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# Product Portfolio Management—Governance for Commercial and Technical Portfolios over Life Cycle

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## Abstract

Companies face an important question on whether they should allow product portfolio renewal to occur without interference by merely adding new products, or should the renewal be governed based on strategic and financial targets over life cycle? New product development phase is well covered in the product portfolio management (PPM) context, but later product life cycle phases are not covered well in this context. Neither are the different product structure levels adequately taken into account, instead the current PPM only discusses the “product” in general terms. Based on analysing the portfolio related practical challenges in ten case companies, and realising the deficiencies of current PPM theory motivated this explorative multiple case study. The principal results of this study involve revealing the need for a new potential PPM governance model that enables managing commercial and technical product portfolios over life cycle phases. A governance model framework, based on horizontal and vertical portfolios managed by two centralised teams, is proposed. Based on the data, and views of industrial experts, the created new PPM governance model has potential to aid business managers in understanding PPM as an entity that has a role in managing existing product portfolios and their renewal based on commercial and technical portfolios over life cycle as collaboration between business and engineering teams in all organisational levels.

## Keywords

Product Portfolio Management, Governance Model, Collaboration, Dynamic Decision Making, Product Life Cycle

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## 1. Introduction

Focus on fulfilling short term customer requirements over the past 20 years has resulted in vast amounts of incremental type of new products and product development projects. As a consequence, less pure new products, completely new product innovations to the world have been created [1]. A diverse product portfolio is seen as a way to increase sales and to fulfil customers' requirements [2]-[4], a leading trend where more products are introduced than removed. For example, according to [5] for each removed product, 1.8 new ones are added to the portfolio. These above described issues are potential drivers for many product portfolio management (PPM) challenges in industry. Overly broad product range can lead to mass confusion by the customers, thus weakening overall sales and the sales per product ([2] [6]-[8]). Also, unnecessarily broad product offering leads to product complexity, negatively impacting productivity, product development time and demand supply chain costs [9]-[11]. Company's product portfolio may expand or even explode rapidly due to simultaneous company mergers and acquisitions, e.g. [12]. A fundamental challenge in PPM is the lack of interest and understanding about the PPM concept by different teams of senior management.

The portfolio management approach has been practiced in many areas such as financial assets, projects, IT and products [2] [10] [12]-[20]. As discussed by many authors, the basics of portfolio management seem to be the very same: to oversee the rationale of many things which may or may not be dependent on each other. The product portfolio management can be seen as a platform resulting in strategic product and release road maps [21] [22] and to enable successful and constant incremental and architectural innovations [14]. PPM deals with market analysis, product development strategy and product life cycle management, both for existing and new products [21]. This is when product portfolio management (PPM) is seen as the supervising element of product management and requirements development at enterprise level [18]. In essence, product portfolio management is about strategic choices on markets, products and technologies [23]. The products in a portfolio can be classified in many ways; by customer segments, by technology generations, by product families, by hardware (HW), software (SW), services, documentation products, and such [24].

The organisational design and management practices have a direct impact on a company's performance for simultaneous break through initiatives and traditional enhancements [14]. According to the study by O'Reilly & Tushman [14] different organisational structures, management approaches, processes, and cultures are required to manage the existing business and simultaneous development of new businesses and products. Organisational structure classified as "Ambidextrous organisations" achieved over 90% of their targets while other three different structures were not as successful. However, regardless of line organisational models there is always a possibility of misalignment between organisational structure and product architectures, impacting the efficiency and capabilities of product development teams to develop the product platforms and related applications [14] [15]. According to [25] the more platform development impacts technical components, product architecture and sellable product items, the more crucial the existence of a cross functional steering body becomes. However, [26] did not find direct correlations between the organisation and governance models, and the success of the business. Instead, the more significant impact is seen to originate from the quality and systematic use of formal product creation processes rather than the organisational model [15] [26].

