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# Product-level profitability analysis and decision-making: Opportunities of IT application-based approach

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**Abstract:** Product Portfolio Management (PPM) is vital for companies to succeed. It aims to constitute a profitable entity for company products in the long term. The extant literature on PPM is, however, lacking in IT application-based discussion, which links to the potential of IT system independent analysis and reporting. One potential application is producing accurate product-level profitability calculations. This study aims to conceptualise application-based PPM analysis and identify the related data needs. Additionally, the opportunities and risks related to the implementation of the concept are studied. The study combines a literature review with qualitative company analyses. The results aid in understanding application-based PPM analysis and clarify the related opportunities for its use. Our research appears to indicate that application-based PPM analysis has the potential to improve product portfolio-related decision-making while reducing the manual work needed for profitability reporting.

**Keywords:** product portfolio management, data-driven management, application-based PPM, fact-based analysis, digitalisation, performance management, product lifecycle management

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## 1 Introduction

Portfolio management has earlier been studied extensively in new product development (NPD) context (e.g. Cooper et al., 1997; 1999; 2001). The discussion on product portfolio management (PPM) has **evolved**, however, **since the earlier studies**. For example, **recent research** suggests that PPM should cover **the** commercial and technical levels of products over their lifecycle (Haines, 2014; Lahtinen et al., 2019; Stark, 2016; Tolonen, 2016). The ability to make effective decisions **about** which products to develop, sell, deliver, and invoice is important. Also, understanding which products are strategic and profitable can be beneficial (Hannila et al., 2020; Lahtinen et al., 2020; Tolonen et al., 2015b).

Product profitability reporting is a challenge, **however**, for PPM (Hannila et al., 2020; Tolonen, 2016), and **Hannila et al. (2020)** found it surprising that products cannot be analysed effectively **using** the **companies'** extant data. Profitability is addressed more at the company level rather than at a product level. The ability to **determine** profitability at the product level would provide new opportunities for **PPM**. **However**, obtaining **such** information **using** current methods, which often entail manual work, seems to be a challenge for companies (Hannila et al., 2020).

**Employing an** application-based approach might **support** dealing with product-related data assets **information technology (IT)** system-independently. **The term 'system independent'** refers to data analysis done outside the operational IT systems. **The PPM analysis described here is** an IT application-assisted analysis of company products **done to facilitate product** decision-making. Simply put, it would raise above the existing information systems. **However**, the data in these systems are still needed for **the PPM analysis**. Currently, **the concept of** application-based PPM **analysis** necessitates research to enable accurate product-level profitability calculations for complex products.

Application-based PPM analysis is supported by preconditions presented by Hannila et al. (2020) as requirements for product-level profitability analysis. These preconditions include productization, consistent commercial and technical product structures, product classification, a corporate-level data model, and adequate IT support. They seem to be requirements for the application-based PPM analysis as they ensure data availability for profitability analysis. Hannila et al. (2020) fail, however, to consider the practical realisation based on applications. Neither have the opportunities nor risks related to implementing an application-based approach been studied. The clear research gap serves as a major motivation for this study. There is also a potential to provide useful information for companies aiming to implement application-based PPM. However, as Hannila et al. (2019a) noted, data should be considered first and technology only after that. This does not mean that technology is unimportant, but that it does not reach its full potential without data.

In this study, the scope of our PPM investigation is limited to those aspects related to application-based PPM. The study's aim is to conceptualise an IT system-independent approach to application-based PPM analysis and reporting and to identify the necessary core elements and data needed for that approach. It also attempts to identify any potential opportunities associated with and risks related to implementing this approach.

The following research questions (RQs) are designed to achieve the above-mentioned objectives:

**RQ1:** What is application-based PPM analysis and what kind of data does it need?

**RQ2:** What opportunities would application-based PPM analysis provide, and are there any risks associated with its implementation?

The research questions are approached qualitatively using inductive logic. The data sources for this study are the existing literature, interviews of and informal discussions with the case company representatives, and case company internal materials.

