



MBA Thesis

Definition of a methodology to analyze the Product Portfolio Management

Example analysis of the cloud computing
market PPM

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The author(s) declare(s) that they have completed the thesis work independently. All external sources are cited and listed under the References section. The thesis work has not been submitted in the same or similar form to any other institution(s) as part of another examination or degree.

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Abstract

Companies invest their resources into different products. That constellation of products, how they interact with each other, and how they are positioned defines the company's Product Portfolio. Moreover, that constellation of products is critical for the company's financial success.

The Product Portfolio evaluation is essential to assess if the company's resources are invested in the most efficient way or if there could be some optimizations that would improve the results. A key outcome is that in order to optimize the Product Portfolio, a company must first evaluate and characterize that portfolio.

This work aims to define a methodology for holistically evaluating a company's portfolio by analyzing different parameters. This new methodology will be used in an example market. In this work, we ran the evaluation in the cloud computing market, a new market that is still growing but with few remarkable players that account for more than 50% of the market's total revenues.

In the analysis of the cloud computing market and the main suppliers in the market, we will apply the suggested methodology. That would enable to summarize the main characteristics of the leading players' portfolios and provide optimization recommendations that would improve the portfolios' quality and ultimately the results of those companies.

Keywords: Product Portfolio, Product Management, Product lifecycle, cloud computing market

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List of abbreviations

ADL	Arthur D. Little
AFC	Average Fixed Cost
AG	Applied to companies in German-speaking parts, it is the equivalent to incorporated.
AI	Artificial Intelligence
AWS	Amazon Web Services
B2B	Business to business
B2C	Business to consumer
BCG	Boston Consulting Group
CCPM	Critical Chain Project Management
CRS	Constant Returns to Scale
IRS	Increasing Returns to Scale
ML	Machine Learning
MRPL	Marginal Rate of Productivity of Labor
NEER	Nominal Effective Exchange Rate
NPD	New Product Development
NPS	Network Performance Score
PPF	Production Possibility Frontier
PPM	Product Portfolio Management
PSUs	Public Sector Undertakings
SLR	Statutory Liquidity Ratio
TP	Total Productivity
VMPL	Value of Marginal Rate of Productivity of Labor

I. Introduction

The companies' resources are limited, and the big challenge is to find the optimal way to invest those scarce resources into different available projects. In a product-oriented company, the needs for different users are streamlined in order to serve different customers with a standard solution (product) [1]. In those conditions, the company must choose to invest resources among different products, and the challenge is to have the most efficient constellation of products (the product portfolio).

While it may be more exciting to think about new products in an isolated way and wonder about those new ideas as the drive for the revenues, the current portfolio is a critical element in most established companies' financial success. Even to develop new products [2], it is crucial to evaluate the product portfolio to optimize the resources' use in the best possible way [3].

Therefore, it is vital to have a deep understanding of the product portfolio to invest resources efficiently. Only then we could maximize the investment into the most profitable products and combinations of those.

However, the product portfolio is an extensive and complex topic. It is not easy to characterize a product portfolio of a specific company or market [4]. In this work, we will develop a methodology that defines the main portfolio characteristics that would enable us to benchmark different portfolios of different companies in the same industry and understand the weak points for those portfolios. In order to keep the scope more focused, we will evaluate this methodology in a specific market. In subsequent studies, this effort of understanding the product portfolio efficiency can be extended to other industries.

I.1. Problem and current research presentation

Several studies analyze the importance of the product portfolio and its links to the company's performance [5]. Hannila analyzes how to obtain the maximum performance in an organization is a prerequisite to have an in-depth knowledge of the products. Of course, the portfolio design is the culmination of the product understanding by elaborating relationships among the products and creating an ecosystem to maximize the company's performance. [6]

In line with Hannila, Tolonen focuses on evaluating the portfolio's role for the company profitability [3], where the accent is in how the life cycle management can improve the portfolio and, consequently, the financial performance of the company.

In addition, Rojas identifies the portfolio as a determining factor for the company's performance and tries to optimize the portfolio by integrating different phases in the end-to-end delivery process. [7]

Therefore, it is clear that a company's profitability depends on the portfolio's design, and it is clear that optimizing the portfolio is a way to improve the company's results. Moreover, the previously mentioned articles are examples of improving specific aspects of the portfolio to enhance the company's results.

However, it is missing in the argumentation that if the portfolio were critical for company performance, we would need first to understand and characterize the portfolio to improve it.

In that regard, there is literature about how to create from scratch an optimized portfolio that would boost performance [8]. However, rarely we can start a portfolio from scratch, and we instead need to characterize something that is already partially available.

A classic example to identify and develop some architecture on the portfolio is the Boston Consulting Group Matrix that creates some categories within the portfolio and, based on those, the investment decisions can be tuned. There are classic studies about the efficiency improvement of the BCG matrix. [9]

Some studies provide some links between the markets and the products to make a more optimal portfolio design [10]. This links very well with the classic BCG analysis by providing rules to optimize the portfolio.

However, previous studies provide some optimization examples, but they do not characterize or identify a portfolio. They provide some recipes on how to improve bits and pieces, but there is no holistic approach. If the portfolio is essential for the company's performance, the analytical approach would be first to understand the portfolio. The next step is to identify the different components or characteristics of a portfolio to perform a full study. Lastly, the company must analyze how to change specific components of the portfolio to improve the company's performance. Without a full view and understanding of the product portfolio, the company's performance would be suboptimal.

1.2. Problem discussion

So, the main question before optimizing the portfolio is to understand it. Some studies aim to characterize the whole portfolio's view. An example is the work by Aversa, where the focus is on the business model chosen and how to adapt the portfolio. [11] In addition, other work like the one by Tudor analyses the entire portfolio and analyzes individual products and the adaptation to the market requirements for each product [12]. Moreover, we can also cite Yu's work as an effort to describe the whole portfolio; in this case, patterns are identified on how to link the customer preferences with the portfolio design. [13]

These articles show several similarities, such as the portfolio analysis from a qualitative perspective and the focus on specific phases of the product's life cycle, i.e., new product introduction, to keep the portfolio design optimized. However, none of these papers discusses how to understand the structure of a given portfolio. One of our work goals would be to get a more comprehensive understanding of the product portfolio and identify all the components that form the product portfolio and hierarchically structure them.

Once the portfolio's structure and hierarchy are settled, the goal would be to identify the different weaker components or where an improvement effort would have a more significant impact. The current literature available for product portfolio optimization focuses on the dynamism and specific circumstances to modify the portfolio structure [14] [15] [16]. However, from that work, we also miss the aggregated perspective to analyze and optimize the portfolio from a static perspective. Another critical point is that the portfolio is an extensive term, and it is not concrete to "optimize the portfolio". If we could at least identify the parts of the portfolio that need urgent action, it would significantly simplify the optimization work.