Dedicated multidisciplinary groups of people can potentially help R&D and enhance the required co-operation with operational business teams and functions such as marketing and sales, operations and services [1] [27]-[30]. Product portfolio management can ensure that major decisions about product development will follow the top management guidelines [21]. According to [27] the importance of PPM is appreciated the most by technology managers and by senior management, and the least among marketing and sales managers who operate at the customer front end. Instead, marketing managers prefer incremental innovations due to the shorter time-to-market, while technology experts look for more radical long term innovations [28]. According to [31] the product portfolio management decisions can be either objective or intuitive, depending on the management culture and the company's decision making processes. However, there is a clear correlation in the business results and use of portfolio management methods and tools for portfolio decisions [23] [32].

The aim of this study is to analyse and develop a new PPM governance model framework that will address the PPM challenges faced by case companies. The above discussion can be condensed into the following research questions:

RQ1. What kind of product portfolio management governance models are recognised in the current literature on product portfolio management?

RQ2: How are product and product portfolio ownerships organised currently in case companies?

RQ3: What kind of governance model is needed to enhance the collaboration of commercial and technical product portfolio owners over life cycle?

## 2. Method

The research was conducted as a qualitative, multiple case study, involving the research process shown in **Figure 1**.

As a first step, the PPM literature was reviewed to provide an adequate basis for the empirical case analysis. The literature review was focused on product portfolio management and line organisational governance models for managing the entire product portfolio both *horizontally over all product life cycle phases and vertically over all product structure levels*.

Based on the literature review the interview questionnaire of 163 questions was developed as a second step of the research. The questions covered PPM and product management methods, processes and tools, governance models, targets and key performance indicators (KPIs). In addition, PPM and product management connection to business processes were included. Total of 23 questions focused on product ownership and PPM governance model related analysis. These questions covered the issues such as who are the owners of the items on each product structure level and life cycle phases, how is the company organised as key functions and decision making bodies focusing on product management and PPM functions and possible cross functional steering bodies. In addition to qualitative data, some quantitative data was collected to obtain understanding of case companies' basic business figures, such as sales turnover, the size of the product portfolio at each product structure level, number of NPD projects, number of HW, SW and Services type of products, the size of the organisations, number of employees in each main function and key financial and other business related key figures.

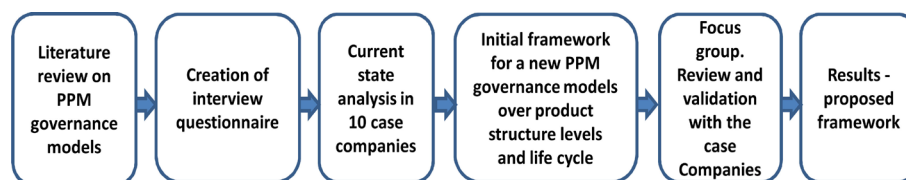
The current state analysis, the empirical research consisted of industrial interviews with ten case companies (**Table 1**) to clarify the current practices and challenges related to PPM governance models within each phase of the product life cycle and on each level of the product structure. The face-to-face interviews were recorded, extracted and transcribed to enable thorough analyses. Notes were taken and shared on a screen during the interviews to allow possible additional statements and corrections. According to [33], typical lifecycle phases include planning, introduction, growth, mature and decline from the markets' viewpoint. Due to the existing and practical wording by most of the case companies the life cycle phases were simplified to four: new product development phase (NPD), active product sales and delivery phase (maintain), spare part sales and delivery phase (warranty) and finally the last life cycle phase in where only the product data is stored without any business activities (archive).

After the literature review and empirical analysis the initial framework for potential new PPM governance model was created to enhance the collaboration of commercial and technical product portfolio owners over life cycle.

The developed initial framework was then introduced to ten case companies during a common face-to-face workshop. The case companies were used as a focus group to review and improve the created new governance model. Based on feedback and recommendations the framework was revised and proposed as a potential solution to manage product portfolios over life cycle and product structure levels.