## 2 Literature review

Active PPM necessitates productizing a company's products horizontally and vertically (Tolonen, 2016). Horizontal perspective refers to structural considerations relating to products over the lifecycle (Lahtinen et al., 2020), whereas vertical refers to considering different levels of commercial and technical product structures (Tolonen et al., 2015a). Products can consist of services, software, and physical elements (Mustonen et al., 2019b; Kropsu-Vehkaperä et al., 2011). The goal of productization is to harmonise the understanding of products and the items that form them. According to Harkonen et al. (2015, p. 70), 'The process of translating, combining and forming a suitable mix of tangible and intangible elements into a product is referred to as productization.' Productization links to product structure considerations, and the same logic applies to different product types (Harkonen et al., 2017; 2018; Lahtinen et al., 2020). Coherent productization enables the analysis of vertical product composition levels to determine product profitability (Lahtinen et al., 2020). Product structure and master data together enable reaching the data consistency required for a product-level profitability analysis (Hannila et al., 2020).

Product lifecycle management (PLM) is about managing products along their lifecycle in an optimal manner (Stark, 2016). Terzi et al. (2010) describe PLM as a business model that is lifecycle-oriented and product centric. Compared to product data management (PDM), PLM is a broader concept (Saaksvuori and Immonen, 2008). A product lifecycle starts from when a product is first conceived and ends when it is disposed. Even after

products are discontinued, however, companies must retain their product data for, at minimum, whatever period is legally required.

Diverse product data are created in different business processes along the lifecycle (Silvola et al., 2019). These data are saved in information systems when they are created. For example, a customer relationship management (CRM) system can store the lifecycle data that relates to customers.

PLM is about management of products and the information about them (Saaksvuori and Immonen, 2008). To connect products and data from business processes, information systems should be fed by PDM/ PLM with product master data (Silvola, 2018). Hannila et al. (2019b) discuss profitability analysis-related data, processes, and information systems. Information system integrations and silos are typical considerations in terms of data trustworthiness, hence an IT system-independent approach might prove beneficial (Hannila et al., 2020).

The vertical and horizontal perspectives of product structure are necessary to be considered by PPM (Haines, 2014; Stark, 2016; Tolonen et al., 2014a; 2015a). This includes developing vertical levels along a product's lifecycle and moving products from one lifecycle phase to a later one (Lahtinen et al., 2020). Different authors have varying views of PPM. Tolonen (2016) sees PPM as its own entity. Stark (2016) understands it as a part of PLM. Haines (2014) classifies it under product management.

Tolonen et al. (2015a) understand the PPM process as a fundamental, high-level business process. Traditional business processes include the product process, the marketing and sales process, the support process, the delivery process, and the care process. Product portfolio renewal is determined by the PPM process whereas the other business processes can be seen as more operational by their nature. (Tolonen et al., 2015a)

The targets of PPM are a portfolio that is in balance, value maximisation, and strategic fit (Cooper et al., 1997; Tolonen, 2016). One way to balance a product portfolio is to include products with different risk levels (Cooper et al., 1997). The value of a company's product portfolio is maximised when it brings in the maximum possible profit (Cooper et al., 1997). If this maximisation is to be achieved over the long term, products should be in development to generate future income (Mustonen et al., 2019a). At the same time, there should be 'shorter-scope' products in the portfolio to ensure continued operations. Regarding strategic fit, products that are in line with a company's business strategy fulfil that target (Cooper et al., 1997). Products can be classified by dividing them into categories of strategic and profitable, profitable but non-strategic, unprofitable and strategic, and unprofitable and non-strategic (Tolonen, 2016; Verrollot et al., 2017).

While NPD phase of PPM was focused on by Cooper et al. (1997; 1999; 2001), Tolonen et al. (2015b) also cover other lifecycle phases while focusing on PPM performance management. Their framework connects PPM performance management and a company's strategy, with an end-to-end approach being the underlying idea. A stream of new products is assumed to come from NPD in a consistent manner. (Tolonen et al., 2015b) Portfolio renewal is viewed as one success factor for a product portfolio's long-term economic sustainability (Mustonen et al., 2019a). Key performance indicators (KPIs) regarding main business processes in addition to horizontal and vertical portfolios constitute the base for PPM (Tolonen et al., 2015b). The explosion of a product portfolio is to be avoided (Haines, 2014; Stark, 2016), and the PPM concept could help in this (Tolonen et al., 2015b).