We can represent the idea in a simple chart:

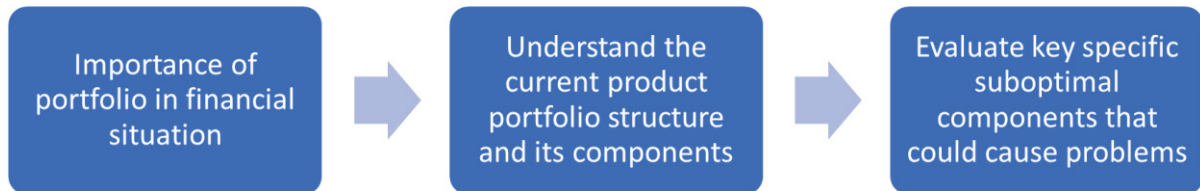


Figure 1 Structure of the thesis proposal

With that structure, we can present the required research question to be answered

- How can the portfolio be analyzed to achieve an optimized design?

Our goal would be to have a full hierarchical characterization of a product portfolio and, based on it, we could identify the weakest portfolio components to enhance it and ultimately invest the scarce resources optimally.

1.3. Problem formulation and purpose

The next point would be to define how we could approach this task and what would be the best way to structure our study. The problem under investigation of the product portfolio analysis is pervasive, and it is not possible to cover a full methodology and validate it widely in any market. Therefore, we will follow an example to evaluate competing companies' portfolios in a specific market, in this case, the cloud computing market.

Also, to perform a complete verification of the methodology, we shall conduct a validation round with some portfolio management experts to evaluate the work's validity. An important point would be that the required interviewed people should ideally not have knowledge in the cloud computing industry, as the thesis instead focuses on portfolio management, and cloud computing is an example of an application of our methodology. If the experts had previous knowledge in the area, there could be a bias in the answers. Simultaneously, the goal would be to focus on the portfolio evaluation and not on the market knowledge itself.

The market under evaluation must be still young and growing as, in a young market, the portfolios remain very dynamic, and a growing market generates much more attention than other markets.

We have chosen cloud computing as a reference industry as it fulfills several points that make it interesting for portfolio evaluation. On the one hand, it is a relatively young industry, barely ten years old. In those circumstances, it is a blooming industry where there is still room to optimize the different portfolios. In the same direction, the cloud computing business is growing fast, at a pace of 30% per year, which forces the market to remain very dynamic, as the growing possibilities involve new strategies and products [17]. So, year after year, the companies offering cloud would need to adapt

their portfolios. Moreover, the market is already of considerable size (300 billion USD), therefore although still dynamic, it is already a market of considerable size.

Another critical point that makes cloud computing a perfect playground to be analyzed is that the market is concentrated in a handful of companies, making it more manageable to perform a detailed portfolio analysis of the main competitors. In fact, three companies, namely Microsoft, Google, and Amazon, own more than 50% of the whole market revenues [18]. Moreover, cloud computing is a crucial market, and it will become a critical area that potentially will influence many other industries [19].

1.4. Delimitations

The topic covered is pervasive; therefore, the paper will identify a product portfolio's optimal design for a given ecosystem. Portfolio analysis has an extensive scope and may require specific market or technical knowledge, which is out of the paper's scope, as the aim is to stay in a generic perspective. The goal is not to go into the portfolio design details but to extract the necessary parameters.

As previously discussed, the desired outcome would be to develop a methodology to identify the product portfolio components and have them weighted in a hierarchical structure. The methodology shall be initially validated but not widely verified.

In this work, we will focus on the cloud computing market to run our portfolio evaluation.

1.5. Thesis structure

The first part of the thesis would include reviewing the available literature to analyze the research community's status in the selected topic. Based on that, we can conduct an evaluation based on the up to date knowledge.

In the following chapter, we shall evaluate how the study will be performed for this thesis. This phase will describe how the different information will be collected and the study's different phases.

In chapter 4, we will present the analysis results, which shall include the application of the methodology to a use case and the result of the interviews.

In chapter 5, we will analyze the results and the links to our presented methodology, and at this stage, we could identify the weak points of the analyzed cases and propose some changes.

Finally, in chapter 6, we would make the conclusions of the whole thesis, evaluating the results and verifying if the research addresses the goals that we set at the beginning and if the selected methodology was appropriate to run the whole thesis.

2. Theoretical framework or Literature review

How can the portfolio be analyzed to achieve an optimized design?

Our research question and thesis work are focused on presenting a conceptual way for evaluating the product portfolio. The analysis will be based on several parameters that will help to characterize the portfolio. However, one of the first points to get a clear view is understanding the current research performed on Product Portfolio Management.

2.1. Product Portfolio Management (PPM) Literature

When working on an existing product portfolio, it is critical to have a life cycle management for existing products. When talking about products, it is essential to understand the life cycle of individual products. Tolonen covers it and mixes the performance's emphasis with a much more aggregated view and tries to cover the whole product life cycle. In general, most of the literature focuses on specific moments like new product introductions. [3] One outcome of the article is that there is pressure to introduce new products in the organizations while the phase-out of products is not well handled, which causes unbalanced portfolios. This article focuses on performance and life cycle beyond new product integration. It considers the products as relatively static. It does not leave the door open for changes in the products to adapt to the market changes.

The previous paper shows a typical example of how the research tries to deal with portfolio optimization by checking specific situations. However, we are interested in a more holistic approach, and several authors have focused on performance as the main driver to define the portfolio. Hannila makes a very detailed analysis of how the performance must be analyzed to achieve the right decisions at a product level. In contrast, if the performance is analyzed only at the company level, it would be complex to make individual product decisions. [6] the analysis is focused on the portfolio's performance within the market and how well the portfolio may address it. In this case, it is evident that only by looking at the financial performance, some essential factors in the company could have been left undiscovered.

Based on the previously mentioned articles, it is evident that Product portfolio management (PPM) is crucial for industrial success in financial prospects. PPM needs to be adjusted as per current market possibilities and available assets in the industry, such as workforce, capacity, and industrial tools. New product introduction can be an outcome of market demand, but it should not overlook the complete product portfolio. It should complement the available portfolio but not at the price of damaging the portfolio coherence, which may have adverse financial consequences. In that regard, it is also interesting to analyze some articles that analyze the portfolio structure's coherence. These articles emphasize the importance of a well-structured offering of products and required product portfolio management.

A structured and well-defined Product portfolio is essential for industrial success. This has been realized by Wind & Mahajan [4] and published an article 'Designing Product and Business Portfolios'. The published article explains four different models based on the growth/share matrix, the business profile matrix, the business assessment array, and the directional policy matrix. Wind & Mahajan pointed out nine different approaches to assist in the selection of an appropriate model. We have used those factors in our portfolio analysis and are listed in appendix 7.1. The article presents a framework as a need to structure the portfolio, and the article also highlights the importance of product portfolio analysis based on driver selection and level. It also helps to understand operational challenges and a possible solution. For example, the location of a portfolio - in any portfolio analysis, the most time-consuming task is the collection of data on the products or other items in the portfolio. Then for

product portfolio management, the authors suggest having a tailor-made approach. Maybe it can cost more, mainly in data requirements and management time, but it can be a perfect fit for targeting the business portfolio industry.

