



15th Global Conference on Sustainable Manufacturing

On the track of human errors - Procedure and results of an innovative assembly planning method

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Abstract

Manual assembly operations are the endmost place of the production process and with it represent a melting pot for organizational, time-related and qualitative errors of manufacturing. Because competitive advantages are increasingly determined in the manual assembly, the creation of economical and reliable work steps is of fundamental importance for future business success. For that reason, at the institute of the authors, a procedure has been developed to use the knowledge of the Expert System for Task Taxonomy that was originally developed to evaluate the error rate of control and surveillance activities in safety critical areas for creating a computer-aided expert system that allows predicting human error probabilities for manual assembly operations. Applying this expert system, production processes can already be optimized during the phase of product design by avoiding critical process steps at an early stage of the planning process. On the basis of a case study, this paper introduces the conception of an Excel-based software tool that allows an automated application of the developed assembly planning method and thereby, generates reliable risk analyses of manual work tasks with little expenditure of personnel and time.

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Keywords: Human Reliability; Manual Assembly Operations; Human Error Probability; Excel-based software tool

1. Introduction

The change in sales markets from seller to buyer markets presents major challenges for domestic industry that result in a strong competition with international competitors [1]. In order to be able to assert itself against the growing competition on the world market, there is currently a trend for manufacturers to increase the number of

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variants with a simultaneous reduction of product life time [20]. In spite of the progressing automation of manufacturing processes, a considerable proportion of the arising assembly tasks are still carried out by humans or by a cooperation of human and machines in assembly lines (cf. [2, 19]). In order to be able to compete, companies must generate stable and efficient production and assembly processes. Also, with the help of proactive quality measures quality-related test and error costs need to be kept as low as possible [3]. However, especially at the beginning stages of a manual assembly line, unstable processes often effect variations of quality which cause high quality-related costs. If the error causes are only discovered during operation, they can only be remedied with a high financial and/or a high time effort for optimizing quality-critical work steps.

In order to already analyse performance reliability of manual assembly processes in the planning phase of a new assembly line, the Department of Quality and Process Management at University of Kassel has developed a process-oriented assembly planning method MTQM (Methods Time and Quality Measurement) which combines aspects of work planning for the time-optimized interpretation of manual assembly tasks with aspects of quality planning for the assessment, evaluation and reduction of quality risks caused by anthropogenic error handling. As a result, the developed method enables the user to perform a prospective evaluation of human errors that can possibly occur while executing typical manual assembly operations (cf. [4]).

After a brief overview of concept and functionality of the assembly planning method MTQM is given, this paper deals with its practical application to the assembly line of a profile manufacturer within a case study. It is shown how human-caused errors can be forecasted and measures for optimizing the investigated assembly station can be derived from results of the risk analysis.

2. The MTQM-method

Although the early recognition of quality-critical manual work tasks constitutes a key element of creating stable and efficient production processes for cross-sectoral manufacturing companies, the prospective examination of human reliability in the assembly process has been neglected in both research and business practice to the recent past. In order to counter this situation, the developed assembly planning concept, which has been developed in cooperation with several industry partners e.g. the automotive and electronics industry on the examples of typical manual assembly tasks from series production (fitting a brake piston, fitting a valve, connecting a control unit etc.), contains the three successive fields of error analysis, reliability analysis and measure development. Figure 1 illustrates the substantial elements of the developed MTQM method and gives an overview of both needed inputs as well as outcomes resulting from method application.

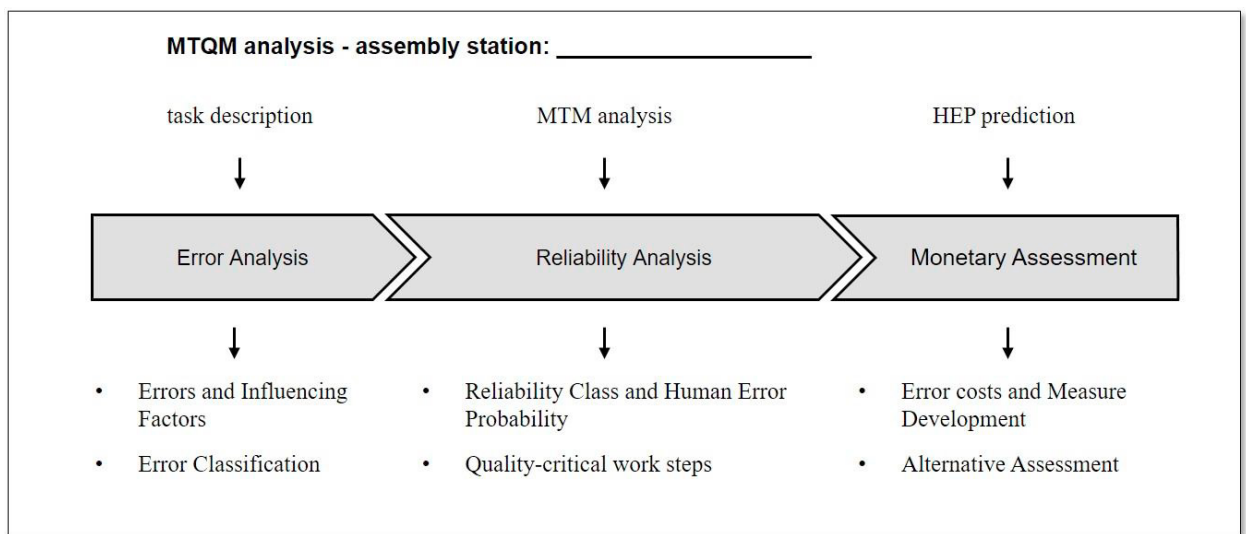


Fig. 1. Methods Time and Quality Measurement - application areas

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