To analyse a product portfolio systematically, the revenue information of commercial items, in addition to commercial and technical product portfolio items' costs, should be known (Tolonen, 2016). This information is needed to conduct a profitability analysis of individual products. In practise, product configurations consist of sales items, and specific



sales items may have many version item options (Lahtinen et al., 2020). The cost and sales data related to sales and specific version items are needed to calculate the profitability of a product configuration. According to Tolonen et al. (2014b), PPM preconditions include reporting capabilities and data availability. Reporting might be handled with application-based PPM, but certain automation could be necessary to be utilised. Robotic process automation (RPA) refers to the automation of processes done in IT applications that are usually performed by humans (van der Aalst et al., 2018). The data needed for the use of it should be structured (Aguirre and Rodriguez, 2017). Relational databases include this kind of data in tabular form (Gandomi and Haider, 2015). For instance, according to Elgaral (2014), enterprise resource planning (ERP) data are structured. RPA could be used to feed data into an application required for application-based PPM. This application would not need to be a part of any existing IT system.

As a synthesis of the literature, Figure 1 illustrates the core elements of application-based PPM analysis for product profitability. These elements consist of the PPM application and the product data located in a company's information systems. For accurate product profitability analysis, the data must be uncompromised product master data, which includes the product structure and the data relating to transactions needed to understand what has been provided and to whom. This way the cost information linked to each product version can be compared to the sales price of each sales item. These data comprise the data assets that, regardless of the information system used, serve as the fundamental enabler of application-based PPM. The role of data quality is particularly emphasised for this type of arrangement. The application would consolidate product data into useful information for a PPM analysis outside the specific IT systems used by a company.

### 3 Methodology

#### *Research process and case company descriptions*

This qualitative study uses the multiple case study methodology. Various cases are analysed to discover different and similar aspects between them (Baxter and Jack, 2008). The literature review's objective was to gain necessary insights on the subjects related to the application-based PPM. Particularly, information on the data needed for application-based PPM analysis was to be covered. The literature review also informed the interviews. The data collection was performed through interviews of representatives from the case-study companies and informal discussions with them outside the interview sessions. Semi-structured interviews were chosen to be utilised in this study as a set of specific topics can be addressed with this interview type while still having an adequate level of freedom in research (Bryman and Bell, 2007). The questionnaire covered PPM capabilities and practices, PLM practices, the business processes used, PPM-related information systems, and the need for real-time PPM information. There were two to four interviewers in each interview session depending on the interview, and notes were taken by each interviewer separately. Snowball sampling was used when case company representatives were identified (Patton, 2002). The representatives of eight case companies were interviewed in total and depending on the company, interviews were conducted either in one go or in several separate sessions. Companies were interviewed one at a time. In total, 53 subjects participated in the study. Unless the interviewees requested otherwise, the interviews were recorded to help with the analyses. The collected empirical data were coded according to discovered themes and then additional analysis and inductive reasoning were used to draw conclusions. Generalisable conclusions are possible to be drawn out of the observations via

inductive reasoning (Bryman and Bell, 2007). However, the findings cannot be widely generalised without further testing.

The case company selection was based on the nature of their products and information system landscape. The products needed to be complex enough and the company mature enough to have implemented the use of many product data-related information systems. The information systems considered relate, for instance, to the management of customer, product, and production data. The fact that the products of the selected case study companies were complex enough for the firms to be selected for this study means that those companies are involved in businesses where the product costs can be complex to define, in contrast to, for instance, resale business product costs. Additionally, the aim of this study was to interview representatives from enough companies to ensure that different product types would be covered. Hardware, service, and software products were all considered during the research. The sample size of eight case companies seemed appropriate as these firms are in various discrete industries and of different sizes.

