

SURVEY REGARDING THE LEVEL OF PRODUCT LIFECYCLE MANAGEMENT IN MANUFACTURING COMPANIES

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Abstract

This article is about a questionnaire survey regarding the level of product lifecycle management in manufacturing companies in the Czech Republic. Based on the research available from foreign and domestic literature, a questionnaire survey was compiled and carried out with the purpose of applying the methods used in the life cycle management in selected areas: maintenance, information systems and the cost of the product lifecycle. The survey is carried out through a printed as well as an electronic questionnaire with additional structured interviews in selected manufacturing companies in the Czech Republic, Slovak Republic and Romania.

Key words:

Survey, questionnaire, product life cycle, life cycle costing, reliability, maintenance, IT.

Introduction

The Management of Product Lifecycle is aimed in driving all the particular areas, which have a direct influence on some of the life cycle stages such as maintenance, quality, information systems and costs - research, development, production management, etc. Among the life cycle management are a number of methods and techniques with different approaches regarding the necessary data input and as well as the results we get from them. The common element is the valuable information supporting the management, which helps us make the right decision and choose the optimal way of solving the economic problem. Among the aforementioned methods belongs the design cost, LCA - Life Cycle Assessment, LCE - Life Cycle Engineering, LCC - Life Cycle Costing, WLCC - Whole Life Cycle Costs, PDM - Product Data Management, etc. Until now were created many tools, methods and techniques for managing the life cycle, but these tools are limited to the evaluation of certain selected specific tasks. The models have a number of assumptions and initial conditions, in order to allow universal applicability for a wide range of users. The aim of the research activities is to explore the degree of the usage of these methods and to develop comprehensive tools for design, analysis, evaluation and management of engineering products in terms of their life cycle and eliminate the discrepancies between theory and practice for lifecycle management.

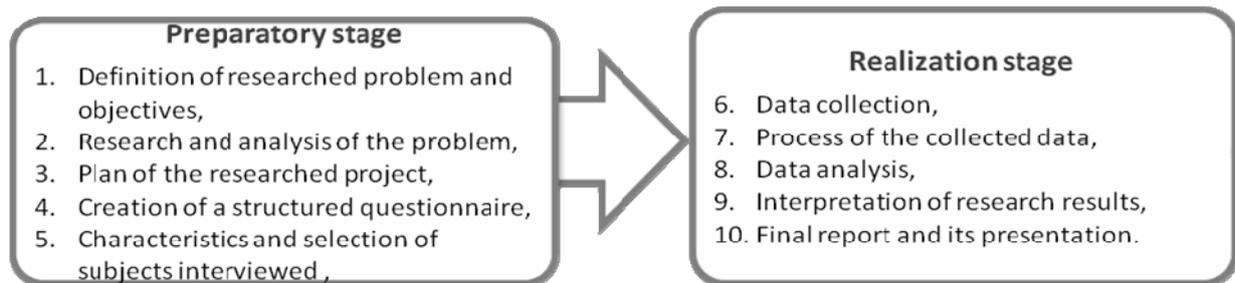
1. Methods of the research

The survey is carried out in two phases. The first phase contains the research of domestic and foreign literature, journal articles and other information sources thematically focused on life cycle management, life cycle costs, maintenance, failure and use of information systems in the life cycle management. Based on this previous research, a structured questionnaire was created which is the main result of the first phase of our research. The second phase consists of conducting a survey aimed in assessing the relative importance of these areas in the application of selected approaches and methods to support product lifecycle management in practice. The questionnaire is made in combination with a structured interview to the responsible employees of selected industrial enterprises. The relevant data obtained by this questionnaire are further statistically worked and according to the answers received a chart is made from which one could easily read the usage of the present tools and methods used in the management of the product lifecycle. This research is also part of the doctoral dissertation papers of the PhD. students from the Department of Management and Economics within Faculty of Mechanical Engineering, Czech Technical University in Prague.

All the process of this unique research made at the Department of Management and Economics within Faculty of Mechanical Engineering, Czech Technical University in Prague can be structured in the following steps:

1. Definition of researched problem and objectives
2. Research and analysis of the problem

3. Plan of the researched project
4. Creation of a structured questionnaire
5. Characteristics and selection of subjects interviewed
6. Data collection
7. Process of the collected data
8. Data analysis
9. Interpretation of research results
10. Final report and its presentation.



Picture 1 – The process of research of lifecycle product management

In present the research is in the phase of data collection.