## 3. Results

The current literature, briefly summarised in the introduction section defines the PPM as the management of products and related product development projects during the NPD phase of the life cycle by the executive level cross functional teams. Horizontally the current literature on PPM well covers the NPD phase. The later phases



**Figure 1.** The research steps and process.

**Table 1.** Characteristics of the case companies.

Case	Portfolio size	Product type	Business life cycle stage	Business type	Markets
A	Small	HW Services	Growth	B2B	Domestic
B	Large	Solution HW SW Services	Mature	B2B	Global
C	Small	SW	Growth	B2B & B2C	Global
D	Large	HW Services	Mature	B2B	Global
E	Small	Services	Growth	B2C	Domestic
F	Small	HW SW	Mature	B2B	Global
G	Medium	HW SW	Growth	B2B	Global
H	Medium	HW Service	Mature	B2C	Global
I	Medium	HW Service Solution	Mature	B2B	Global
J	Large	HW Service Solution	Mature	B2B	Global

of the life cycle such as maintain, warranty and archive have not been covered adequately. In the literature, product portfolio management is seen as the management of products, covering NPD phase and merely focusing on which product development activities and projects ought to be prioritised and executed. Vertically, the current literature discusses generally the “product” perspective of portfolio management. The meaning and the definition of the product as an individual item or group of items leaves room for many different views. The more detailed meaning of the product as sets of items on sellable and technical product structure levels of a product portfolio has not been clarified by the current literature. The literature leaves fundamental questions open relating to the product portfolio management overall life cycle phases and product structure levels.

### 3.1. The Case Studies

Ten case companies represent both large and global but also small and growing businesses with different type of products such as Solution, HW, SW, and Services. Very different case companies were selected intentionally to see potential differences in governance models. In larger companies, the interviews were conducted as several workshops including cross functional groups of managers, while in smaller companies only CEO, R&D, or Product Management type of managers were interviewed.

The company analyses revealed that the understanding of product and product portfolio ownerships has many alternative viewpoints. According to the interviewees, the product portfolio ownership means mainly business and technical responsibilities and is dependent on the consistent definitions of product portfolios. The concept of ownership is seen to require more clarity on responsibilities and expected activities. In a typical event, the case companies have simply followed their customers’ requirements and adapted accordingly by the means of new product development without paying attention on the growing size of the product portfolio on many product structure levels and over product life cycle phases. Lack of clear portfolio understanding and ownerships decreases the capabilities of efficiently managing and communicating product portfolio changes, and weakens cooperation with the main stakeholders such as R&D, Sales and Marketing, Operations and Services, not forgetting customers, suppliers and other essential stakeholders.

The interviews revealed that the smaller the company is, the simpler the product portfolio is, and the lighter the governance model. In a new growing company, the product portfolio management is typically looked after by CEO. As stated by the CEO of one of the smaller companies “there are no clear agreement of the product

ownerships, in practice CEO has taken the owner role both in commercial and technical side of product portfolio”.

One case company was establishing a new PPM team by grouping existing product managers together as a centralised team. An interesting observation entailed the very different roles of product managers. For example, a Head of New Product Management Team stated: “Product Managers own sales items but the ownership of other sellable levels in a commercial product portfolio are not clearly specified”. The way they were organised differs a lot as well. Product Managers were located in R&D, Business Lines or in Customer Teams depending on their responsibilities. In some cases the even bigger surprise is the complete lack of these roles. The Owner of the Product Development Processes in one of the companies stated: “There are no Product Managers named in the company, what should they do?” Hence, it seems that one very expected product management role has nearly completely been ignored, the awareness and management of the product profitability. This results in fundamental questions in terms of governance models.

Only in the largest case company there is a separate PPM team organised in addition to product managers in business units and business lines. Nevertheless, the new PPM team still had challenges in applying their role and in getting visibility over the entire product portfolio. A member of the PPM Team described the decision making environment as: “The highest product investments and product family decisions are prepared by Portfolio Decision Team for the decision making by Executive Board. Lower investments can be decided on product program level by the Program Management Team. Product decisions inside product families are done by business lines.”

In most cases the product ownership can be also be seen as very collegial and covered by the executive board, or a cross functional management team, without dedicated role nominations. The Vice President for the R&D stated: “There is no PPM function organised but CEO, COO and R&D managers form a cross functional board.” However, regardless of the size of the company and its product portfolio, there are ambiguities surrounding the ownerships and governance of products and product portfolios. The overall challenge is in arranging reasonable time and resources for PPM. The case companies’ current product portfolio management practices are summarised in [Table 2](#).

