

Conference Paper

Identification of Problem Criteria within the Framework of Product Manufacturing Optimization

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Abstract

The article represents the initial stage of the thesis on a topic of increasing a processing accuracy and reducing operating costs for multi-part manufacturing. Numerical control machines are the objects of investigation. This work is aimed to determine the criteria for the problem of couplings production in multistage production at the enterprise. The analysis of the coupling production system is carried out by the "black box" modeling method. Input and output data of production are also described. A list of criteria for formation of possibilities of products' manufacture optimization is received.

Keywords: system engineering, life cycle, CNC machine, manufacturing optimization, production, problem criteria, system approach, black box model

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1. Introduction

System engineering as distinguished part of the life cycle of a system appeared after the end of World War II due to the rapid onset of creating new technologies and their use in large military and commercial developments in the second half of 20th century. The reason for the allocation is an increase in risks and in increase in the complexity of systems which required a careful assesment of the possible consequence [1]. The purpose of system engineering is to lead the development of complex systems (a system is a set of interconnected components that work together to achieve the goal). As opposed to traditional disciplines system engineering consider the system as a whole takes an interest in customer needs and operating conditions develops the concept of the system and its behavior at all stages of the life cycle (Fig. 1).

The first stages of the system engineering work on the project involve the maximum contribution to the development of the system, which determines its success. The primary objective of the needs analysis phase of the system life cycle is to show clearly and convincingly that a valid operational need (or potential market) exists for

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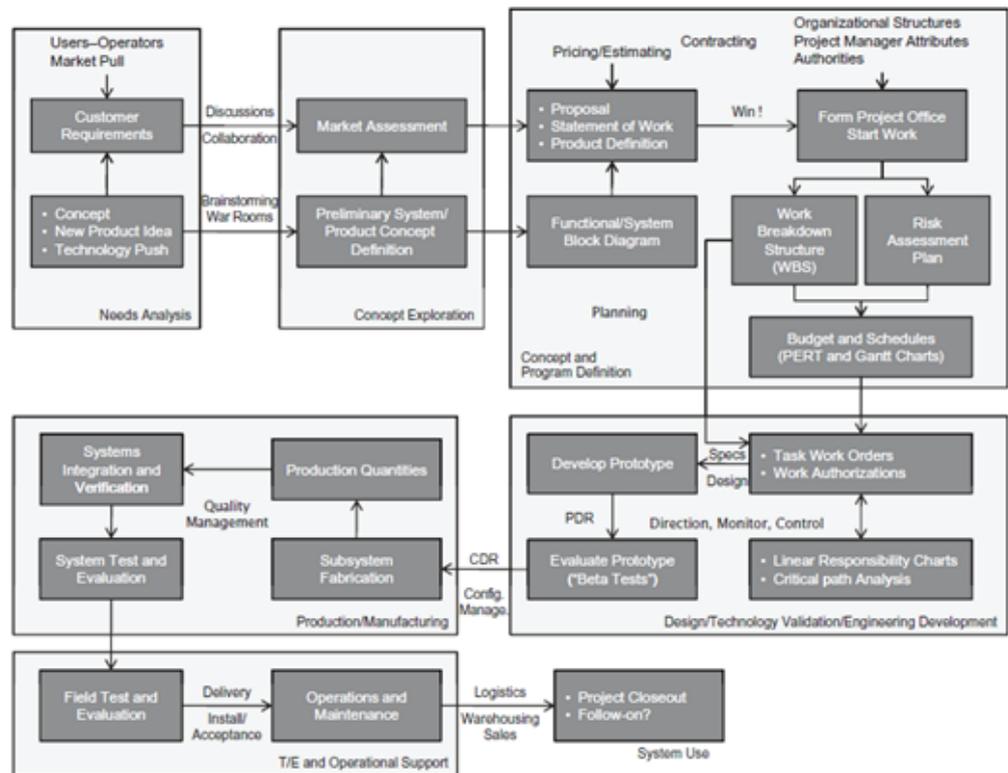


Figure 1: Life cycle systems engineering view. PERT, Program Evaluation and Review Technique; PDR, Preliminary Design Review; CDR, Critical Design Review.

a new system or a major upgrade to an existing system. In short, this whole process must produce persuasive and defensible arguments that support the stated needs. Activities, such as market analysis, assessment of competitive products, and assessment of differences of the current system relative to the proposed new system, establish a need (potential market) for a product that will be the object of the development. The place of the needs analysis phase in the system life cycle is illustrated in Figure 2. Its inputs are seen to be operational differences and/or technological opportunities.