As mentioned, it is vital to fill the gap between an optimized portfolio and positive financial results. To understand the importance of product portfolio management in terms of business and profitability, we have reviewed P. Aversa, S. Haefliger and D. Reza 'Building a winning business model portfolio' [11]. The article addresses how companies can achieve high performance from a portfolio of business. In this article, the authors formulated three questions to build a winning business model - What should be considered when thinking about business model diversification? How can we assess and optimize its value? Moreover, how should you modify your business model portfolio over time? Authors recommend that companies should share valuable assets such as financial and knowledge resources across different business models. This will help to optimize costs by making the portfolio more open for offerings. When looking for a new business model, managers must ensure that the new business models utilize available resources and capabilities. The authors also emphasize doing continuous market study and development to have an updated product portfolio. They have analyzed Amazon's business model from 1995 to 2016 in this article. It ends by focusing on maximizing the complementarity across a business model portfolio. It is essential to identify the relationships between the different business models' resources and capabilities and their performance impact.

It is easy for big and well-established companies to have new resources and update their product offering by adding new products. Most of the time, adding a new product is a market-driven approach and can be more profitable if it is performed by keeping other available products in structure. This is presented in the article Product Portfolio Management: An Important Business strategy, [20] by M. Doorasamy. He has presented different models as a relation between product portfolio management and new product development. The article started with gapping product portfolio values done by analyzing the value of the right product portfolio and realizing the possible full potential that can be extracted by managing the product introduction. Marked by M. Doorasamy, approximately 80% of all new products failed per year.

M. Doorasamy shows some practical consequences of his study, and he mentions that the companies that launched those products suffer financially. Furthermore, in the end, a layoff or complete shutdown of the company occurs. M. Doorasamy [20] has explained Four models for PPM. The first model is "Blue Oceans-Red Oceans Strategy", which focuses on providing a market for a new environment with more opportunities. In this model, a six-path framework is presented to address six critical feathers of the product portfolio. The red ocean represents the key segment's focus, and the blue ocean shows guidance to achieve results. The second model represents cross-functional work possibilities. All project teams using the available products and have total support from top management to create an offering to the customer. In this way, they can work in different market segments without higher investment in new products. The third model is a visual representation of how the problems encountered by organizations. Also, how in the new product development process feed each other to get overall economic success. The fourth model shows best practices for product portfolio management is doing the right projects the right way. This model focuses on the importance of decision-making guided by best practice 'the right projects the right way'.

These models present an interesting idea that the portfolio is influenced and at the same time influences other factors than the pure product dimension. Therefore, there is a concept that we name the extended product portfolio, in which we are not referring only to the products themselves but to all the parameters in a company that could determine the success of product success or failure. This concept will be used in chapter 3 to define the critical dimensions to evaluate within a portfolio.

This relationship between portfolio management and other corporate factors can also be represented by the influence of management and decision-making on portfolio management. In product portfolio

management, decision-making plays a vital role in resource allocation, especially for small companies. McNally describes a "new" way through the "New Product Portfolio Management". While this way of just adding "new" to something which was always there, just because things are more cross-functional nowadays (this could be applied to everything). [21] In his first article, McNally presents product portfolio management as a critical topic that heavily impacts the whole organization's performance. Also, there is a well-developed link between the portfolio and the management and how they influence the decisions. McNally points out management and their decision making as a critical aspect for portfolio management. In her second article, McNally makes a more in-depth analysis of the decision-making and management personality as an important motivation for the portfolio. [22] It is still fascinating that we focus on decision-making and how management plays an important role. This opens a new dimension in how the management, through leadership and personality, can influence decision-making when introducing new products.

We realize that there are many factors that directly or indirectly affect PPM in the industry. To understand those factors, we have reviewed several articles, and one of them is based on explaining organizational factors that influence new product success [23]. The authors develop testable hypotheses by integrating new products and alliance literature. In the article, we can perceive a constructed and presented cooperative competency derived from related concepts of mutual adjustment, absorptive capacity, and relational capability. These parameters are the critical factor for new product development success.

These articles point us already in the direction of how the portfolio can be assessed by checking different companies' parameters. This will be applied in the methodology discussed in further chapters, and this structure was also described by Larry P Pieshko [24]. He focused on addressing contemporary marketing strategies' complexity and originality and presented an updated version of Ansoff's product-market growth strategic matrix, with nine distinct growth options replacing the original four options in Ansoff's model.

Once the portfolio structure is better organized, it is also required to give some hierarchy to that structure as not every parameter would be equally important. An article presented by Henrik et al. [25] can help us understand that relative importance as it analyzes critical success factors for new product development, which we can also use for portfolio assessment. First, it recommends analyzing and synthesizing those factors through a literature review of the research on the front end in new product development (NPD). This is what we have focused mainly on in this section.

This article also proposes implementing a framework that features two types of success factors: foundational success factors common to all the ongoing projects and project-specific success factors for all individual projects. In this article, the authors proposed to have a better product/project definition. NPD begins when relevant key actors in the firm recognize the potential of an idea to lead to product development. The front end of NPD concludes with the go/no-go decision for a proposed product. The decision to begin or to abort product development is made concerning the robust product definition. This means that the robust product definition exerts a powerful influence on product development. This article uses a literature review on the front end in NPD as the inspiration for the creation of a front-end conceptual framework. This is what we have focused on in section 3.4.2. The framework is built on two success factors for front-end activities: foundational success factors and project-specific success factors. The framework also highlights the interplay between these success factors relevant for firms working with new product ideas and concepts, regardless of firm size.

The literature has a significant interest in New Product Development, and although this thesis is not focused on that space, NPD provides us hints to perform a holistic portfolio structure. A new product launch requires a previous assessment of the existing portfolio, and obviously, a new product launch has a significant impact on an existing PPM. Calantone et al. [26] explain Controllable Factors of New Product Success. The article is presented by keeping the international environment in focus for

product development. The product is launched for the global market where product quality and accessibility are described and discuss different trade challenges and complications. The article explained three critical factors, first to develop a model of factors associated with new product success. Second to directly compare the factors that managers perceive to be associated with new product success in the United States and China. Moreover, the third one demonstrates the application of various statistical analyses for increasing the confidence that may be placed in empirical findings and outline methods for assessing whether significant estimation biases exist in cross-sectional data. United states and china were in focus in this article, but most of the parameters are common and can be used between other countries' trade.

Calantone highlights the need for analysis in marketing research, salesforce, distribution, advertising, and promotional resources when new products are launched in the market. Also, technical resources and skills are positively linked with proficiency in conducting technical activities. Furthermore, to do that, first, sufficient R&D and engineering resources and skills are related to proficiency in performing technical assessments, designing products, and manufacturing products. Second, higher proficiency in marketing and technical activities leads to a higher level of the new product. Third, it is essential to collect and assess the market and competitive information to understand customers' needs, wants, and specifications for the product.