Based on the evidence, an improved and more consistent understanding of the PPM concept might be needed regardless the way the case companies have organised their decision making. Some key product decisions are made only at business line/product manager level or even within customer account teams without the strategic and financial analysis of products from the viewpoint of the entire product portfolio. As stated by the Director of the Product Platforms: “The Product Board focuses on customer project specific topics only, cross projects coordination does not exist at all.” As an example of the more developed PPM approach the Vice President for Product Management pointed out the main focus areas of the meetings: “The agenda topics in cross functional meetings are technology and product road maps and sales opportunities”.

The relationship between financial success of the company and product portfolio management governance models might be unclear. This was emphasised by a Product and Engineering Process Owner: “The agenda topics are research, innovation and development issues, road maps, specific themes, patents, major milestones of R&D programs and some individual R&D projects. Sales, costs and profitability issues are not discussed here.” This is a bit strange as on one hand the executive board of the company is responsible for the competitiveness and financial success of the business, but at the same time they may have un-clarity about which products are competitive, fit the company strategy, and are profitable.

On the *vertical direction*, the governance over product structure levels, the fundamental borderline can be seen between the commercial product portfolio and the technical product portfolio ([Figure 2](#)). The commercial product is more familiar to teams working in marketing & sales, product management and with customers. Technical side of the product portfolio is better known by product development and engineering, manufacturing, testing purchasing, logistics teams and suppliers. As commented by the Head of New Product Management Team: “Five Product Managers are named as product owners to own commercial parts of products. Technical structures are owned by the Product Owner in R&D.” In the case companies, the number of product structure levels varies between 3 - 9 depending on the complexity of products and fragmentation of line organisations and design teams. The more complex and deep the product architecture is, more unclear are the related ownerships on commercial and technical items over product families, product configuration items, sales items, version items, common modules, common platforms, subassemblies and the lowest level of components. The more extensive the offered solutions and systems are, more they are seen to cross the borders of possible sub-product portfolios,

**Table 2.** Current product portfolio management governance practices in case companies.

Case	Product portfolio decision and governance bodies	Product and portfolio owners	PPM team exists	Product managers exist
A	CEO	CEO	No	No
B	Executive board, portfolio decision team, business line management team, product program team	Sales items: Product managers; Other sellable levels: No named owners; Technical HW platforms: HW related R&D teams and “clusters”; HW component platform: Component technology team	Yes	Yes
C	A cross functional board	Commercial product portfolio: chief operating officer, COO; Technical product portfolio: R&D manager	No	No
D	A cross functional “equipment development and offering steering	Commercial product portfolio: CEO, product managers and other executive board members; Technical product portfolio: Main designers (purchasing can sort and change HW components creating additional challenges)	No	Yes
E	Board of directors	VPs of business units	No	No
F	A cross functional team	Commercial product portfolio: A cross functional team; Technical product portfolio: R&D management in co-operation with demand supply chain management	No	No
G	A cross functional steering	Commercial product portfolio: Product managers—technical product portfolio: Product owners working in R&D; Product road: R&D manager	No	Yes
H	Executive product steering committee, product steering committee, product committee, product management	Commercial product portfolio: Product managers in the sales and marketing function; Two global technical product platforms: Two “global model owners”	No	Yes
I	Product development and technology team	Product managers own functionalities and requirements of products but are not nominated as product owners. Technical SW and HW platforms are owned by platform owners. Technical item structures and BOMs are owned by main designers for single products	No	Yes
J	Product board	Commercial product portfolio: Product owners; Technical product portfolio: Chief engineers in development phase and product technical owners in maintenance phase	No	Yes

resulting in more challenges in final ownerships, both from sales recognition and technical viewpoints. The R&D Manager described the ownership challenges as follows: “Technical product portfolio and structures are owned by Main Designers but Purchasing can sort and change HW components which creates functionality challenges.” In addition, the product portfolio ownerships can be fragmented due to organisational structures over business units, business lines, product design competence areas, development projects and steering bodies. This makes the overall visibility and control over vertical product portfolio even more challenging.