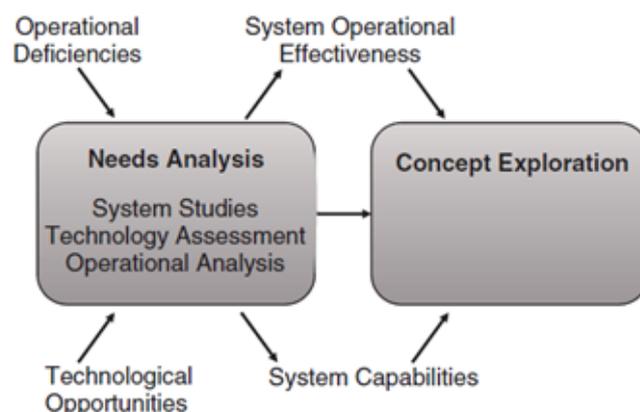


Figure 2: Needs analysis phase in the system life cycle

The impetus for the initiation of a new system development generally comes from one of two sources: need driven or technology driven. Being the initial phase in the system development cycle, the needs analysis phase is inherently different from most of the succeeding phases. There being no preceding phase, the inputs come from different sources, especially depending on whether the development is needs driven or technology driven, and on whether the auspices are the government or a commercial company.

The final and most critical step in the application of the systems engineering method is the systematic examination of the validity of the results of the previous steps. In the case of the needs analysis phase, the validation step consists of determining the basic soundness of the case that has been made regarding the existence of a need for a new system and for the feasibility of meeting this need at an affordable cost and at an acceptable risk [2].

2. Results and Discussions

In the framework of the study on the existing target problems at the enterprise, the goal was identified - optimize the production of couplings for pumps by increasing the quality of the product and reducing operating costs.

To study the manufacturing process of the coupling, a “black” box model will be build. A “black” box is not a directly observable set of unknown structures, phenomena and properties, the nature of which can be judged only by the input and output, for example, by the characteristics that are noticeable when information is being received by system and is being exited from the system (Fig. 3) [3].

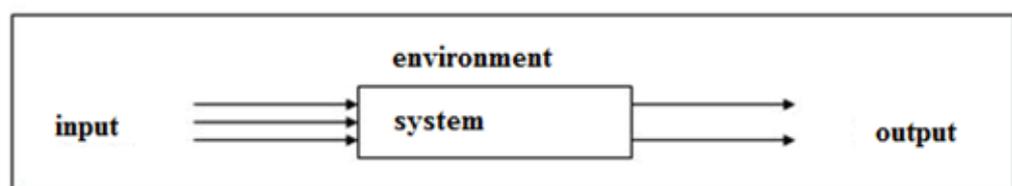


Figure 3: «Black» box model

In the model, only the input and output connections of the system with the environment are specified, i.e. set of input and output variables. The “black” box makes it possible to determine the input parameters and the result of the system, to determine changes in the output parameters and the ability to adjust the input characteristics.

At the time of this writing, the input parameters include such characteristics as a request for the manufacture of a product, material, resources (time, labor, etc.), tools (machines, fitters, etc.), standards, norms and limits, outputs - a set of ready-made documentation for the manufacture, finished product, waste (fig.4).

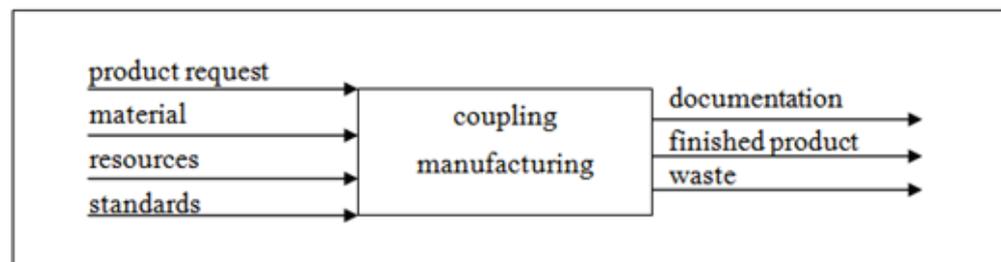


Figure 4: «Black» box for the coupling manufacturing process

To achieve better performance following criteria were identified:

1. Casting quality. In the manufacture of the product, the coupling uses metal casting technology. Since the company uses tenders to purchase material, the supplier and, accordingly, the quality of the supplied resources can change. When a new batch is delivered, the process of metal development takes place, the period of which can be determined with an error. Mastering involves changing the technological process of casting a workpiece due the properties of the material. Work on this process is a time-consuming procedure with errors from several months to a year [4].

2. Processing quality. The processing technology on CNC machines of the workpiece prepared at the casting stage involves the creation of an internal plane. When processing the internal volume, considerable time is spent on deepening the tool into the material, which increases the manufacturing time of one part, product and batch of finished products. If optimize the processing time of the workpiece on CNC machines, the production time of the batch will be reduced, which will make it possible to get a large profit for the same period of time [5].

3. Number of stages. Based on the above paragraph, it can be argued that changing the number of stages that allows performing high-quality operations in less time is a priority than implementing the entire creation process on one machine, because it is spending more time. However, it is worth considering the logistics system within the enterprise. If it is difficult to move the workpiece between stages, it is necessary to rebuild the location of the machines relative to each other in accordance with the technological process or to plan the technological process with minimal time costs for transportation between stages

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