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*Make Harmony Between Technology and Nature, and Your Mind will Fly Free as a Bird*
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# MULTICRITERIA PRODUCT DEVELOPMENT AS EFFECTIVE MANUFACTURING TOOL

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***Abstract:*** *The multi-criteria product development tool is here presented as an effective and useful tool in the early stage of planning the development of a new product. In large manufacturing industries it is important to develop rationally and economically. Computer capabilities of solving complex problems gave the traditional aspect additional possibility to plan and forecast product developmentA detailed approach to the development of a heating system as a possibility of investment is presented here.*
***Key words:*** *product development, multi-criteria analysis*

## 1. INTRODUCTION WITH THEORETICAL BACKGROUND

The purpose of the future analysis phase is the identification of innovation potentials and the formulation of specific innovation activities for the company. To start off with, general trends as well as more specific developments within the chosen formation fields are analyzed. Following this, the impact these will have on the formation fields and the company in general is projected. Based on this, and taking into account the company potentials, innovation potentials are deduced which will correspond with future market or technology developments. Output from this phase is therefore information regarding company innovation potential or more specific innovation tasks (Eversheim, 2009).

The early stages of the new product development (PD) process are most usually defined as idea generation, idea screening, concept development and concept testing. They represent the formation and development of an idea prior to its taking any physical form. In most industries it is from this point onwards that costs will rise significantly. It is clearly far easier to change a concept than a physical product. The subsequent stages involve adding to the concept as those involved with the development (manufacturing engineers, product designers and marketers) begin to make decisions regarding how best to manufacture the product, what materials to use, possible designs and the potential market's evaluations (Trott, 2008).

Today's computer aided design technology, for example makes it relatively easy to create three dimensional (3D) models of a part. However, simultaneously translating inarticulate customer tastes into a product concept, or a verbal product description into visual styling designs and numerical specifications remain difficult. Similarly, the timing of problem solving in consecutive stages of development, such as prototyping or tool building, and the number of iterations in the design-build-test cycle may affect the overall lead time and the productivity of development process (Sérgio et al. 2003).

During the application of the methodology, the number of ideas - originally in the form of futuristic projections and innovation potentials and then in detailed product concepts - is constantly being reduced. This reduction in the number of ideas through the so called idea funnel is necessary as the required work content is increasing as the ideas are becoming more and more concrete - there is a reduction in flexibility and agility available per idea.

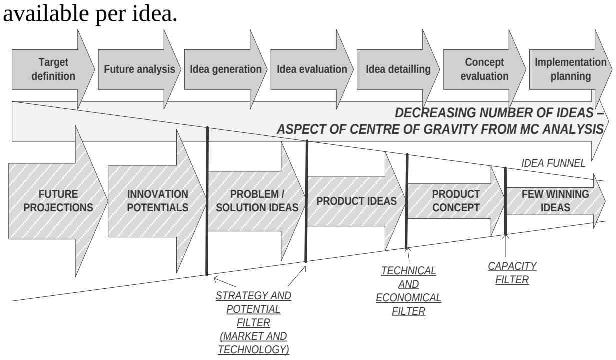


Fig. 1. Successive choice or elimination of ideas and refining / focussing them

The main requirement for a methodology used to plan technical innovation can be summarized by the innovation funnel presented in Fig. 1. The multi-criteria (MC) method used in the methodology is mapped and modified according to this relationship between concreteness of an idea and number of ideas. This means that the more concrete the formulation of an idea - depending on the stage within the planning timeframe - the more detailed and specific the relevant methods used become (push for creativity, analysis, evaluation etc.). MC method in integrated in all stages of the innovation funnel.

The presented article shows the possibility how a firm can, in the initial phase of choosing the most appropriate heating system on the base of MC analysis, seek the most suitable one. Additional information about the research in provided in the doctoral thesis (Kostanjevec, 2009).

## 2. APPLICATION IN PRACTICE

The idea about MC analysis of product acceptability in the market was developed from observing two-dimensional graphs showing the dependence of the dependent variable from the independent one. The independent variable represents time, the dependent one is derived from the observed and most representative parameters (Kostanjevec, 2009).

Besides the strategic goals, an analysis of the technological potentials is required for product innovation planning. Here the enterprise potentials refer to the totality of all company capabilities, in answering requests for problem solutions and reacting quickly to new market requirements as well as to develop and apply new products and commercial success.

The analysis and collection of trends is a continual process used in the early clarification. A trend can be described as the basic direction of either a development or a development bias. The "trend scanning" takes place in different observation areas, which together form the observation field. It represents the global environment of the formation field. In the ideal case, detailed information on developments in single observation areas already exists in the business so that these can be analyzed formation field-specifically. If the trend-scanning in a business is established, a list of trends from the various observation areas exists, that is reviewed, updated permanently and/or analyzed regarding its relevance. In addition to the available trends, the observation areas can be examined formation field-specific. Obviously, a complete analysis of the collection of trends is required.