*Horizontally*, the individual products should be managed *based on their life cycle phases*. The number of life cycle phases, in the case companies varies from 3 to 9. In the smallest companies and in most simplified cases they only include development, active sales, delivery, and removal. In larger companies the life cycle phases are defined in more detail, including phases such as create, implement, ramp up, maintain, ramp down, care and obsolete. The ownership of a single product can stay the same or is changed along the life cycle phases. However, the product portfolio life cycle phases were not clearly defined for all product-structure levels resulting in additional ambiguity in the ownerships. The case companies seem to pay more attention on new product ramp ups than older product ramp downs resulting in un-planned growth of product portfolios and product cannibalisation. This is regardless of the ideal situation, from the portfolio management perspective, being a more synchronised approach. Individual products, single components, modules and units are management independently with a very light connection between sub-portfolios, and other products within them. The length of the product life cycles are planned in few cases only, most of them involving consumer products.

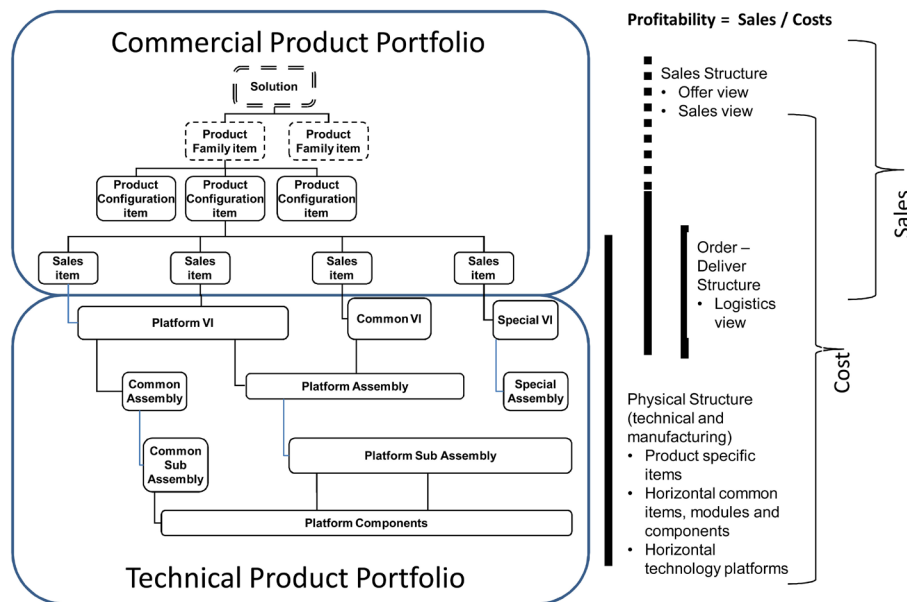


Figure 2. Product structure, commercial and technical portfolios.

### 3.2. The Proposed Framework

The foundation is that: product portfolio management should aim at strategic and cost efficient renewal of product portfolios by adding new products to the product portfolio, enhancing and modifying the existing products, and removing non-competitive products.

In order to respond to the challenges such as unnecessary product portfolio explosion on different product structure levels and over life cycle phases in the case companies, the governance model ought to acknowledge *product structure levels vertically*, and *life cycle phases horizontally*. In addition, the framework for product portfolio management should tackle challenges, regardless of the way companies are organised, and should not be dependent on the size of the company and its portfolio.

Product portfolio renewal requires strategic product portfolio management over vertical and horizontal sub-product portfolios. Ideally, the horizontal and vertical product portfolio renewal would occur in balance and synchrony with new product introductions and old product ramp downs. The renewal of commercial portfolio is seen by the customers in the form of new or enhanced solutions, product families, product configurations and sales items. Within the technical portfolio the renewal occurs on main assembly, sub assembly and component levels, ones that are not always visible or directly linked to the renewal of commercial sub-portfolio levels. For example, product cost reduction efforts are not visible on the commercial side but only on the technical side. In order to leverage the benefits of technical platforms and commercial applications, both technical and commercial sub-portfolios need to be managed over life cycles as a collaboration of business and engineering teams, under the supervision of companywide product portfolio management.

