7th INTERNATIONAL SYMPOSIUM ON INDUSTRIAL ENGINEERING

INDUSTRIAL ENGINEERING DEPARTMENT,
FACULTY OF MECHANICAL ENGINEERING,
UNIVERSITY OF BELGRADE, SERBIA
&
STEINBEIS ADVANCED RISK TECHNOLOGIES,
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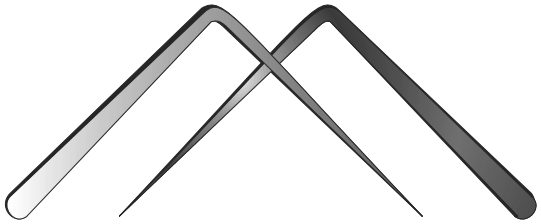

SIE 2018 PROCEEDINGS

Editors:

Vesna Spasojević-Brkić
Mirjana Misita
Dragan D. Milanović

27th-28th September 2018
Belgrade, Serbia

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PREFACE

Since the first symposium in Belgrade, Serbia more than two decades ago, in 1996, International Symposium on Industrial Engineering - SIE has been held regularly every 3 years. It represents an opportunity for researchers in the Industrial Engineering community to review and evaluate their scientific achievements over the period since the previous SIE, share their most recent results and ideas, and discuss possibilities for new directions in research, joint experiments and observing campaigns.

The aim of the 7th International Symposium on Industrial Engineering – SIE 2018 is to contribute to a better comprehension of the role and importance of Industrial Engineering and to point out to the future trends in the field of Industrial Engineering. The Symposium is also expected to foster networking, collaboration and joint effort among the conference participants to advance the theory and practice as well as to identify major trends in Industrial Engineering today. According to these goals the Symposium addresses itself to all experts in all fields of Industrial Engineering to make their contribution to success and show capabilities achieved in the work that has been done are very welcomed. SIE 2018 provides an international forum for the dissemination and exchange of scientific information in industrial engineering fields through the large number of multidisciplinary topics.

The book brought together 58 papers and more than 170 authors from 12 countries, namely from Serbia, Portugal, Finland, Switzerland, FR Macedonia, Italy, United Kingdom, Thailand, Slovakia, Canada, Poland and Bosnia and Herzegovina. The submitted full length manuscripts were peer-reviewed, and selected for publication by experts in their respective fields. The authors ranged from senior and renowned scientists to young researchers. Only unpublished papers were accepted and the first author is responsible for the originality of the paper. All papers are classified into six chapters, including opening and closing plenary lectures.

We expect that papers and discussions will contribute to better comprehension the role and importance of Industrial Engineering in this and other countries, both in domain of scientific work and everyday practice.

Our efforts in organizing would not succeed without the considerable help of the members of Scientific Program and the financial help of Ministry of Education, Science and Technological Development was greatly supportive for the success of the entire project.

At the end, the editors hope, and would like, that this book to be useful, meeting the expectation of the authors and wider readership and to incentive further scientific development and creation of new papers in the field of Industrial Engineering.

Welcome to the 7th International Symposium on Industrial Engineering – SIE 2018! We wish to all participants a pleasant stay in Belgrade and are looking forward to seeing you all together at the 8th Symposium on Industrial Engineering – SIE 2021.

Belgrade, September 2018

EDITORS

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CAD/CAM TOOLS IN RISK ANALYSIS DURING DESIGNING PROCESS

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Abstract. *By definition, the risk represents suspense in relation to the desired outcomes. According to that, this project includes the algorithm which with the help of the tool CAD/CAM provides step analysis in the process of projecting to realization of the finished product. As well, algorithm points out the possible risks when presenting element or finished product.*

Key words: *designing, risk, CAD/CAM*

1.INTRODUCTION

Due to lack of communication in management, there are numerous weaknesses in the process of product development because the final product wasn't what customer's initial thought was.

The reason why risky management exists is because customers are often ambiguous and they have different perspective in visioning certain things, therefore, there is a problem for a designer on how to translate customer language into measurable characteristics of products or services [1].

The risk represents suspense in relation to the desired outcomes. Risk-based designing provides designers to establish factors which could be influencing certain processes to deviate from the desired result. Risk management implies that negative factors of designing should be reduced to the lowest measure and opportunies be taken to the maximum so that there are no negative occurrences.

The goal of this business is to find a solution and to avoid risks in the earliest phases of management. Presented algorithm with application CAD/CAM tools, provides elimination of potential risks during element designing or entire product.

2. RISK IN DESIGNING

In the process of realization grand engineering projects, Miller and Lessard[2] pointed out that understanding and managing risks represents challenging tasks for designers in the early stages. As well, failure of large engineering projects could lead to serious damages that could appear due to not taking risks in consideration [3].