In the trend test, the examination of the resemblance of the trend identified in the individual observation areas is important. During the resemblance analysis, the goal has to be to objectively rate the weighting of the trend while avoiding a overrating of a trend direction by the consideration of several similar trends. If similar trends are taken up in the matrix such as Table 1, this could lead to an overrating of future projections.

Table 1 shows the matrix of a different heating system for complex production building hall located in Maribor, Slovenia. The production carried out in the hall is complex steel construction. Data from Table 1 estimate most of the parameters for all the heating systems. In the empirical research, all the possible types of heating systems appropriate for serial production were collected. Limitations of different combinations of heating systems were eliminated in the beginning due to the demand for fast and effective service and universal spare parts.

| Time (year) | Heating system parameters estimated in % | | | | | | |
|---|---|---|---|---|---|---|---|
| | Radiator | Floor | Wall-floor | Convection | Tube - heat radiation | Other | Σ |
| 2001 | 15 | 21 | 7 | 11 | 40 | 6 | 100 |
| 2002 | 16 | 22 | 7 | 11 | 39 | 5 | 100 |
| 2003 | 16 | 20 | 5 | 12 | 42 | 5 | 100 |
| 2004 | 14 | 19 | 6 | 11 | 45 | 5 | 100 |
| 2005 | 16 | 19 | 6 | 11 | 46 | 2 | 100 |
| 2006 | 15 | 20 | 9 | 6 | 45 | 5 | 100 |
| 2007 | 14 | 17 | 12 | 10 | 42 | 5 | 100 |

Tab. 1. Analysed parameters of heating through time aspect

## 3. CONCLUSION

Future product developments can be predicted independently from current production boundaries. This gives development much more flexibility. Reliable trends for the most important product parameters can be evident from market demands.

In Fig. 2, a multi-dimensional graph is displayed; in which each parameter in Tab. 1 has its own dimension and polarity defined. The movement of data for each parameter is independent of other parameters, but they all describe a single product. For this reason, the common centre of gravity is a generic indicator of the movement of production parameters for the evaluated product.

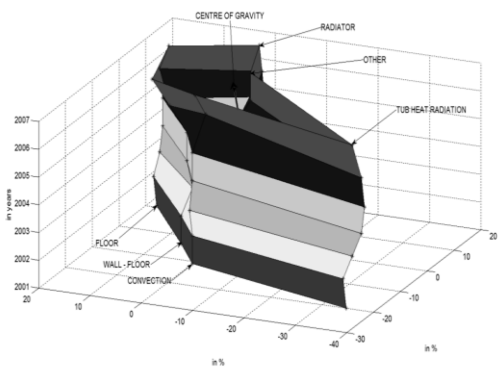


Fig. 2. 3D model with the addition of the centre of gravity as a possible trend

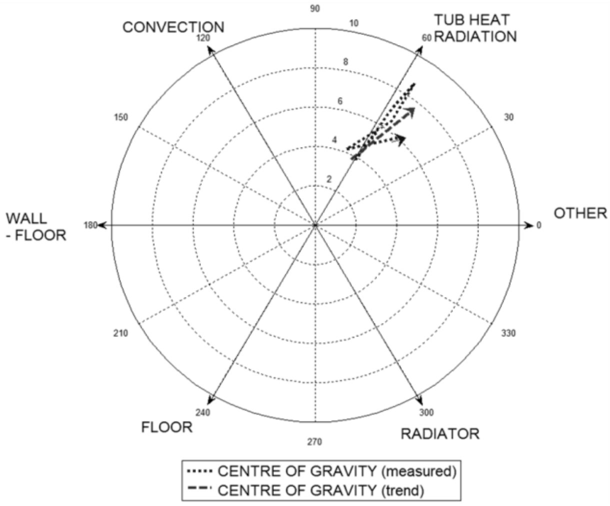


Fig. 3. Polar graph of the movement of the centre in the observed years of specific product (real case study)

Fig. 3 shows the centre of gravity from Fig. 2 in polar graph. With a "dotted" line the centre of gravity as calculated from 3D model from Fig. 2 is drawn. With "dashes" the linear trend is indicated. In the polar view in Fig. 3, the movement of focus in a particular direction and certain intensity is shown. In the analysis, the parameter of tube heat radiation is the most suitable. For the company, the most appropriate manner of heating according to MC analysis is by tube heat radiators.

The life cycles of technologies, products and processes are becoming shorter, so it is very important to predict technology in planning (Clark, Fujimoto, 1991).

An alternative form of PD can be based on the simple idea that a product at a given time is of various parameters an instance (Kostanjevec et al. 2008). With the powerful tool of MC analysis, investors can correctly forecast PD in an early phase of idea creation. In a variety of simultaneous projects, the project manager can compare competitive products in the market with developed MC model with speed and mathematical correctness. With additional graphic support of the model, forecasting of development is even easier.

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