This view of the portfolio structure is vital when analyzing the portfolio in chapter 3.

2.2. Methodology literature

Our selection of methodology and formation of arguments is based on 'Research Methods for Business Students' written by M. Saunders [27]. This book helps us to find a suitable methodology to formalize our research work. This book explains the difference between quantitative and qualitative research methods, also, an explanation of the logical analysis and frequentist probability.

In order to validate our methodology, we performed interviews with experts in portfolio management. These interviews need to be carried based on a structured methodology. We have worked on a mixed-methods approach, similarly presented by E. A. Berman, "An Exploratory Sequential Mixed Methods Approach to Understanding Researchers' [28]. In this article, the authors explain a sequential mixed methods design characterized by an initial qualitative phase of data collection and analysis, followed by a quantitative data collection and analysis phase, with a final phase of integration or data linking. To understand how theoretical methods can be explained more in practice, we reviewed the article 'Using Mixed-Methods Sequential Explanatory Design: From Theory to Practice [29] that explains the outlines of steps for graphically representing the procedures in a mixed-method study. We have also included those graphs in our research work.

The mixed methodology approach seems more appropriate to answer our research question and to map a good coherence between our methods and used research articles, and we have reviewed a few more articles. One is presented by Ronald [30] and his co-authors. They bring different elements of qualitative research papers into coherent textual patterns. In this paper, four editors of The Qualitative Report present how they collaborate with authors to facilitate improvement papers' coherence in such areas as co-relating title, abstract, and the paper proper. The key is the coordination of the method employed and calibrating the exuberance of implications with the essence of the findings.

3. Methodology

3.1. Define the type of study

Depending on the philosophy associated with the research, there would be different possibilities [31], and in this case, we are confronted with the research question.

Given that the study is broad, it involves a complex topic, and as we cannot just go to the details directly, the most sensible way to approach the study would be with a combined purpose. Besides, we must consider that in our initial phase, we considered several phases in our thesis. It may be logical to match the different phases of our study with different methodologies or ways to approach every phase. As a summary, the different phases that we aim to cover in our study are the following:

- Structure of the product portfolio in different components and hierarchies
- Identify the importance of those components and create aggregated dimensions to evaluate product portfolio
- Evaluate the components which are critical in the portfolio
- Validate the methodology and results with experts in the Product Management field

In the first stage, to answer the question "How can the portfolio be analyzed to achieve an optimized design?", we need to understand how the portfolio is structured and draft the basics, defining the main principles.

Indeed, with an exploratory study, we need to be flexible. The study must adapt as we find new data, as, by definition, we are trying to understand the mechanism that triggers an unknown phenomenon. In this phase, we would generate a list of parameters to be evaluated.

Once we understand the product portfolio's general behavior, we can go into a more in-depth detail level by aggregating the individual components and understanding their impact. In this case, we are instead looking at an explanatory study where we try to find correlations and propose the best product portfolio strategy based on available evaluations.

For this analysis, we need to evaluate data from real companies to understand the laws that explain the behavior, but we will go into the tactics' details later. Again, for this purpose, we would also check quantitative data, but at some point, qualitative data would also be helpful to add some subjective evaluation.

In addition, as the last step, we would validate the study with some experts in the product portfolio topic. That part would also be embedded in the explanatory study.

We can visually represent how we are going to face the study:

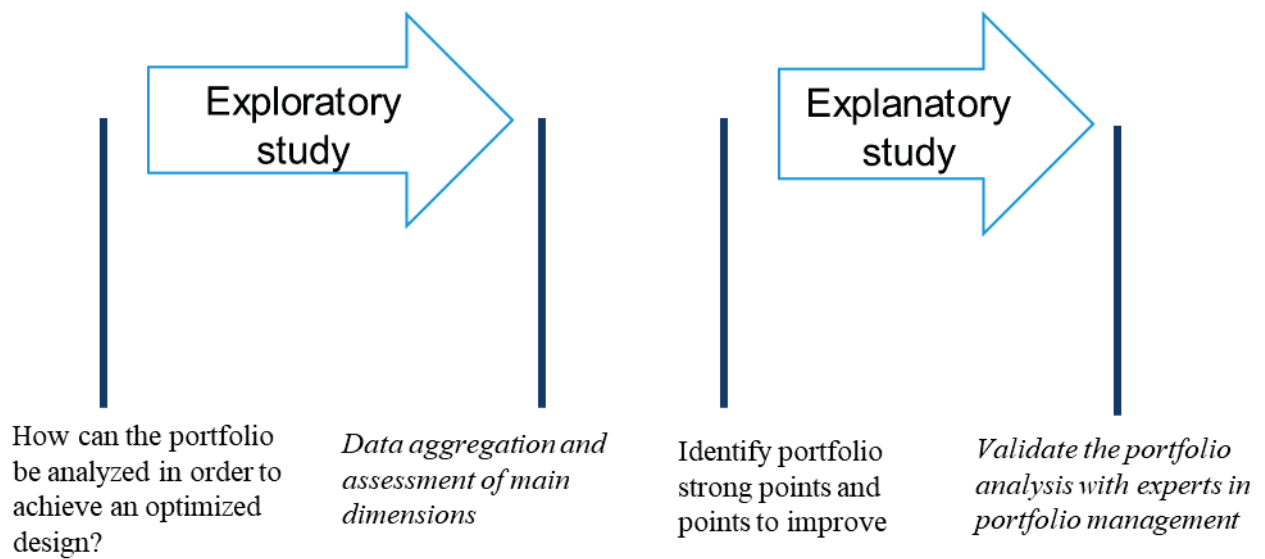


Figure 2 Summary of the research design

As we can see, it is a sequential design, where we answer a different question at each phase. Each part of the study would follow different methods.

3.2. Methodological choice: quantitative, qualitative, or mixed methods

We follow Saunders to define the methodological choice if we would use quantitative or qualitative methods.

According to Saunders, the methodological choice must define the philosophy that we follow. [31] Again, as we have different goals, we may choose different philosophies to achieve different tasks.

In the beginning, we initiate an exploratory study to understand the basics and what are the key parameters to evaluate. For such a general study, a philosophy based on positivism could help us be more objective and formulate the relations nearly as physical laws. Positivism is a classical approach, but it still may be adequate to evaluate social sciences from an objective perspective that connects well with an exploratory study. [32]

An obvious choice for a positivist approach would be to use a quantitative research design that matches well with positivism [31]. However, according to the literature [33], a single approach of either quantitative or qualitative may be too restrictive. On the other hand, a mixed design could open new possibilities and would be more flexible to enable different sources. As well, mixed research methods are more appropriate for more complex studies.

With that regard, a mixed-method would fit well. Besides, there is the known sequential mixed exploratory design. In the beginning, there is a qualitative phase to gain some knowledge on the topic and then start a quantitative phase to generalize some laws that would apply. [28] This design would be very appropriate for our initial exploratory phase to answer our research question and understand the issue.