In order to obtain information from interviewing subjects a structured questionnaire was established. This serves both to collect data directly from respondents of the survey and also as a support for conducting the interview. Two methods of data collection are used:

- Questionnaire
- Structured interview

2. The questionnaire

Questions put in form of a questionnaire were chosen due to its clarity and gaining of the information directly from the corresponding respondent. In the same time the questionnaire reflects the structure of the interview ensures a standard unit of matrix for writing down the data and makes the processing of the collected data easily.

Questionnaires are created in Adobe Acrobat Professional and are sent to respondents by e-mail. They can directly fill in the answer in the electronic form or use the printed version. This method of data collection was chosen in favor of the online tools questionnaire, like Google Docs or Lime Survey, mainly for the following reasons:

- Easy to print and fill in onto the printed version;
- Possibility to fill it in offline, to save your form questionnaire and redistribute to more people necessary due to the great complexity of the questionnaire and the need of being filled by several target persons;
- General knowledge and use of PDF file format;
- Easy processing of the collected data.

The main disadvantage is the considerable amount of work involved in the preparation of the forms and the rigidity regarding the editing of the form.

In the questionnaire were used all the basic types of questions - one choice, multiple choice, scale, text answer, etc.

The questionnaire was designed to verify the following hypotheses:

- Use of the tools of product lifecycle management increases the level of efficiency of the entire enterprise management;
- Use of methods of lifecycle's costs in manufacturing companies is limited;
- Not enough attention is paid too the maintenance in the Czech medium-sized manufacturing companies, thus it's not properly planned and managed, the costs associated with it are not sufficiently monitored and allocated;

- Software tools which support the lifecycle management contribute to more effective manufacturing processes LCM;
- Specialized software tools which support the products’ lifecycle management are used to the lower limits due to the higher costs and uncertainty about the real benefits of these tools.

The questionnaire is divided into three thematic areas of questions, and we took in consideration the fact that is not necessary, nor possible for each respondent company to fill in all of its parts, which are as follows:

- a) Lifecycle Costs and their monitoring;
- b) Ensuring the serviceability of the product within the operational phases of the product’s lifecycle;
- c) Software tools which support the lifecycle management.

2.1 Questionnaire I - Life Cycle Cost and monitoring

This section of the questionnaire is devoted to cost of products throughout their whole life cycle. This is an unconventional approach to costs where the costs of products are perceived as complex of producer and consumer costs including the costs connected with end of product life cycle. The questionnaire is to verify to what extent your company assesses and evaluates the Product Life Cycle Cost and how do you use these costs in Product Portfolio Management.

Target person: The goal of questions is primarily to determine the extent to which Life Cycle Costs are used in the development of products which attention is paid to the links between technical parameters and Product Life Cycle Cost, which procedures are used to calculate Product Life Cycle Cost, what are the decisive obstacles of wider use of Product Life Cycle Cost in your company. The questionnaire could be answered by the representative of the development. Due to a wider range of some questions we could expect also participation of representatives of other departments, such as controlling and marketing departments.

Explanation of frequently used terms: Product Life Cycle Cost (LCC) is the sum of all costs incurred throughout the life cycle of a product - costs associated with the development, design, production preparation, production, operation, maintenance and liquidation of the product (by product end user). Analysis of the cost of the product life cycle is the process of comprehensive assessment and evaluation of the cost of the product from the product design phase of the idea until the end of its life cycle.

2.2 Questionnaire II - Ensuring the serviceability of the product within the operational phase of the Product Life Cycle

This part of the questionnaire is focused on the maintenance and management of manufacturing and logistics of the firm. The questions relate primarily to the management and maintenance planning and monitoring and evaluation costs associated with maintenance

Target Person: Most of the questions directly related to maintenance issues could be answered by the head of maintenance (or other person responsible for this area). The final part of the questionnaire focuses on costs could be answered by the officer responsible for managing and monitoring costs - the controller.

This questionnaire is divided into several areas:

Defining the position of maintenance - respondent defines the scope of maintenance and characterizes the importance of maintenance to ensure the operability of the company.

Maintenance strategy - respondent defines which approaches and strategies are applied in the management and maintenance planning in the company.

Causes of failure - the respondent characterizes the typical causes of failure (if they are monitored and set by the company).

Use of IT tools in the management and maintenance planning - when the company used Computerized Maintenance Management Systems, the respondent describes how they are used in company, in which way this system is used, which are the main benefits and shortcomings of the implemented systems.

Costs associated with maintenance - respondent characterizes the amount and trend of the cost of maintenance and explains what kinds of cost are monitored in the company and to what level they are allocated. This part of questionnaire should be answered by maintenance manager or in consultation with controlling manager.

