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The Functional Products technical lifecycle and its four sub-lifecycles

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Abstract

The paper provides a further verification of the Functional Products (FP) technical lifecycle and additional details regarding its four sub-lifecycles concerning: hardware, software, service-support system and management of operation. Outlined, in a novel way, is how the four sub-lifecycles may be embodied in order to manage and keep the FP technical lifecycle running at an agreed-upon level of availability. The FP technical lifecycle is further analyzed from the viewpoint of its supporting role to the FP economic lifecycle, as well as compliance, regulatory and commercial aspects.

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1. Introduction

The aim of this paper is to provide a further verification of the previously proposed Functional Products (FP) technical lifecycle [1] and outline additional details regarding its four sub-lifecycles concerning hardware, software, service-support system and management of operation. The lifecycle aspects, which commonly are regarded through the lenses of economy, ecology and society, are gaining in importance and becoming increasingly interesting due to the increasing awareness and actability of customers and society pertaining to these aspects. However, in this paper the FP technical lifecycle will be viewed from the following perspectives: supporting role to the FP economical lifecycle, compliance, regulations and commercial.

Many manufacturing companies, in order to strengthen their competiveness under conditions of increasing globalization, strive to develop, market and sell offers based on advanced concepts or business models, rather than conventional products and services. The paper focuses on such a concept or business model i.e., FP [1] [4, 10-12], which incorporates hardware (HW), software (SW), service-support system (SSS) and management of operation (MO) into a combined package that provides a function with a specified or agreed-upon level of availability to customers. Other potential guiding contract parameters may be to reach a certain result or level of productivity through the function provided. Throughout the overall FP lifecycle, comprising both the economic and technical lifecycle, operation of the FP needs to be managed, improved and optimized. The FP offering optimizes the long-term value for both the customer and provider and facilitates a sustainable win-win situation.

The definition of an FP technical lifecycle, which can range up to 20-30 years, has been initially proposed in [1], and the main focus of this paper is to further verify the definition as well as provide further details on its four sub-lifecycles. Since the four main FP constituents: HW, SW, SSS and MO define the FP concept, the FP technical lifecycle may be delimited and defined by the perimeters of these four main constituents. According to [1], the FP technical lifecycle is to a large extent

[1] The concept of FP has similarities with, for instance, Functional Sales [2], Extended Products [3], Total Care Product [4], Product-Service System (PSS) and Industrial Product-Service Systems (IPS^2) [5], Servicizing [6], Service Engineering [7] or Through-life Engineering Services (TES) [8] in the sense of increasing the focus on soft parts such as services, knowledge and know-how etc., additionally offered. Tukker and Tischner [9] have identified three main PSS categories: product-oriented, use-oriented and result-oriented, which may also be applicable for the other concepts.

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defined by the HW and SW technical sub-lifecycles. Further, according to [1], the SSS enables the technical lifecycle through proactive/reactive service and maintenance. The SSS has its own technical sub-lifecycle as well, and relies on, for instance, access to spare parts, service/support personnel, skills and knowledge, etc. In addition, the MO technical sub-lifecycle manages, coordinates, ensures and supports the other technical sub-lifecycles [1].

The FP technical lifecycle enables and supports the FP economic lifecycle, based on the provider-customer relation, and sustains a win-win situation between the provider and its customers. According to [1], if the win-win situation can no longer be sustained for certain customer instances, the contracts need to be re-negotiated in order to find new a win-win situation(s). If a win-win situation is not sustainable for a majority of customer instances, the contracts will probably be terminated, thereby ending the current economic lifecycle.

Current research on the FP technical lifecycle is scarce; however, [1] outlines it on a high level. A number of publications bring up certain aspects that should be considered during the FP technical lifecycle, e.g., [4, 10, 12-14]. Regarding the related research within the closely related concepts TES, PSS and IPS^2, the literature review did not reveal any publications explicitly addressing the technical lifecycle. However, aspects thereof are addressed in e.g., [8, 15-16] for TES, in [17-21] for PSS, and in [5, 22-24] for IPS^2.

Due to economic issues, the expected technical and economic lifecycles are sometimes extended considerably further than envisioned from start. Common examples of such are public transportation systems e.g., railways and subways [25]. Baker [26] argues that many offers' lifecycles are shortened and that their through-life plans no longer have any major technology insertions or mid-life upgrades. Although, if such offerings are sold as FP, the FP provider must keep maintain them to meet the agreed-upon level of availability. To maintain a win-win situation, the customer must understand that the provider needs to be compensated for the foreseen costs and risks assumed, which in not necessarily the case when conventional products with services are provided.

Currently, the literature lacks contributions which address the FP technical lifecycle and its four sub-lifecycles in a detailed manner. There are several relevant contributions on FP through-lifecycle aspects, but these papers do not consider the FP technical lifecycle in any great depth. Thus, the research question addressed in this paper can be formulated as: how may the FP technical lifecycle and its four sub-lifecycles be embodied? The purpose of the paper is to outline additional details of an FP technical lifecycle, which can be used by industry as well as researchers. The FP technical lifecycle will be discussed from the following perspectives: its supportive role in the FP economic lifecycle, compliance, and regulatory and commercial aspects.

2. Research approach

The research approach was based on a literature review followed by empirical studies at four manufacturing corporations. The literature review was used to guide the empirical studies, and a potential outline of the proposed contents of the FP technical lifecycle and its four sub-lifecycles was sent to the respondents prior to the interviews. The empirical studies were conducted using semi-structured open-ended interviews [27, 28] with ten respondents working for corporations active in the Faste Laboratory at Luleå University of Technology, Sweden, which is a VINNOVA (The Swedish Governmental Agency for Innovation Systems) Excellence Centre concerned with FP Innovation. In addition, one additional corporation, Electrolux, which sells functional offers to customers, also contributed to the empirical studies. Thus, the respondents were well aware of and knowledgeable regarding FP. The respondents were professionals responsible for services, research coordination, development and sales at four international corporations. The respondents' years of experience (YOE) are indicated below as well:

1. Bosch Rexroth Mellansel AB (seven respondents – manager services, technical product managers motors and systems, systems engineer motors, systems monitoring engineer, simulation engineer, mechanical engineer, 10-40 YOE)
2. Volvo CE (one respondent – chief project manager, 15 YOE)
3. Gestamp Hardtech (one respondent – manager tool design and development, 25 YOE)
4. Electrolux (one respondent – regional category manager, 25 YOE)

The purpose of having multiple corporations with diverse focus was to ensure an advance in the understanding of the FP technical lifecycle and which aspects and perspectives are of importance, considering the similarities and differences between the corporations [cf. 29]. Although the corporations provide different offers, they all face the common challenge of how to best develop, market and sell FP and/or related offerings such as PSS/IPS^2. The corporations are all manufacturing corporations with roots in hardware development. Additional components have been added to their customer offerings, and what the additional components comprise and their importance differs depending on the industry and customer segments served. The FP planned or currently offered by the corporations differ and have differing emphasis on the composition of hardware, software, service support system and management of operation. Initially, semi-structured interviews were used, with open-ended questions allowing the respondents to give detailed answers and add extra information where deemed necessary [30]. The data collected were corroborated with the interviewees during the interviews using a projector when face-to-face, or via a shared application window when using conference tools such as Lync or Skype. The interviews lasted for about one and a half hours on average. The collected data were displayed and analyzed using a matrix [31]. The analyzed data were used for the conceptualization of an FP technical lifecycle and its sub-lifecycles, and which aspects thereof were considered as important or vital.