Continuing the study, we would face an explanatory study, where again we would need to evaluate a possible associated philosophy to answer the question. It would still be a good debate if we could use different philosophies within the same study. However, we can think about each task separately for simplicity, so each one is a different research project with different goals and objectives. From that perspective, we would need to make sure that we satisfy our goal in the best way, so we could say that we are based on a different philosophy for this second question.

In this second question, as we need to get some creativity and develop something new, we would need a philosophy that would enable us to be more creative. In that sense, relativism empowers us to create a more profound understanding of the topic studied. [34]

With that philosophy in mind, the most logical methodological choice would be a qualitative choice, but as discussed before, using a mix of methods would be beneficial. In this case, if we add quantitative methods, we could build a more substantial theory.

A method that would fit would be a sequential explanatory one. In this method, we go through the available data to understand the relations more profoundly in the first phase with a quantitative analysis. In the second phase, we run a qualitative analysis in order to explain or motivate the reasons for what we have found in the first phase. [29]

Considering the overall research, the quantitative first phase of this second question could overlap the quantitative analysis of the sequential exploratory research for the first goal.

Therefore, if we put the whole research again together, we get the following graph:

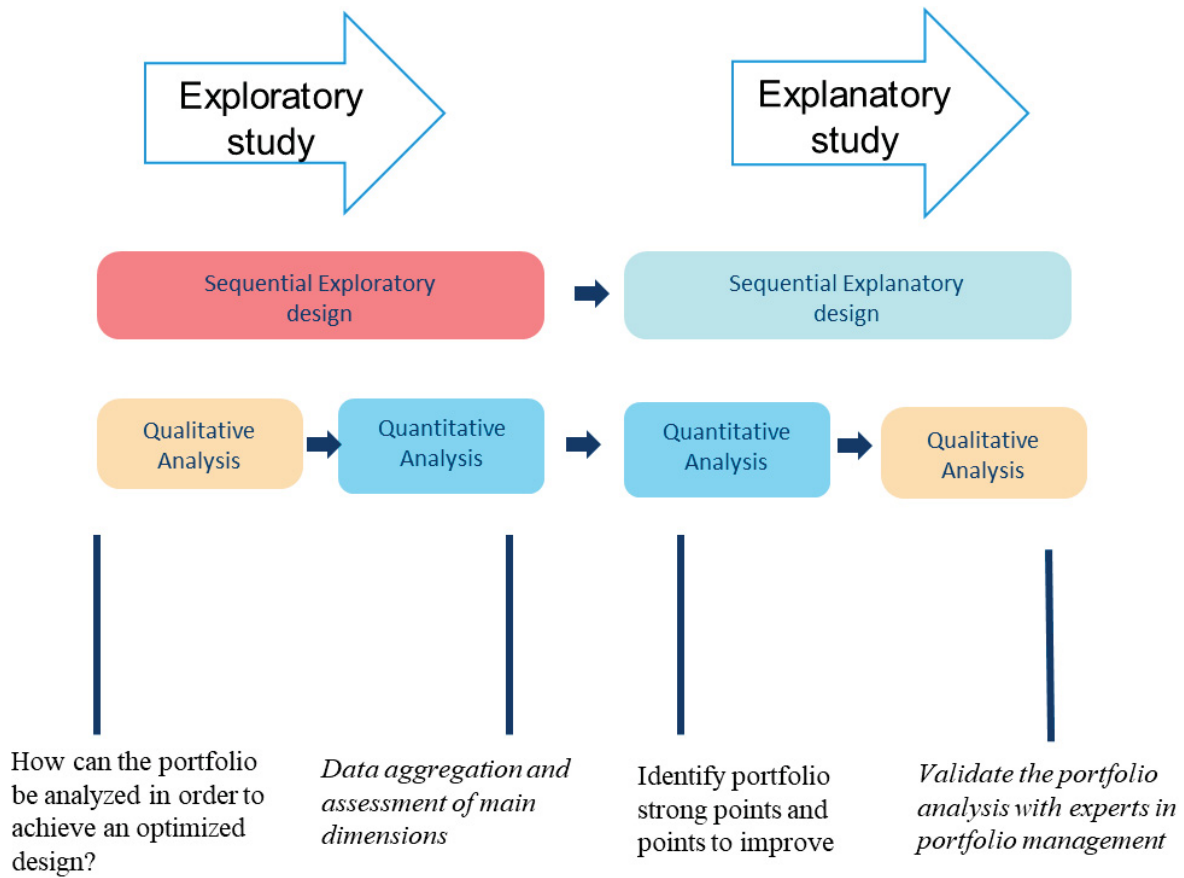


Figure 3 Research design methodological choice

We can easily see what we already mentioned that the quantitative analysis of the exploratory design could connect with the first phase of the explanatory design. It makes sense that understanding the scope is connected to a phase where we already look for connections among the different variables to generate some recommendations.

3.3. Research strategy: case study, survey

Before going into the research strategy's details, it is important to note that coherence has a vital role in the research. So, a part of the study, like research strategy, cannot be analyzed independently, and it has to be seen as a part of a whole. [30]

Therefore, while analyzing the research strategy, it is essential to keep in mind all the previous sections that we already discussed and analyzed. We would follow Saunders to apply the best fitting strategies. [35]

At the start of the qualitative study of the exploratory phase, we could do a case study that is well adapted to an early understanding of a topic. [36] In this stage, the goal would be to evaluate a sample individual to get an in-depth understanding of the product portfolio.

For the second phase of the exploratory design, we could perform a documentary research among several companies and generalize the parameters that we learned in the first phase. As a reminder, the first analysis performed in the case study is qualitative, and the documentary research is quantitative.

The next stage would be the explanatory study, where we perform at the beginning a quantitative study. In this case, the case study is well adapted but now with a different perspective, and the goal is to validate the laws that rule the product portfolio. It is important to note that, while in the first exploratory case, we use a case study for a qualitative analysis, now we use it for a quantitative analysis. Indeed, a case study can be used in both quantitative and qualitative analysis, and it is well suited for explanatory analysis as well when used together with a deductive approach. [37]

To finalize the explanatory study, we can use the grounded theory to analyze and interpret the data collected in previous phases and use deduction to build up a higher level of relationships based on the knowledge that we already collected. [35] Grounded theory is a very well adapted method to create complex explanatory relationships, and it may obtain more in-depth knowledge than case studies. [38]

As done in the previous chapters, the result can be summarized in a graph:

