Knowledge Building in der Automobilzulieferindustrie: Lernen auf dem Weg von der Grundlage zur Serie

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Abstract

The article is contributed by a natural scientist and an engineer who work in the field of research and development (R&D), namely in the automotive supplier industry. It is our nature to like solid ground under our feet. Our daily challenge is to „make things work“.

R&D people – like people in other scientific fields as well - are most familiar with (mental) models. They use *practical* models, e. g. a technical drawing or a scheme of forces acting on a multi-body system in order to describe properties or anticipate behaviour of technical entities. By means of experiment and measurement of „real object“ properties, a coincidence (within certain limits) of what is seen from the real object and what is expected from the model can or cannot be determined. There is a *direct feedback* through the experiment. The models can be verified through testing *at any time and place*. Their precision can be quantified. The models can be simple or complex. No matter how complex, they necessarily represent partial aspects of the technical entity they refer to. - We consider this type of *practical* models to be on a *level 1 of abstraction*. They are essential to „make things work“ efficiently on the technical level. The better the models, the less trial and error.

Our main interest here however is rather to find a set of models that helps to improve the control over the R&D process as a whole. The models represent methods that ought to be applied and structures that ought to be established in order to make an R&D process successful. Evaluation of success will be discussed below. A feedback from the „real world“ is – as for practical models – also available. However usually, a feedback loop is much longer, and the multitude of factors determining the outcome of an R&D process much poorer controllable. On this level, we can merely claim that a set of methods and structures is *likely* to yield desired results. The models wrapping the methods and structures we consider to be on a *level 2 of abstraction*. An important difference from the *level 1* models is that the experiment of an R&D project cannot necessarily be repeated at any time and place.

To summarize in other words, we are going to explain an R&D people's imagination of how and under what conditions R&D people deal with knowledge. We will refrain from assessing or even building any knowledge management *theory*. It would be higher than *level 2*. Our ambition is to offer a concept for acting with knowledge in a certain field. We let the concept become only as abstract and thus generic as verification in the „real world“ allows. We will leave farther reaching concepts to the philosophers and will therefore avoid concepts such as ontology, epistemology, etc.

Our reasoning will be as follows:

1. Knowledge management, or – to use a more colloquial term - learning is essential for everyone to find a way through life. Acquiring and applying, i. e. managing knowledge for a specific purpose can create some sort of value. Value is assessed through society.
2. Our western society aims at a high standard of living. It esteems goods and services which improve or satisfy the individual's desire for convenience, comfort, reliability, security, mobility, symbols, etc. The society – or in a more narrow sense the community of consumers – rewards novel products on the market through a high demand. High demand means an improved market position for the supplier. The success of *inventing* a novel good or service *and diffusing* it on a market we call innovation. Innovation is commonly achieved through companies.
3. Companies are organizations that in many ways are embedded in and linked to society and a general state of the art. We suggest a map of a business landscape clustering some key elements

that are tangible for individual and organisational knowledge building for the purpose of achieving innovation.

4. We explain problem-solving schemes that include the procedural elements of knowledge building in a design process.
5. We look at the organizational front-end process of developing prior to a series production commitment.
6. We look at the „nature“ of state-of-the-art technology. Technical products today to a vast and further increasing extent combine the physical world with an information and signal world. We explain the key components of such *mechatronic* products. They come from various engineering discipines, or *domains*. The domains represent their specific knowledge in non-coherent partial (*level 1*) models.
7. We look at a (*level 2*) „V model“ for specifically designing mechatronic products and their production systems.
8. We look at an alternative (*level 2*) „Nautilus model“ that, unlike the previous, explicitly accounts for controlling the learning process and dealing with limited resources.
9. We further consider the conditions for successful applied research, i. e. „seeking again“. Exploring the potential of novel concepts commonly means experiencing serious obstacles. They can be of technical, political, or organizational nature. We look at a model of how to allocate development capacities and thus distributing learning successfully over the beginning life cycle of a novel product. The notions of know-how and core competency are touched.
10. In order to beat the organizational reality with its limitations in terms of time, budget, skills, know-how and infrastructure available we use an organizational framework that we label *innovation cell* (IC). The innovation cell can enable the development of novel products in historically grown organizational structures. It can support a rapid market introduction. The IC members must combine knowledge from non- or weakly connected organizational units as well as from key suppliers and a pilote customer in a creative, systematic, and heuristic way. Specific effects and phenomena of an IC as an organization within an organization are described.
11. We refer to the automotive industry: For the above reasons, cars have been and continue to be desirable goods for people. Their life cycles have a considerable impact on society and vice versa. The competition within the automotive industry forces automotive suppliers to be highly innovative. Requirements in the automotive industry are particularly demanding, possibly only paralleled in the aviation industry. Meeting time, quality and cost targets requires an outstanding understanding of and dealing with chances and risks, strengths and weaknesses being involved.
12. Concluding, it seems worthwhile to refer the presented – as we assume: best-practice - concept of dealing with knowledge to a systemic consideration as explained by NATKE. This may lead to a *next level* abstraction dealing with thinking structures and problem solving abilities.