Nowadays, all of the attention is given to technical risk [4] that implies to: 1) impossibility of determination interpersonal relations between key processes, 2) lack of access to technical expertise, 3) lack of agreement about analysis, tools and designing techniques, 4) lack of knowledge about technology application, 5) wrong technology choice, 6) limit in existing technologyapplication.

Designing is information process of transformation in which low level informations (estimates, analysis, stimulations, graphic display) are transforming in higher level informations. Generally, life cycle of a product from an idea to realization is going through following stages: designing, production, usage (exploitation) and recycling, look at the picture 2

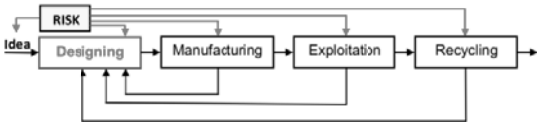

Fig 1. Stages in product life cycle

During the process of designing in an early stage of product development, the quality of a product is generated, but there is also a big number of errors. If errors do not become detected and eliminated in

initial development, the progressive growth of total expenses and qualities will show up. Errors detection in later stages in the life span of the product leads to higher costs of their remediation. A large number of errors arise in the product development phase and technology design. However, in the product development phase and technology design, the errors are the most difficult to detect.

As it was already mentioned, it is considered as technical risk which should be estimated cautiously when making decisions about the project [5]. Due to the same source, considering technical risk the processes are improving with described procedures and the expenses of defective product are being reduced (Corrections, warranties and additional services).

According to ISO 31010 standard [6], possibilities for risks inclusion could be: 1) avoiding risks and taking to consideration risks as a possibility, 2) taking over risks to take opportunities, 3) elimination of a risk cause/source, 4) change of probability or consequences of risk sharing, 5) risk retention based on the information

As well, the process of managing the risk implies following activities [7]:

- Risk identification: certain occasions, acts or occurrence can lead to risk. In this case, the main question is who to recognize it and how to proactively participate in these scenarios. In this category various sorts of abruptions, defects, poor production of finished pieces and low product quality could be included.
- Risk assessment: Estimation of risks and priorities are needed to determine compatible acts of management for identifying risk factors in accordance to the situation at the design levels.

As well, risk identification and estimation could be observed and indicators in which direction should activities go. Some risks could be reduced through common action in the designing team, as with the other risks, every designer has to deal with the problem individually. Generally, every designer that resorts to apply the strategy for risk managing, should include following [8]: risk transfer, risk taking, risk elimination, risk reduction, further analysis of individual risks

3. CAD/CAM TOOLS IN RISK ANALYSIS

Nowadays, CAD programs possess in their own libraries large number of standard parts and elements, where by calling from the base and inserting them, the elements are easily placed on the drawing.Also, all these elements can be corrected in the drawing.

By development of powerful hardware solutions, a completely new approach to 3D model analysis has been developed. This approach is reflected in the formation of a detailed model and its use in virtual experiments, in a similar way as it would have been in reality with a physical model. This means that it is no longer necessary to wait for months to create a physical model in order to carry out tests, and later expensive procedures and modifications with the final goal of achieving the required characteristics [9].

The goal of 3D modeling at the design stage is to eliminate risk through: timely problem solving, the development of more creative and reliable products, reduction of post-war costs, modification of the real model or the flow of the production process itself. CAD programs allow for certain changes of a constructive nature to be made. Advantages in the model domain allow the introduction of all changes, where each change is automatically implemented on all drawings where this phenomenon occurs. Nowadays, some industry branches can't even be imagined without the use of CAD tools in 3D modeling and drawing.A typical example for something like that is the air and automotive industry that uses many CAD programs for the basic tool to model various parts. which later, with the help of special methods, examine and simulate various external physical influences.

In its foundation, the platform for testing and realization of 3D models includes programs CAD, CAM, FEA. The CAD system is used in the process of product design.It represents developed computer hardware and the corresponding software that is that is used for designing and constructing [10]. In the preparation of technology, a computer is used in the computer (Computer Aided Manufacturing) or computer assisted technology development, or computer development of a technological process.

FEA programs are used to model elastic components, which takes into account the influence of elasticity during simulation in order to predict results with greater accuracy, as well as to determine the strain of the most critical parts and define their load bearing capacity in order to finalize the mass of the components.

4. METHODOLOGY- ALGORITHM

In this project, the design process will be explained with the analysis of risk occurrence in all its stages. As an example,we will use a model for mechanical

forks in the automotive industry (see picture 2). On this example, CAD application software was used in order to reduce the risks involved in designing, but also to avoid poor communication in relation to marketing - design - the manufacturing process.
The algorithm of the new product design process is given in the picture 2.