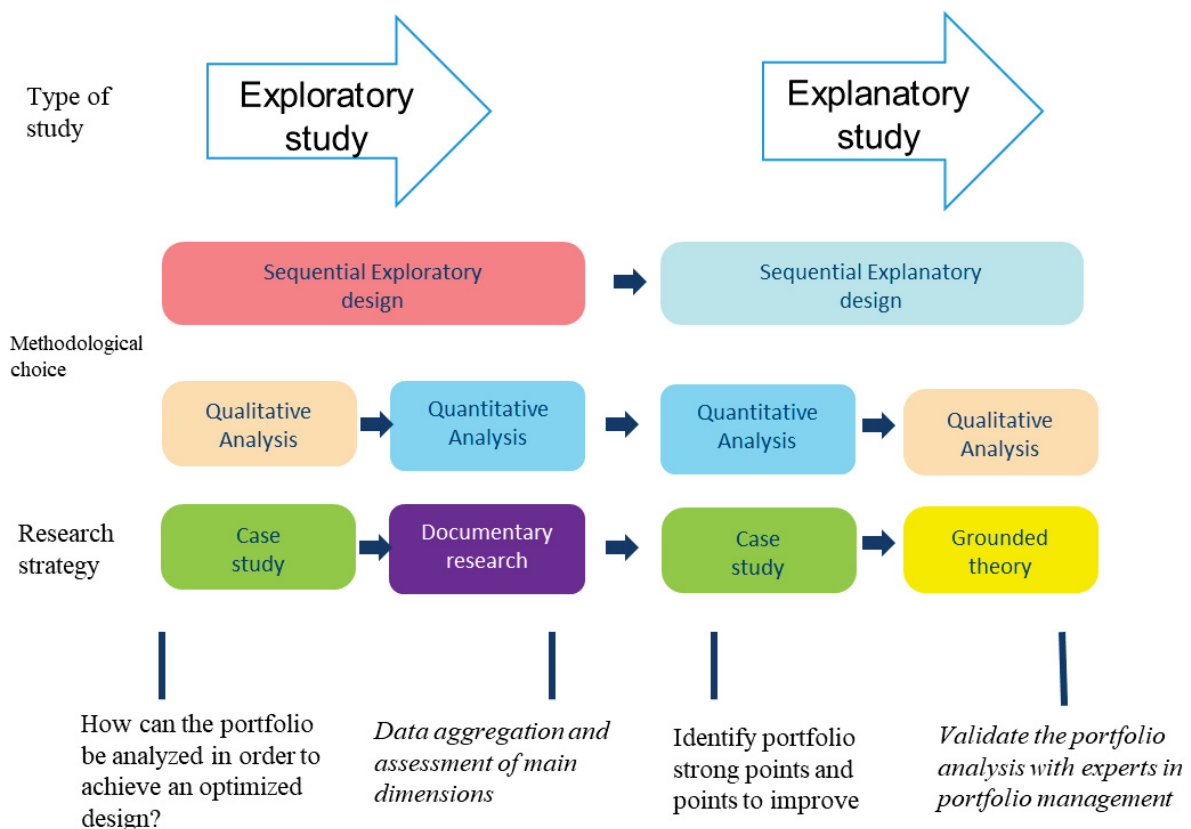


Figure 4 Research strategy

3.4. Define the materials/tactics

Now that we have a more precise overview of our study's parts, we need to match those with the previously identified phases of our sequential study, as referred to in chapter 3.1.

We will define each phase and the methodology followed in each of those steps.

3.4.1. Product portfolio breakdown in categories

As presented before, we will first analyze the performance of different competing companies in a specific subsegment to analyze the parameters that could trigger a given portfolio's success.

The structure of a portfolio is a complex topic, and it is evaluated in the literature, especially after the seventies. A good starting point of analyzing the portfolios is to check the classic approaches, which have influenced the current studies. In a detailed analysis of the BCG matrix, both dimensions represent the product perspective on one side analyzing the specific product life cycle status, and in the other dimension, we represent the market situation [39]. Within that approach, it is assumed that we are comparing products in a portfolio available in the same company.

Another classic example is the GE matrix [40], where the evaluation also focuses on two different axes, one to assess the product strengths and the other to evaluate the industry or market. In the Ansoff matrix, we also use the indexes to plot the product and industry information [24].

One clarification regarding the industry evaluation is that the market cannot be entirely dissociated from our product dimension analysis [24]. So, the industry dimension evaluation assesses how well a product adapts to the analyzed market.

Therefore, it sounds clear that product and industry are two of the main dimensions to be evaluated in the portfolio analysis. However, in the classical analysis, there is another dimension that is not evaluated in detail. In the classical evaluation, we consider evaluating different projects or products within the same company, and there is no assessment of the corporate intrinsic factors.

This would connect with the evaluation of the extended product portfolio mix, in which in a product portfolio, we have to consider a broader range of parameters that would influence the portfolio [20]. Indeed, to develop new products or manage the current portfolio, the company's organizational factors must be evaluated to understand the adaptability of the product and market analysis [23]. This could be considered an added third dimension of the classic methods, where we can also add the corporate factors that would enable us to evaluate the differentiating factors between different companies.

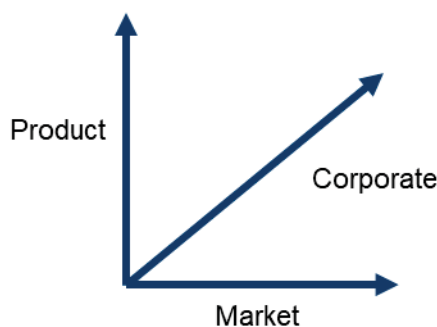


Figure 5 Portfolio dimensions

As a conclusion, to provide a hierarchical organization, we distribute the parameters to be evaluated in 3 different categories.

1. The category of the product and portfolio by itself,

2. The category of the relationship between the portfolio and the industry
3. A final category about internal company factors. Although these last factors are not included in the classic portfolio management and could not be changed by the portfolio management group, they affect portfolio success [20] [23]. Therefore, they should be considered as well in the analysis as a separate category

The following step in the organization is to increase the granularity of the evaluation of the main categories. To obtain the biggest detail and aggregate more factors, it is essential to evaluate individual parameters within the main categories [4]. The split down in independent factors is already done in the classic methods, especially in the GE matrix [41], the BCG matrix, and the Ansoff matrix. In the corporate evaluation, there are papers evaluating the different components that would make sense to be evaluated [20].

Therefore, the goal would be to collect the parameters specified in previous studies, group them, and potentially add new ones that we consider essential. A list of the evaluated parameters and the reasons to include the different categories can be found in appendix 7.1.

From the extended list of parameters, the goal is to have a comprehensive list, not too extensive in the number of parameters, as this would facilitate the analysis and evaluation of the components. However, it is as well important not to lose important information [42].

The essential parameters to be investigated in each of those branches according to our study are:

- Purely product related
 - Number of products
 - How many products does a company have to serve a given industry?
 - Structure of the products within the portfolio
 - How well are the products arranged within the portfolio?
 - Technical quality
 - How well is each product designed to achieve the design goal?
 - Investment in the product
 - How much has the company invested in a product?
 - This is important to measure as it behaves as a barrier for entry, but also because it shows the readiness to invest in a specific product
 - Integration of the portfolio/cross-selling
 - How well the different products in the portfolio interact with each other to provide a rich solution offering?
- Industry-related evaluation
 - Potential growth of the industry
 - How much we expect the product target industry to grow?
 - Market share of the product
 - How much market share does the product currently have?
 - Product adaptation
 - How much are the products adapted to the customer's need from a market perspective?
 - This differentiates from the technical quality as this is more adapted to what the market requests, not what the company pretends to achieve. Big companies can modify the user behavior to match with their own design plan, meaning that companies can direct users' behavior
 - Broadness of the portfolio
 - Are the products only adapted to specific use cases, or are they generic?
 - Comparison with competitors
 - How good are our products compared with our competitors?