The case companies all have their headquarters in the same country. According to the Eurostat's 2019 classification criteria in which medium-sized firms have 50 to 249 employees and large firm have 250 or more employees, seven of the selected case-study companies are large and one is medium in size.

The case companies' industries are diverse, and the largest company has a revenue of billions of euros per year. The businesses of the chosen companies are mature. Table 1 presents more specifics on the case-study companies. The products of the selected companies comprise hardware, services, and software except for company E, which has hardware and service products but no software products.

The initial validation of the IT system-independent application-based PPM concept was performed in a workshop with the participating case companies. Also, an initial proof of

concept took place at one of the companies, and real business data were used, with promising results. This testing indicates that the concept is realistic and feasible using existing technologies.

## 4 Results

### *4.1 Application-based PPM analysis and related data needs*

This study aimed to clarify the viability of application-based PPM analysis for fact-based PPM analysis. The concept is to carry out analysis outside individual IT systems on application basis to support the PPM analysis and decision-making. The concept addresses vertical product structure levels, and also products horizontally along the product lifecycle phases, and PPM focus areas. This is achieved with calculations that use business process-related product data and provide support for fact-based decision-making in real time. An application would consistently link product data from business processes to individual products and sales items. Product portfolio management KPIs such as the average profitability of products in a certain product family and product-level profitability could be calculated with the application.

As we concluded from the literature review, the data needed for application-based PPM analysis include the data related to the PPM goals of a balanced product portfolio, value maximisation, and products aligned with the company's business strategy. To make educated decisions regarding value maximisation, one needs information on the profitability of individual products, market segments, and customers. The application could assist in the essential fact-based analysis of products. To define the profitability of a product, related cost and sales data are needed. This structured transactional data seem to be extant in existing IT systems, generally in the ERP and CRM systems. However, it

cannot be accessed automatically due to the lack of consistent productization of the technical and commercial portfolio items. For instance, an interviewee from Company A stated that 'Data is available in our IS systems, but it is hard to get it out for a specific non-operational purpose'. The initial proof of concept for application-based PPM analysis was done at Company D, and the company representative responsible for conducting it commented on the results: 'The technology needed does exist and barriers are only managerial'. The representative also stated that 'The initial results are promising'. Table 2 presents the observations of case company representatives regarding the actions needed to make data available for application-assisted profitability analyses. Each company seems to understand the principle of calculating product profitability.

It might be possible to calculate the chosen KPIs on products' relation to the company's business strategy, product profitability, and product portfolio balance using the application. The data needed for the KPIs would include, for example, information on the product risk levels, on product alignment with company strategy, and on their nature of supportiveness. Supportive products are those that are strategic yet unprofitable, loss-leaders if you will. These products may facilitate the sales of profitable products. For example, say a company can only sell a certain laptop model at a loss but removing it from the portfolio would mean fewer customers would buy the firm's profitable accessories. That laptop would be a supportive product. Additionally, individual sales items that are unprofitable alone can be supportive if they enable the sales of profitable product configurations. However, the present paper mainly considers how portfolio value can be maximised through having access to product-level profitability information.

*Finding 1: Application-based PPM analysis appears to be a viable concept for enabling fact-based, efficient analysis of products and product portfolios. The analysis appears to be possible using the existing data in IT systems as long as the consistency is ensured.*

## 4.2 Opportunities and risks *associated with application-based PPM*

### *Empirical findings on opportunities associated with application-based PPM*

The case-study companies do not commonly use a systematic PPM process, as Table 3 shows. The following observation made by a Company H interviewee typifies the practices of these firms: 'PPM activities are made but an official process is not in place'. In addition, these companies typically do not systematically track the number of replaced sales items. In some companies, the product portfolio was said to include more items than would be desired. Several interviewees also said that manual operation is the main obstacle to their ability to analyse the profitability of individual sales items. Generally, achieving accurate product-level profitability calculations would require a substantial number of manual calculations, if such calculations were even possible with the available data. For the case companies, the ERP and CRM systems are the typical systems used to store product-related cost and revenue information. The systematic PPM analysis and decisions on company products are currently not being carried out due to wider understanding on PPM lacking, and effective means of analysis currently missing.