2.3 Questionnaire III - Software Tools for Life Cycle Management Support

This part of the questionnaire deals with software support of product life cycle management (PLM) processes.

Product life cycle, or its management, respectively, includes many areas of enterprise management. Therefore, it's necessary to focus the questionnaire in a more general way. Level of utilization of product life cycle management software support tools is closely related to company's overall IS/IT level in general. To take this into account, the questionnaire first deals, in the questions of first part, deals with aspects expressing the company's overall IS/IT level. These aspects include for example unified IS/IT strategy, centralized IS/IT management and purchase, etc.

The following part of the questionnaire is subsequently directly related to some selected tools for PLM software support - these tools include for example Knowledge management tools, CAD/CAM, tools for maintenance planning (CMMS) and some others. Besides discovering which tools are in use, within the company, this part also emphasizes finding out main benefits and drawbacks of the abovementioned software tools.

Last part of the questionnaire is directed to the future - it is focused on a perspective of developing a portfolio of software tools related to PLM. Respondents are asked about key criteria which play role in choosing software tools (price, supplier references, seamless integration with existing IS/IT infrastructure...) and also about "limiting factors", which may lead to the situation when a company doesn't use software support tools in any great extent and isn't going to expand its portfolio in the future. There can be many such factors, aside from financial restrictions, we can for example mention general distrust towards IT, uncertainty about real benefits of such tools etc.

Target person: Most of the questions is directly related to subject of PLM software support. The target person is therefore mainly a specialist (or specialists) responsible for maintenance, operations and development of company's software tools portfolio, which is most likely an IT manager. In the case when an IT manager isn't able to answer some questions (for example those related to user experience with some tools), we should put an effort to get such information from the people working with such tools (specialists from corresponding areas).

Explanation of frequently used terms:

Life Cycle Cost (LCC) represents a sum of all costs during the whole product life cycle - R&D, design, pre-manufacture stages, manufacture, operations, maintenance and disposal (carried out by end user).

3. Survey

At the present time, we have just completed the first stage of addressing selected respondents from the branch of production machines manufacturers, associated within Association of Engineering Technology. The questionnaire was sent to approximately 25 companies. Unfortunately, the return rate was very low - just 4 questionnaires. This can be explained mainly by quite a great complexity of research topic, wide coverage of the questionnaire and also by a fact that the questionnaire addresses not only one, but several target people in each company.

Because of the abovementioned low return rate, currently, we are performing a second stage of survey, where additional subjects will be asked to cooperate. Selected companies will then be surveyed through structured interview. This should help in getting a representative statistical set for relevant evaluation of the whole survey.

Conclusion

Goal of the planned survey carried out by Department of Management and Economics, Faculty of Mechanical Engineering, CTU Prague, is mapping and identification of methods and procedures of lifecycle management in manufacturing companies. Results of this survey will then be used to create appropriate tools for life cycle management, which would eliminate deficiencies and correspond to companies' needs. The survey is carried out in the form of a questionnaire, which has been composed based on literature research and practical feedback. Creation of the questionnaire is being done in cooperation with Association of Engineering Technology. Survey will be carried out in selected manufacturing companies in the Czech Republic, Slovakia and Romania.

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Bibliography

- [1] DHILLON, B. S. *Life Cycle Costing: Techniques, Models and Applications*, Amsterdam, Gordon and Breach Science Publishers, 1989, 354 p. ISBN 978-2881243028.
- [2] HENDRICKSON, CH. T., LAVE, B. L., MATTHEW, H. S. *Environmental Life Cycle Assessment of Goods and Services: An Input-Output Approach*, Washington, RFF Press, 2006, 272 p. ISBN 978-1933115238.
- [3] SAAKSUORI, A., IMMONEN, A. *Product Lifecycle Management*, Springer, 2008, 266 p. ISBN 978-3642096846.

- [4] DEKKER, R.: *Applications of maintenance optimization models: a review and analysis*. Reliability Engineering and System Safety [online]. 1996, no. 51 [cit. 2009-10-21], p. 229-240. Available on WWW: <sciencedirect.com>.
- [5] DEKKER, R.: *On the use of operations research models for maintenance decision making*. Microelectron. Reliab. [online]. 1995, no. 35 [cit. 2009-10-23], p. 1321-1331.
- [6] AL-NAJJAR, B.: *The lack of maintenance and not maintenance which costs: A model to describe and quantify the impact of vibration-based maintenance on company's business*. International Journal of Production Economics [online]. 2007, no. 107 [cit. 2009-10-23], p. 260-273. Available on WWW: <sciencedirect.com>.