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Digital Planning of Harmonised Quality Testing Activities throughout the Product Life Cycle

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Abstract

Contemporary companies tend to avoid quality testing activities as they are regarded as non-value-adding efforts. Nevertheless, certain quality tests are mandatory to ensure the product quality to the customer. In order to reduce financial efforts and avoid testing overhead, quality testing activities need to be planned and harmonised throughout the entire product life cycle. The following paper focuses the development of a digital configuration system for quality testing activities throughout the product life cycle. To identify all important inspection processes, an overview of life cycle-orientated quality testing activities is presented. Thereafter, a development concept for the digital configuration system is introduced. The scope of the paper includes the digitalised process of planning quality testing activities in context of product life cycle management applied within developing and producing companies running volume production.

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1. Introduction

Contemporary companies often classify quality testing activities as non-value-adding processes. Therefore, activities related to quality inspection are frequently brought into focus of optimisation projects with the result of occasionally being eliminated from the process concept. This implies that the process itself needs to be designed in a way that quality requirements can be met which is often unreasonably expensive. In addition, a certain amount of quality testing activities is necessary to determine whether the inspected product, process or service complies with its specific requirements [1, 2]. First, these inspections assure product quality to external customers. Second, companies are able to derive measures for continuous improvement by using the knowledge about failures and process capability which is acquired by quality inspections [3]. Third, especially supplier companies have the obligation to prove their quality assurance activities using certain pre-defined documents [4]. Hence,

quality testing activities are necessary support performances for value-adding processes and need to be planned thoroughly.

Due to the fact that quality testing processes are non-value-adding activities, companies are panting for aligning and optimising their inspection activities throughout the entire product life cycle [5]. When drawing an extensive balance sheet for quality testing activities, time and financial efforts spent on inspection activities should be minimized throughout the entire product life cycle. A suitable concept for summarising expenses on quality inspection is the idea of stating out a “quality testing footprint”, which is used in latest research activities (see [6]).

Quality testing activities take place in different stages of the product life cycle [5, 7]. The most popular testing activities are common inspection routines during the stage of production, such as dimensional checks or functional tests. However, quality management has extended its activity focus during the last century from the production stage to all phases of the product life cycle [8]. Hence, activities related to quality

testing also take place in both earlier and later stages of the entire product life cycle. Exemplary inspection processes are design reviews in the stage of product development or reliability tests during product use.

Considering quality testing activities throughout the product life cycle, a huge variety of dependencies between particular inspection processes can be identified. For example, functional tests performed in the stage of production can be aligned with the results of a design review which is conducted during product development [9]. In order to align quality testing activities and therefore optimise the quality testing footprint, interdependencies between quality inspections need to be identified and analysed. At first, a common understanding of quality inspections as well as a review of common inspection activities is mandatory. Hence, the present paper provides an overview on quality testing and inspection activities throughout the product life cycle. Based on the identification of relevant testing processes at all stages of the product life cycle, interdependences between inspection activities as well as influencing boundary conditions can be analysed. On the basis of a deeper understanding of the interconnections, it is possible to align quality testing activities at all stages of the product life cycle. For this purpose, a development concept for a digital configuration system of life cycle-orientated inspection planning is introduced. The development approach towards the digital configuration system is presented as well as the field of application in context of product life cycle management and digital process planning.

2. Inspection Planning within Product Life Cycle Management

2.1. Product Life Cycle Management

Aligning quality testing activities throughout the product life cycle requires a common understanding of both quality testing activities and the product life cycle term. The present paper refers to the definition of product life cycle management named by Eigner and Stelzer. They consider the product life cycle concept as one of contemporary companies' core processes, covering all activities related to planning and designing products, resources and processes as well as activities within product use and recycling [10]. In order to structure the entire process, different stages within the product life cycle can be identified. These stages as well as exemplary corresponding tasks are illustrated in figure 1.

The illustrated understanding of product life cycle management is commonly spread. Similar product life cycle concepts can also be found within [11, 12].

As product life cycle management includes all activities regarding product and process planning, it also comprehends the task of planning and harmonising quality inspections. This especially applies when considering quality testing activities throughout the entire product life cycle (also see chapter 3.3). Furthermore, the stage concept, illustrated in figure 1, facilitates a classification of quality testing activities into different phases of the product life cycle.

2.2. Inspection Planning

The planning and development of quality testing activities is performed within the process of inspection planning. Examining contemporary literature, significant differences in the definition of the term "inspection planning" can be identified. According to the guideline VDI/VDE/DGQ 2619, inspection planning deals with the process of planning quality testing activities which are conducted during the stage of production [13]. Hence, the scope of inspection planning can be seen as defining quality testing activities related to the stages of manufacturing and assembly. Consequently, the process of inspection planning mainly takes place during production planning since manufacturing processes as well as necessary resources are planned during this phase. Nevertheless, various quality testing activities executed at production stage are identified and determined in earlier stages of the product life cycle, as shown in [14].

The definition of inspection planning introduced above is a conventional definition stated by various authors, such as [15, 16, 17, 18]. Adjacent to this interpretation, a more comprehensive definition can be found in contemporary references. According to these, the process of inspection planning does not only comprise quality testing activities conducted during the stage of production but also the process of planning inspection activities taking place during further stages of the product life cycle [4, 19, 20, 21]. These are inspection activities from the perspective of quality assurance addressing process results from early stages of the product life cycle, such as verifying design quality during product development [5, 22, 23]. For example, quality inspections such as FMEA execution or design reviews investigating the results of a development process also need to be planned. Hence, the comprehensive process of inspection planning plays an important role in the context of product life cycle management. The present paper adapts this comprehensive definition of inspection planning.

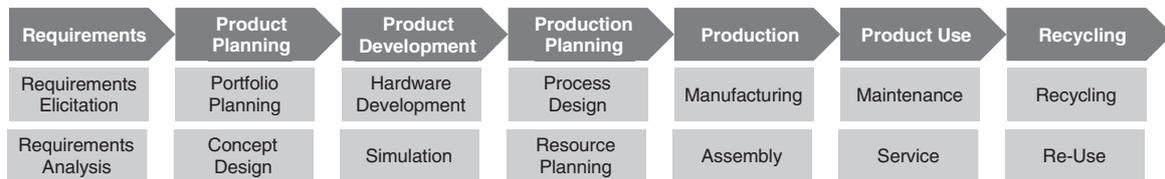


Fig. 1. Concept and stages of product lifecycle management.

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