Some of the interviewees realised that PPM analysis might technically be possible even with the current product lifecycle management systems but that the necessary functionalities were not available, even in ERP as an extension. However, the interviewees indicated strongly that they did not wish the analysis to be integrated with any of their individual systems. One of the underlying motivations for this reluctance is they did not want to link the commercial and technical sides of products in one system. The interviewees were very interested in the opportunities for using an application-based approach outside their current systems. The interviewees agreed with the basic principle of analysing product profitability. They also indicated the specific sources of data in the

context of their companies. The main requirement for the presented concept to work is that the necessary data is available. The typical data sources in the company context are the IT systems. For product profitability, the necessary data likely reside in the CRM and ERP systems. The data needed include the sales data for sales items and the cost data for the sales and version items. The product master data should be consistent and the needed transaction data must be connected to it. Figure 2 illustrates the essential links to the needed product data for product-level profitability analysis with the conceptualised application-based PPM.

The interviewees were greatly interested in the concept of application-based PPM analysis for their companies and in the information it could produce. Some interviewees even saw the wider potential of such an approach to analyse data from various sources. One interviewee, for example, envisioned using this approach for analysis in a supply-chain context. However, in a strategic sense, PPM information is not necessarily needed in real-time as 'real time' appeared to mean to be different periods for different companies—a day, week, or month—depending on their business. Also, meetings with a strategic PPM focus might only be organised on a monthly basis. Instead, the PPM information is hoped for the use of operational business processes in a real-time format. Yet, some interest for real-time PPM information for use in strategic PPM exists. Strategic PPM considers what products should be offered instead of deciding on more operational actions related to the company products. In addition, our study found that Internet of Things (IoT) data could be used by the concept application and that the application could link it to a product. In conclusion, the detected opportunities for using application-based PPM analysis can be divided into providing support for the PPM process, enhancing forecasting abilities and reporting efficiency, and additional opportunities for operational business processes.

### *Support for PPM process and **enhancement of forecasting abilities***

One benefit of using application-based PPM analysis would be the new possibilities for analysis and reporting to support the PPM process. As a systematic PPM process is not commonly used in the case companies, it would be necessary for them to establish this process first. After that, using the concept of application-based PPM could lead to better business decisions related to company products. For example, some of the case company product portfolios contained too many products, which may have occurred due to the lack of a PPM process. Application-based PPM analysis might drive a more focused product portfolio by promoting a better understanding of core products and enabling new ways of acting on non-profitable ones. One opportunity for application-based PPM in this respect could be that its efficient analysis could support decisions to decrease the size of overly large portfolios by ramping down unfavourable products. The analysis could also provide new opportunities to understand products at different structural levels and the impacts of the number of items at each level.

Application-based PPM analysis could also increase companies' forecasting abilities by efficiently producing information on the effects PPM-related actions have had on products historically. For instance, this kind of action could be the addition of a new product variant to the portfolio. This could help with forecasting the impact of similar actions being considered by a company. One Company D representative identified this possibility, saying 'It might be very beneficial to analyse the impacts that additions of different product variants have caused'.

### *Better profitability reporting efficiency*

As the case company representatives viewed manual operation as a hindrance to their ability to analyse the profitability of individual sales items in many cases, the



implementation of the **concept of** application-based PPM could **obtain** deeper analysis with greater efficiency. **Currently, the case company representatives see product-level analysis as entailing substantial manual work, which makes it infeasible. Thus, one important potential impact of application-based PPM is its ability to decrease and perhaps even eliminate this type of manual work. This situation emphasises the need for application-based PPM analysis and suggests that companies should study this approach in terms of how it might benefit them specifically.**