- Price
 - How much does the user perceive the price of our solutions?
- Profitability / cost
 - What are our margins for a given product?
 - Known the margin and the market share, we can calculate the total profit
- Corporate internal factors
 - Marketing
 - How well are the products promoted?
 - Delivery
 - How easily can we deliver our products?
 - Support
 - What is the support level offered by the company?
 - Life cycle management
 - How easy is it for the company to change products, discontinue or create new products?
 - Financial stability
 - How stable is the company within a specific market?

We can summarize the factors in the portfolio in a schema:

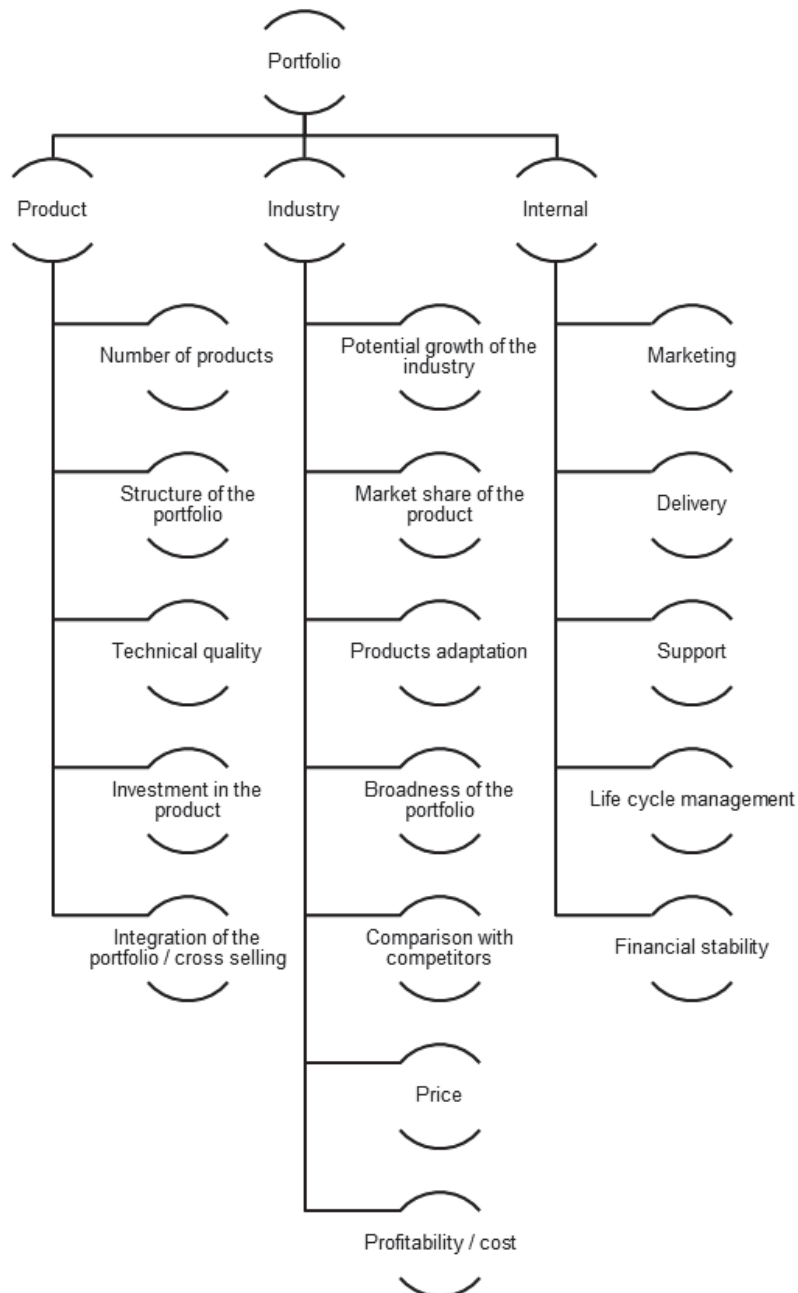


Figure 6 Portfolio factors schema

Another important point would be how to measure the degree to which every parameter is fulfilled.

It makes sense to have all the parameters measured on the same scale, although not all the values can be assessed in similar scores. A solution would be to use a Likert scale where every parameter is measured from 1 to 5 based on the degree of accomplishment of a parameter from 1 – "strongly disagree" to 5 – "strongly agree" [43].

Once we have a standard scale for all the parameters, it would be essential to set some rules to assign the different scores for every category. The evaluation rules are also specified in annex 7.2, making the score assignment fairer and more equitable [44].

We have currently identified the product portfolio's main dimensions and have assigned different components for each of those dimensions. Finally, there is a methodological way on how to evaluate those parameters. Therefore, we attained the original goal of being able to structure and analyze a product portfolio.

3.4.2. Product portfolio categories weighting

As discussed, it would be essential to weigh the importance of the different values to aggregate the individual parameters into a single measure finally.

Even if the different components are already evaluated, not all of them would have a similar impact on the result. Although we would be doing evaluations, the case is similar to surveys, where every question has an answer and can have a different impact. [45]

We will weigh the importance of a given parameter in a scale from 1 to 3, which are coded: 3 – High importance, 2 – Medium importance, 1 – Low importance.

We will summarize the importance of the single components that we evaluate for each major category (product, industry, or corporate). With those results, it would be possible to get a final estimation for a significant component aggregated from the specific values.

The aggregation of different factors is complex and can depend on the culture of the specific target market [26]. However, as previously discussed, aggregation is key to extracting conclusions in an easier way [25]. Following Calantone again [26], it is essential to collect enough data from surveys, structure the information, and group the factors in the three different weighting levels.

We will start the weighting according to the different dimensions (product, industry, internal). Following Calantone's data [26] and his evaluation of over 500 different product launches, the most critical parameters in order of importance are:

1. Competitive and marketing activities
2. Product quality
3. Marketing resources and skills
4. Proficiency of technical activities
5. Proficiency of marketing activities
6. Technical resources and skills

We will start mapping the product factors and validate the parameters' importance based on several studies [46] [47].

1. Competitive and marketing activities
2. Product quality
 - a. Technical quality
3. Marketing resources and skills
 - a. Structure of the portfolio
 - b. Investment in the product
4. Proficiency of technical activities
 - a. Integration of the portfolio/cross-selling
5. Proficiency of marketing activities

- a. Number of products
- 6. Technical resources and skills

An analytical way to distribute the priorities would be to assign categories 1 and 2 to the high importance weight, categories 3 and 4 to the medium importance weight and 5 and 6 to the low importance weight.

