serves as a guideline on how core competences for new production techniques or processes have to be developed once they are identified.
One task within the development of core competences is to define how to source the technology. The sourcing can be done in different ways, e.g. within the company by internal R&D, external R&D, R&D Joint Ventures or several subtypes of these possibilities (Figure 1) (Christensen, 2011), (Brem, 2012), (Schuh, 2011). These technologies are commonly subdivided into two types: Technologies that are well established in other companies, but are new to the company in question (“new to the company”). And technologies that are completely new to everyone (“new to the world”) (Hermes, 1995).

![Figure 1 – Possible sources for technology acquirement](image)

Keeping in mind the aim of developing core competences and the four criteria that are mentioned above to distinguish core competences from non-core competences, it is clear that several of the possibilities illustrated in Fig. 1 can be dismissed as non-applicable. For example, for a company “buying components from suppliers” is a way of acquiring technology without developing core competences itself. Simply buying components from suppliers (e.g. magnets for the rotor) does not lead to a unique competitive position of the company as all other competitors generally have the option of buying the same product from the same supplier as well. This fact leaves us with basically three options of sourcing technologies:

- Entirely internal research and development (R&D)
- In special cases: Acquisition of companies
- In special cases: Joint-ventures for R&D cooperation

The sourcing of technologies, which is described in the literature, is only one task within the whole developing. A holistic approach as a guideline for companies of developing technologies and execute this plan is still missing. This approach is highly dependent on which out of the three possibilities was chosen. For example, sourcing technology by acquiring companies requires an approach that would roughly include picking the right company and integrating it and its technologies into the buying company. In this paper it is
concentrated on an approach that would help companies with little know-how on certain technologies, to develop these technologies by their own internal R&D.

Case study: Development of a fully-automated machine system for magnetization and assembling of buried magnets in permanently excited synchronous motors

In a current project, a manufacturer of assembly systems for internal combustion engines made a strategic decision to invest into assembly systems for electric motors as traction motors. In this case the production of a permanently excited synchronous motor is considered. Focusing the component rotor of the electric motor, the process step “assembly of rotor magnets into the rotor stacks” (Figure 2) was defined as a core competence in this company. At this point a short description of this process shall be given: The process will be developed as a fully-automated robot-cell including an fully-automated adhesive system. Furthermore it shall be possible to assemble even premagnetized magnets, which represents a major technological challenge. This innovative technology could serve as an unique feature for the considered company which could generate an advantage in competition. That’s why, this technology was identified as a core competence.

![Figure 2 – Possible variations of magnetization and assembling of rotor magnets](image)

In the context of a first approach of the WZL for developing a core competence it is initially necessary to decide how to source the relevant technology, which was already described and shown in Figure 1. Afterwards it is essential to transform the core competence to a core product. Therefore, new markets and customers have to be tapped. In this case marketing of innovative products is important. Once the relevant market was found, it is necessary to keep this technological advantage. Furthermore it is important to analyse possible threats of competitors.
Conclusion

To stay competitive in their respective market, production companies need to identify and develop core competences. At the moment companies of the automobile industry are confronted with technological changes. To spare companies the “fate” of Kodak etc., there is a need for a holistic guideline concerning the acquisition of new technologies. This guideline shall include two steps in general – the identification and the development of new core competences. Approaches for the identification of key production processes are well defined and already being practically applied by companies. But only little work has been done to address the development of core competences once they are identified.

In order to address this practically highly important challenge, an holistic concept for the development core competences is being developed by the Laboratory for Machine Tools and Production Engineering (WZL) of RWTH Aachen University and tested with industrial partners. A first basic approach was given using the traction motor in electric power trains of vehicles as an example.

References