#### *Additional opportunities for operational business processes*

Opportunities **to use** application-based PPM **analysis** for operational business processes can be seen as additional opportunities because the **concept** application **is primarily** designed to serve PPM as a strategic decision-making tool. For example, operational information **on** products may provide opportunities **to** react to circumstances where **a certain product's** profitability is changing. Also, as the use of IoT data is increasing, links between product and IoT information might provide unforeseen opportunities on a large scale in the future. For instance, the flow of produced products might be tracked via the IoT. **If some market becomes saturated unexpectedly and the saturation is detected via IoT, overproduction of the product could be prevented or the marketing focus shifted to other regions. New opportunities for marketing analytics might arise, as one Company D interviewee noted: 'Implementation of the discussed concept could potentially bring a great boost for our marketing activities'.**

### *Risks associated with implementing application-based PPM*

While many opportunities have been defined for using application-based PPM, there are also risks. All such risks presented below were confirmed to be possible dangers by the case company representatives.

One risk is that the KPI values calculated by the application could lead to bad business decisions if the data used are invalid. For example, if cost data linked to a certain product causes the product costs to seem lower than they really are, the product in question would seem to be unrealistically profitable. In this situation, the production could be continued even if it should be ramped down. This emphasises the importance of data quality with respect to application-based PPM analysis.

Another risk is that the implementation of the concept application could cost more than estimated and produce results that are of less value than expected. However, some interviewees had ideas for how existing technology could be applied for the purpose without significant costs.

When it comes to legal risks, if proper precautions are not taken, the concept application might use customer data that has usage restrictions. This could happen if the application established a link between product and IoT data with usage restrictions. One company also mentioned the General Data Protection Regulation of European Union law was also mentioned by a company representative in this context. The General Data Protection Regulation of European Union law has been in full effect since 25th of May 2018 (European Commission, 2019). For this reason, it is especially important to consider customer data usage restrictions with regard to the concept application's use. That said, we note that these types of restrictions are likely to affect the wider opportunities to use application-based analysis that draw data from various sources and are not necessarily applicable to product-profitability analysis.

*Finding 2: Application-based PPM analysis outside existing IS systems is seen as interesting and more desirable than PPM analysis in individual silos. The potential is seen wider than profitability, but the lack of a systematic PPM process, issues with data quality, and the deficient tracking of individual sales items can create challenges for application-based PPM analysis unless the necessary systematics are introduced.*

## **5 Discussion**

This study conceptualises application-based portfolio management **analysis** as a concept that **can** enable **application-independent** PPM analysis and decisions based on company data assets. The application-based PPM **analysis could benefit** companies **that lack clarity regarding their** product-level profitability. **The** product portfolio of **such companies** may include **many** unprofitable products **of which** management is unaware. Application-based PPM **analysis could facilitate developing** profitable products and killing unprofitable ones by **giving decision-makers access to** profitability information. **Furthermore**, strategic fit and balance-related optimisation could be achieved when the concept evolves.

The concept results in digitalisation of a company in a sense that is comparable to a transition from a traditional technology to a new one that makes the older one obsolete. **The initial proof of concept with real business data indicated that the concept is promising and feasible using existing technologies. The application-based approach seems possible via cloud computing.** The transition is from company-level analysis and challenging manual operation to product and sales item levels with automated operation. The discussed concept supports the PPM process over **the product** lifecycle and product structure layers. By starting with considerations related to product-level profitability, a company might **obtain** valuable **product** information. The opportunities of the concept include support for **the PPM** process, **improved** forecasting **abilities and** reporting efficiency via **the** automated

analysis of products and product portfolio, and additional opportunities for operational business processes. The application-based PPM concept relies on data assets aligned by effective productization and consistent product structure as reliable data is needed for PPM analysis and decision-making. It might be logical to begin implementing the concept in small bites, that is, product by product. Overall, the concept may boost the effectiveness of PPM activities, but its implementation might also entail some risks. Thus, careful consideration of gains and costs is necessary.

