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# Managing product reliability in business processes 'under pressure'

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**Abstract**

Product reliability is often seen as a product attribute. Models with different degree of sophistication analyze and predict the reliability of a product as a function of the internal structure (such as components and their relation). The practical relevance of these models, in relation with the (business) processes in which the related products are actually used, is not often addressed. Different types of reliability issues, however, can be relevant for products in different industrial contexts. This paper will present a classification model to describe different business processes, based on the degree of product innovation. It will also propose a taxonomy that can be used to classify different types of reliability problems. As this paper will demonstrate, only certain combinations of reliability problems are relevant for certain business processes. It will also show that, given certain technology trends, some combinations will become more relevant in the future. The final part of this paper will demonstrate that especially for these combinations many of the existing reliability analysis and prediction methods can be considered inadequate.
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## 1. Introduction

In modern product development many companies struggle to maintain a balance between on the one hand performance and (technical) innovation (realizing a product that *does* what it *should do*) and on the other hand product quality and reliability (realizing a product that *does not* do what the product *should not do*). The use of new technology may be beneficial with respect to achieving certain advantages in terms of functionality and cost but (often unproven) new technology in combination with customers not familiar to this new technology may lead to all sorts of unanticipated quality and reliability problems. When, for a given business process, the learning time required to understand and manage these problems is longer than the pace in which innovation takes place, this can easily lead to business processes that are difficult to control. In literature this relation between product performance (in terms of quality and reliability) and execution of the primary business processes is often neglected. This leads at this moment, as this paper will demonstrate, in many companies to relatively large numbers of unpredicted and unmanaged problems. Also for problems where the cause is known, the time it requires to discover the (root-)cause is becoming for many companies unacceptably long. This paper will describe a number of trends currently dominating industrial business processes and the impact of these trends on product quality and reliability. It will address also some first ideas on how product quality and reliability could be managed in future business processes.

## 2. Different business processes and the impact on product development

In reliability literature the most common criteria to replace or repair a product is a technical product failure. In addition to these technical criteria, companies can have also other reasons to replace a product. One reason can be that a new, alternative, product becomes available that has

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certain advantages in terms of functionality or efficiency. In some of those cases it becomes economically justified to replace a still fully functional product by a new, 'better', product. In cases where the economic lifetime[1] is much shorter than the technical lifetime[2], companies will easily replace fully functional products; if the reverse is the case companies will seek ways to extend the technical life of a product by introducing different forms of maintenance and/or repair strategies. This process of optimizing the operational lifecycle costs of a product is a process of continuously evaluating the added value created by a product versus evaluating the possibilities to replace (or upgrade) a product. If the performance benefits[3] created by a introducing a new product outweigh the sum of the required investments (in this new product) and the existing performance benefits (created by the old product) it will be, in general terms, useful to replace a product. In order to make such a decision it will be necessary to have knowledge of two aspects: the operational lifecycle costs of both existing and future products and the rate in which products with a certain level of innovation are introduced into the market.

If the performance benefits of a product are constant in time the only criteria to replace a product will be innovation; the difference in performance benefits over time compared to the investments for the new product will determine the required pay-back time and therewith the decision for replacement.

For products that are subject to physical degradation the performance benefits will, however, not be constant. Either the performance may degrade or, due to effects such as wear-out, the likelihood of failure (and therefore the costs of maintenance and repair) may increase. Lifecycle strategies will therefore require both knowledge of the rate of innovation for certain products as well as the rate of degradation (and the impact on the performance benefits) for these products.

Which reliability problems are relevant for a product is strongly dependent on this lifecycle strategy; depending on developments in technology, the market, and the type of product that is being developed, companies will have different focus with respect to product reliability. In order to determine what reliability problems are relevant for what type of lifecycle strategy, this paper will use the innovation rate or the, closely related, ratio between technical and economical lifetime as factor to distinguish between different types of business processes. Although, the actual number of lifecycle strategies will be much larger (and the underlying decision processes far more complex) this paper will describe a number of 'generalized' business processes and will propose a set of relating lifecycle strategies with respect to product reliability. This paper will use the following business processes:

A. Business processes depending on products where the economical lifetime is much shorter than the technical lifetime. Especially thanks to recent developments in semiconductor industry and, related, developments in information technology it is for (fully functional) products in this category not uncommon to be discarded and to replaced by a product with more/better functionality. In this case the economical life (often 0–3 years) of a product is shorter than the technical life. Examples of products in this category are personal computers and other products with a strong IT content (e.g. mobile phones). Manufacturers of disposable products typically belong in this category, but also manufacturers of short cycle consumer products. Companies in this category will try to employ the latest technology in the shortest possible time in order to achieve (or maintain) a competitive advantage.
B. Business processes depending on products where the economical lifetime is comparable to the technical lifetime. This second category consists of the business processes that generate products with an extended (3–10 years) but still moderate lifecycle. Products like cars or more traditional consumer products have a modest degree of innovation (and the inherently related time pressure in their development process is also modest). Since in these business processes the emphasis is not, as in the previous process, on innovation but mainly on product costs this category will use different business processes and therefore different methods and tools to assure product performance, quality and reliability.
C. Business processes depending on products where the economical lifetime is much longer than the technical lifetime. The third category concerns business processes that are depending on systems with a long lifecycle (10 years and beyond). For example capital intense systems, like oil refineries, are such products or systems. The companies build, use, and maintain these systems to generate other types of products: mostly raw materials like chemicals or food. Here the degree of innovation is low due to considerations with respect to safety and the impact of failures when things go wrong. If a new technology becomes available it is rigorously tested before it is applied. In contrast with the earlier processes the emphasis will be on avoidance of (functional) risks, on system availability (uptime) and on the safety of the systems used.

Not all types of reliability problems will be relevant for all types of business processes. Research in the wear-out behavior of strongly innovative products such as hard disks, used in game controllers, may be interesting from an

[1] Economic lifetime is defined in this document as the average time where it is justified to replace a product for economic reasons.

[2] Technical lifetime is defined in this document as the average time that a product requires to reach end-of-life due to technical failures.

[3] Performance benefits are defined in this document as the added value created by a product minus the total costs of operating a product.

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