The proposed new product portfolio governance model framework should respond to the idea of continuous product portfolio renewal. The framework assumes frequent horizontal flow of products and items in all product structure levels from NPD phase to later phases of the life cycle. Also, for the framework to be effective, product portfolio, sub-portfolio and item ownerships are necessary to be agreed and communicated on all product structure levels and over life cycle. The developed framework for PPM governance model, one that acknowledges all product structure levels, over life cycles, can be founded on four main enablers:

- Vertical sub portfolios and their owners according to product structure levels
- Horizontal sub portfolios and their owners according to product life cycle phases
- Product Portfolio Management Team consisting of vertical and horizontal sub portfolio owners chaired by Head of Product Portfolio Management
- Product Portfolio Management Board consisting of executives of business processes and functions, chaired by CEO and assisted by Head of Product Portfolio Management



The recommendation is to first describe the common product structure and vertical sub-portfolios accordingly, including companywide owners for them. Vertical sub portfolios can be created based on common product structure levels from the highest solution layer to the lowest component layer (Figure 2).

Horizontal sub portfolios can be created based on four product portfolio life cycle phases: New Product Development (NPD), Maintain, Warranty and Archive. The focus of NPD portfolio is on product concept development, design and engineering. Maintain portfolio covers ramp up, active sales and delivery and ramp down phases of product life cycle. Warranty portfolio focuses on spare parts and care service businesses. Archive portfolio controls legally required product data archive for obsolete products. By using this type of two dimensional governance model the relation and the management between vertical and horizontal sub-portfolios can be better ensured.

To enable the functioning, and effectiveness of the proposed framework, vertical and horizontal sub-portfolio owners need to be assigned simultaneously with Product Portfolio Management Team (PPMT). Vertical sub-portfolio managers are responsible for vertical sub-portfolios, over product structure levels, from solution sub-portfolio to lowest component sub-portfolio. Accordingly horizontal sub-portfolio managers are responsible for horizontal sub-portfolios, over life cycle phases, from NPD sub-portfolio to Archive sub-portfolio. PPMT, headed by product portfolio manager, manages the product portfolio renewal and related analysis, reviews, and prepares the decision making. PPMT owns and develops the PPM concepts, processes and tools. PPMT owns the agreed vertical and horizontal portfolios, communicates the targets, KPIs and the progress of the portfolio development within the organisation and relevant stakeholders.

The fourth enabler in the framework is the Product Portfolio Management Board (PPMB) as a highest decision making team. By nature PPM impacts the content of all business processes, thus the members of the board are proposed to be CEO, Heads of Sales, Product Management Teams (PMTs), Operations, Care, R&D, F&C and Product Portfolio Manager. PPMB meetings are potentially chaired by CEO and assisted by Product Portfolio Managers. PPMB is responsible for PPM targets and KPIs, and decision making according to agreed criteria, processes and tools. The proposed new product portfolio governance model framework should respond to the idea of continuous product portfolio renewal (Figure 3).

The proposed governance model framework is reviewed and discussed within a common work shop with all case companies. The proposed new framework was seen potential both for smaller and larger companies due to “fact” that the vertical and horizontal portfolios (over product structure and over product life cycle) need to be