### *5.1 Theoretical contribution*

This study provides a unique contribution by presenting the concept of application-based PPM. The findings are in line with and complement Hannila et al. (2020) regarding data-driven, fact-based analyses related to PPM. The present study tackles the research gap related to the lack of application-based solutions for PPM analysis and decisions by conceptualising application-based PPM analysis and discussing its data needs. Thus, earlier PPM knowledge (e.g. Cooper et al., 1997; 1999; 2001; Haines, 2014; Stark, 2016; Tolonen, 2016) is extended to cover the concept of application-based PPM. The findings are in line with previous studies' understanding of the role of consistent product structure and productization for fact-based analysis of products and the portfolio (Lahtinen et al., 2020). However, it also makes an original contribution by taking such thinking a step further toward digitalisation of the analysis based on data assets. To get usable data for application-based PPM, the preconditions established by Hannila et al. (2020) should be met. The presented concept further complements previous studies (Harkonen et al., 2015; 2017; 2018) by creating practical linkages to productization. This study supports the portfolio renewal as one success factor for the long-time economic sustainability of companies (Mustonen et al., 2019a) by working toward the creation of automated means for the

necessary analysis. In addition to the introduction of the concept, the consideration of the opportunities and risks related to implementing the concept is also a new contribution.

## *5.2 Managerial implications*

Managers can benefit from an understanding of the concept of application-based PPM analysis and its related opportunities and potential challenges. It is important to note here that such tools do not exist to better enable company product decision-making based on product-related factual data. The application-based approach draws relevant product-related data from various sources for the analysis and operates the application independent of the operations of existing IT systems. This study identifies the core elements of product-profitability analysis together with the related data needs, but the potential opportunities for use are wider. The data needs for an application-based PPM with a different focus can be different. For example, IoT data can be beneficial for different types of application-based PPM analysis. The opportunities for using the concept could provide motivation for its implementation. Furthermore, using the concept successfully might lead to better business decisions in the future. The significance of understanding product-level profitability lies in its ability to help companies make better decisions and create better possibilities for their long-term success. The ability to understand the profitability of individual sales items would make it possible to promote the most profitable product configurations. Adding the strategic nature of products to the picture would provide a more comprehensive view of the product portfolio which could be visualised to make perceiving it easier. The overview of the portfolio would include information on the strategic status and profitability of each product.

## 6 Conclusions

This study focused on the **concept of** application-based PPM **analysis** to enable better **use** of product data for fact-based **analyses**. **The opportunities and risks associated with** application-based PPM were also identified. This study attempts to cover the initial concept of application-based PPM. The data needed for the application-based approach **include** company data assets stored in IT applications. The concept's **potential** relates to the PPM targets of the portfolio balance, value maximisation, and strategic fit. This study **focuses specifically** on value maximisation.

The limitations of this study include the **relatively small** number of interviews and analysed companies. **Also, none of the studied companies have a strong PPM process in place in a wide lifecycle sense. The findings regarding the presented concept must be further tested in companies before they can be generalised widely. Also, the data gained from the interviews may not provide a holistic picture of the circumstances of the case companies because the interviewees have individual viewpoints and the manner of doing business can vary between business units within a company. Yet, as the case company industries are diverse, the study results should be somewhat generalisable. It might be that some companies have already taken steps towards automating product profitability calculations and that adopting the introduced concept would not improve their situation considerably. The question remains, however, of whether they apply consistent productization logic combined with efficient use of IT and data assets. Finally, the presented concept might open new gains in other areas via digitalisation.**

**Future research topics in this area** could include considering practical implementation steps for the application-based PPM **and further testing the concept**. In addition, **the** legal restrictions that might apply when using **the concept** could be **the subject** of further research, **as could** a deeper **investigation into the risks associated with** the concept. The

opportunities for implementing the concept could also be studied further, along with its practical implementation in real business environments.