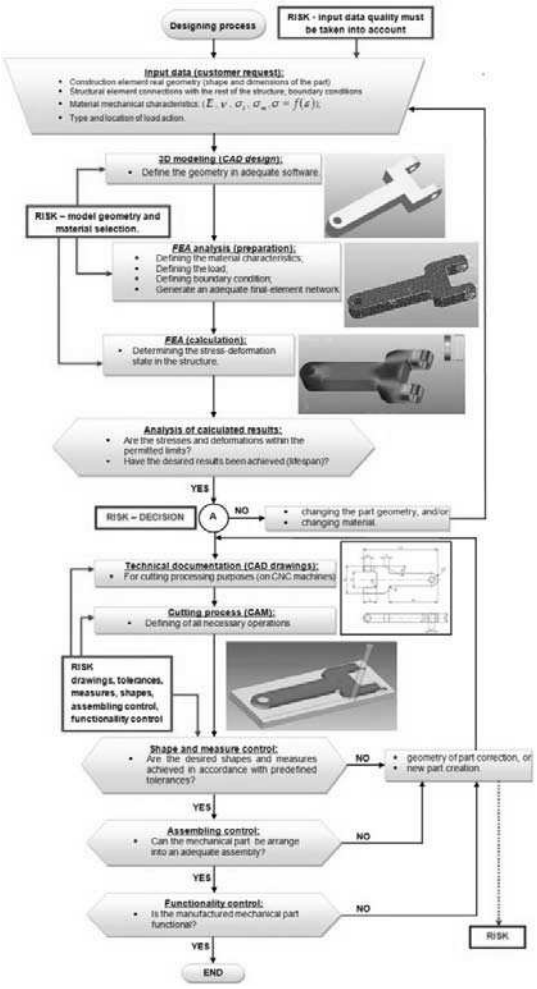

Fig 2. Designing process algorithm

The first step is defining the input data necessary for the entire process of conquering a new machine part and setting up technical and technological requirements. Here the risk can be involved if the input data not considered high-quality.
The second step is the 3D modeling of the machine part (in some of the available CAD software). Then, the preparation of the 3D model for the FEA - Finite Element Analysis and the calculation of the strength of the projected work is carried out. After the budget has been executed, the obtained results are analyzed from two aspects:

1. Are the stresses and deformations within the permitted limits?
2. Have the desired results been achieved (lifespan)?

The analysis of these results represents a step where the risk elements regarding the geometry of the set model and selection of materials are considered. If satisfactory results are not achieved, it is necessary to make certain corrections in terms of changing the material, and/or the geometry.The procedure is done iteratively, until the set requirements are met from the aspect of the strength of the structure, the planned (designed) working life of the construction.
Then, the planning and part realization on the CNC machine is done, with the previous drawingslaunching. In order to eliminate the risks, it is necessary to define in the drawing the appropriate measures tolerances, shapes and positions, which are determined in advance by the function of the projected machine part within a certain sub-assembly.
Finally, the realized geometric measures control, shapes and positions within the previously defined tolerances is carried out.
In order to eliminate the occurrence of risks, part assembly control, as well as control of its functionality within the sub-assembly, is of great importance. If these conditions are not satisfied, it is necessary to correct the geometry of the work, if it's possible. Otherwise, the new part is being developed.
The stream designing, i.e. the development of a new product indicates an obvious link between CAD and CAM tools. Changes on the 3D model are automatically manifested in the remaining modules (phases) within the overall design process. This greatly saves resources: people, resources and time, and therefore, money.
Based on the presented algorithm, the principle of functional characteristics and application of reference technology in the realization of the product has been respected. By its very nature, the functional characteristic refers to an existing product on the market, which has the same function and / or almost the same functional value for the user. The purpose of the functional characteristic is comparison with the new product, which will lead to improvement.
After completion of the project / product, most designers want a new opportunity to start all over again in order to do the right thing and for everyone to understand it. Unfortunately, a small number of them get an opportunity to do this. Solutions to the problem and potential solutions are obtained through

the knowledge of individuals, which indicates the loss of freedom in design.

5. CONCLUSIONS

The development of information technology enabled designers to present a new product or more combinations to obtain a sustainable production concept in a short period of time and with low costs, especially through the application of the 3D modeling program.

Product design is a risky activity in the production process. Success at the design level also determines the product price.

In the analysis of the demonstration model, it was tried to satisfy all conditions with the maximum exclusion of all predictable and unpredictable risk factors:

- the designing process should enable accurate and transparent steps in terms of providing solutions,
- the model should be neutral in the first consideration, and then the conditions of concretization,
- the elements of the model must be precisely defined,
- the proposed steps have to be accurately described and explained,
- analyzes and results obtained with other models should be carried out,
- the model should be understood by designers in practice,
- the model should be applicable.

This work shows the importance of CAD application software in the new product development. The application of software accelerates the development, analysis and decision-making of acceptable and solutions. With CAD application software it is possible to execute: static size calculations, stability and vibration calculations, multi-criteria optimization and determination of thermal changes in the design.

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