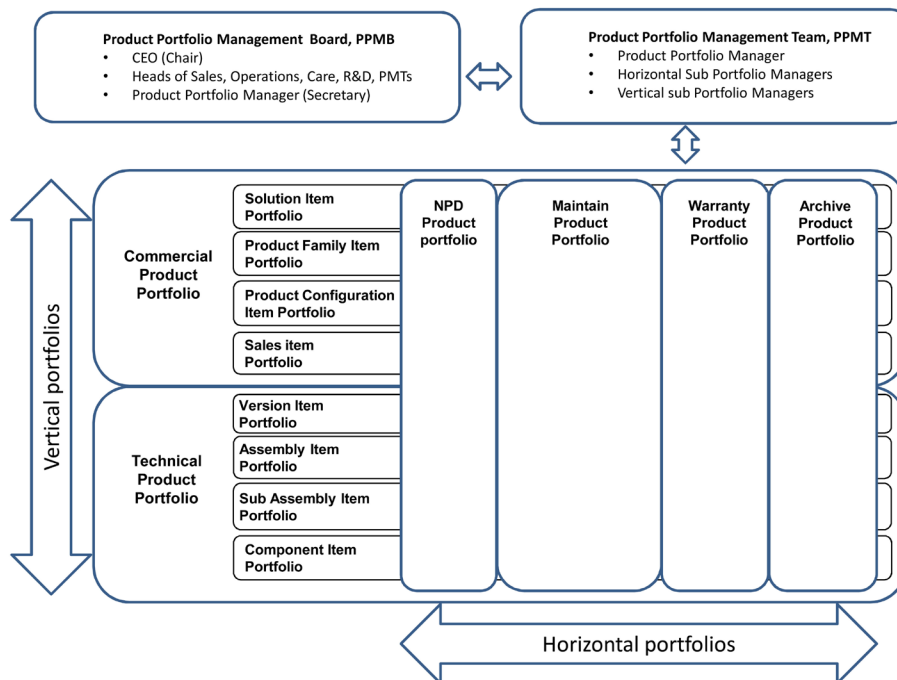


Figure 3. The developed framework for Product Portfolio Management Governance.

managed regardless the size of the company or the number of employees. The proposed framework is currently heading toward real-life piloting and relevant training has been initiated. The case companies are introducing the framework and developing it for their purposes.

#### 4. Conclusions

The current literature on PPM covers well the NPD phase of the product life cycle including related product portfolio management targets and KPIs, processes and tools. PPM decisions are seen as the responsibility of executive level cross functional teams. However, there are no practical descriptions of the PPM governance on how to manage the product portfolio both *vertically over product structure* levels and *horizontally over all life cycle phases*.

The company analyses revealed that product ownership is not always clear. Hence, the definition of ownerships may require more clarity on responsibilities and expected activities. In smaller companies the ownership of the products is clearer and often adopted by the CEO. In some growing case companies the product managers are nominated as product owners for the commercial elements. Technical structures are owned by separate product owners in R&D. The more extensive the offered solutions and systems are, more they are seen to cross the borders of possible sub-portfolios, resulting in more challenges on final ownership, both from sales recognition and technical viewpoints. Product ownership and management focus more on the level of individual products only leads to growing portfolios, un-healthy competition between products and too long and un-profitable life cycles. The entire product portfolio and sub-portfolios are not clearly defined vertically over the product structure and horizontally over life cycle.

A framework for PPM governance model was created based on four enablers identified to support implementing PPM governance model vertically and horizontally over product structure and life cycle. The enablers for the framework include vertical sub-portfolios and their owners, horizontal sub-portfolios and owners, Product Portfolio Management Team (PPTM) and Product Portfolio Management Board (PPMB), all companywide and over functional organisations and teams. This type of governance model framework may have the potential of enabling effective and strategic product portfolio ownership and management.

The managerial implications of this study include the potential new PPM performance management framework as a precondition for improving PPM practices in the case companies. The findings can aid business managers to collaborate actively with engineering teams, and in understanding PPM as an entity that has a role in managing products and portfolios based on strategic and financial targets over all product structure levels and life cycle phases according to well described vertical and horizontal sub portfolios.

The limitations of this study include analysing a limited number of case companies with a low maturity level of companywide PPM ownership, analysis and decision making practices. Due to the existing overall lack of knowledge on the PPM concept, the developed and validated PPM governance model framework will not be enough for the case companies to implement proper detailed PPM practices. It will serve as the second critical step after setting strategic targets and key performance indicators for establishing PPM governance over product structure and life cycle based on company strategy “innovation portfolio”. The earlier life cycle before NPD portfolio, was excluded from the scope of the study due to the already wide end-to-end life cycle scope, from NPD phase to the removal and final archive phases.

Fundamental questions were raised during the analysis, ones that might prove worth further research, including 1) can product portfolios be more visualised vertically and horizontally to increase the understanding on the related PPM challenges and points for management attention; and 2) what kind of processes and tools could serve both the vertical and horizontal analysis and decision making; 3) what kind of product structure, configurability and modularity would enable more efficient productisation and renewal of the product portfolio?

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