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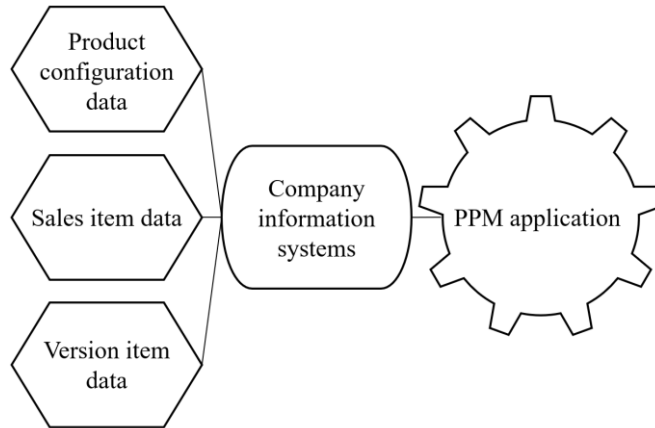
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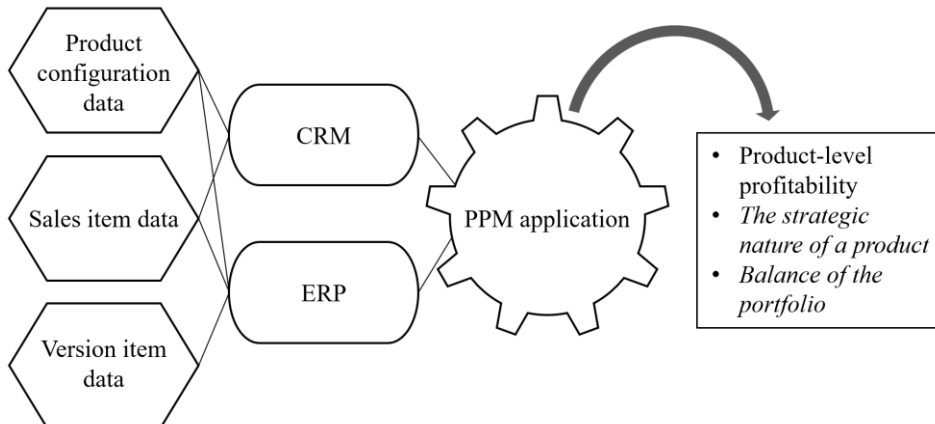
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**Figure 1.** Illustration of the application-based PPM core elements for profitability analysis.



**Figure 2.** Visualisation of product data and sources needed for determining product-level profitability in application-based PPM.



**Table 1.** Expertise of interviewees.

Case Company	Market area	Expertise of interviewees
A	Global	Applications, Management, Marketing, PLM, PPM, Product development, Product Management, Sales, Supply chain management
B	Europe	Management, PDM, PLM
C	Global	Digitalisation, Management, PDM, PLM, R&D, Sales
D	Global	Finance, Management, Marketing, NPD, PLM, Product management, R&D, Supply chain management
E	Global	Development, Finance, Management, Production management, Quality management, Sales
F	Global	Development, Management, PLM
G	Europe	Business development, Management, Finance
H	Global	Digitalisation, Information, IT, Management, PLM, Project management

**Table 2.**

Case Company	Agreed on the basic principal of application-assisted profitability analysis	Thoughts on achieving data consistency to gain data availability for application-assisted profitability analysis
A	Yes	"There is a lot of work to do, but we are making progress"
B	Yes	"It might not require that much effort for us, but we are not yet there"
C	Yes	"I think that we have potential to achieve the needed consistency"
D	Yes	"As some consistency exists, we could achieve limited insights even without any changes to the way we operate, but there is room for improvement"
E	Yes	"First, we should have a common understanding on what our offerings really are"
F	Yes	"It would require considerable efforts"
G	Yes	"Proof related to the benefits of service productization might be needed to motivate actions related to our service business"
H	Yes	"The idea is to focus on the productization of future products"

**Table 3.** Findings from the case companies.

Case Company	Systematic PPM process is in place	Sales items are followed systematically	Analysis viable in existing IS system	Interest towards application-based analysis
A	No	No	The idea is not liked	Yes
B	No	No	The idea is not liked	Yes
C	No	No	The idea is not liked	Yes
D	PPM activities seem to be considered more than in other analysed companies, but a systematic PPM process is still missing.	Some following exists but the big picture is lacking due to insufficient productization of services	The idea is not liked	Yes
E	No	No	The idea is not liked	Yes
F	No	No	The idea is not liked	Yes
G	No	No	The idea is not liked	Yes
H	No	No	The idea is not liked	Yes