The next dimension would be the industry dimension. Again, we will use the Calantone analysis and match the other studies' parameters [48].

- 1. Competitive and marketing activities
 - a. Potential growth of the industry
 - b. Products adaptation
- 2. Product quality
- 3. Marketing resources and skills
 - a. Market share of the product
 - b. Broadness of the portfolio
 - c. Broadness of the portfolio
- 4. Proficiency of technical activities
- 5. Proficiency of marketing activities
- 6. Technical resources and skills
 - a. Profitability / cost

Again, with the industry dimension, we can map the factors to the importance.

The last dimension to map would refer to the internal factors, and we try again to match those dimensions to their importance.

- 1. Competitive and marketing activities
 - a. Marketing
- 2. Product quality
- 3. Marketing resources and skills
 - a. Life cycle management
- 4. Proficiency of technical activities
 - a. Support
- 5. Proficiency of marketing activities
 - a. Financial stability
- 6. Technical resources and skills
 - a. Delivery

We proceed to summarize the results into tables organized per dimension.

Table 1 Product measured parameters

Parameter	What we measure?	Importance
Number of products	Is the number of products too big or too small?	Low
Structure of the portfolio	How well are the products arranged within the portfolio?	Medium

Technical quality	How well is each product designed to achieve the design goal?	High
Investment in the product	How much has the company invested in a product?	Medium
Integration of the portfolio/cross-selling	How well the different products in the portfolio interact with each other to provide a rich solution offering?	Medium

Table 2 Industry measured parameters

Parameter	What we measure?	Importance
Potential growth of the industry	How much we expect the product target industry to grow?	High
Market share of the product	How much market share does the product currently have?	Medium
Products adaptation	How much are the products adapted to the customer's need from a market perspective?	High
Broadness of the portfolio	Are the products only adapted to specific use cases, or are they generic?	Medium
Comparison with competitors	How good are our products compared with our competitors?	Medium
Price	How much does the user perceive the price of our solutions?	Medium
Profitability / cost	What are our margins for a given product?	Low

Table 3 Corporate measured parameters

Parameter	What we measure?	Importance
Marketing	How well are the products promoted?	High
Delivery	How easily can we deliver our products?	Low
Support	What is the support level offered by the company?	Medium
Life cycle management	How easy is it for the company to change products, discontinue or create new products?	Medium
Financial stability	How stable is the company within a specific market?	Low

3.4.3. Aggregated dimensions to assess the different categories

Besides, to summarize each major category's results, we will aggregate the results considering the importance and the rating, and then doing an arithmetic average. We would practically multiply the Likert single scores by their importance, mapped to a 1 to 3 scale and then divide by the number of parameters multiplied by the weight.

This is a typical way on how to aggregate the Likert results. [49] In this way, we will have a score for the product, industry and corporate.

The equation for this method would be:

$$Aggregatedvalue_{categoryZ} = \frac{x_{z1}W_{z1} + x_{zs}W_{zs} + \dots + x_{zN}W_{zN}}{W_{z1} + W_{zs} + \dots + W_{zN}} \quad (1)$$

Where x_{zn} denotes the Likert evaluation of component n in category z , and W_{zn} denotes the weight of component n in category z .

Alternatively, we can write the equation also as:

$$Aggregatedvalue_{categoryZ} = \frac{\sum_{n=1}^N x_{zn}W_{zn}}{\sum_{n=1}^N W_{zn}} \quad (2)$$

By applying this aggregation, we can have a single score for each category.

3.4.4. Methodology validation by interviewing experts

The last step in our data collection methodology would be to validate the obtained results, and we will do that by performing interviews among experts in product management.

As previously mentioned, this study's primary goal is to evaluate a company's portfolio, and although this may sound an obvious or standard topic, there are few examples of a methodological analysis in the technical literature of portfolio analysis and evaluation. We take an example in cloud computing in our work, but cloud computing is just a market example where the conditions are suitable to evaluate the portfolio due to its specific characteristics. To validate the work and how we approach portfolios' assessment, we should not look for cloud computing experts but for portfolio experts. The main topic is portfolio evaluation and validating the study with people with in-depth portfolio knowledge would corroborate our approach. We do not look for experts in the cloud computing market, as that may be even counterproductive. We do not aim to reach a technical discussion about the cloud evaluation details, but we want to hear from experts if our portfolio evaluation makes sense.

As we have a clear goal in our interview, the first point would be to clarify the interview methodology. In our case, we are doing explanatory research. Therefore, the interview should be open to enable us to collect information that we may not be expecting. On the other hand, it is crucial to have some structure to keep our focus. From that perspective, a semi-structured interview would be an adequate technique. [50]

As summarized in the Saunders book:

Table 4 Interview type suggestion for different purposes

	Exploratory	Descriptive	Explanatory	Evaluative
Structured		✓✓	✓	✓
Semi-structured	✓		✓✓	✓✓
Unstructured	✓			✓

Where ✓✓ denotes more frequent, and ✓ denotes less frequent.

The next steps would be to define the themes to be covered and an interview guide to plan our semi-structured interview.

3.5. Analysis in a specific market

Once the methodology to evaluate the portfolio is settled, and we have a consistent way to evaluate the portfolio, then we could already evaluate the chosen market, in this case, the cloud computing market.

As previously discussed, the cloud computing market is still relatively young and has a considerable size and still growing. This market is relatively big, accounting for more than 200 billion USD per year [51], and the market is growing yearly at a rate of more than 20%.

So, it is a right mix of a considerable market, in which we can already see different already established strategies for portfolio, and at the same time, the young and fast-growing pace forces the portfolios to remain adaptable. So, the cloud computing market conditions make it an adequate candidate to evaluate different companies' portfolio strategies.

The next point to evaluate is which specific companies we will analyze. The cloud computing market is similar to other similar technological markets with the network effect, like the mobile telecommunications market, where the conditions seem similar to a natural monopoly [52]. In these conditions, after the market stabilizes, the market participants can be mapped into market leader, challenger, follower or niche [53]. Typically, after the regulation kicks in, the number of competitors will be limited and generally below five players in a given market. It is out of the scope to go into these details, but a conclusion is that evaluating a limited number of market participants would probably give an excellent overview, as eventually, the market will concentrate. In this case, three prominent companies operate worldwide and accumulate more than 50% of the whole market, namely Amazon, Microsoft and Google [18].

These companies are relatively well established in the market, and also, they are growing at a high pace (together with the full market), and they compete in the whole world. Therefore, these three companies are perfect for conducting our analysis, as the prominent representatives of the market.

We can apply the previously discussed phases to our selected market and companies.

3.5.1. Example of market portfolio categories evaluation

This analysis would be a qualitative one as we would evaluate the individual components based on the assessment of the specific parameters as specified in appendix 7.1 and 7.2. Although we would, in the end, set a numeric score for each of the components, we still consider this a qualitative analysis.

The analysis will be performed for every company under study.

From an aggregated point of view, we analyze this phase:

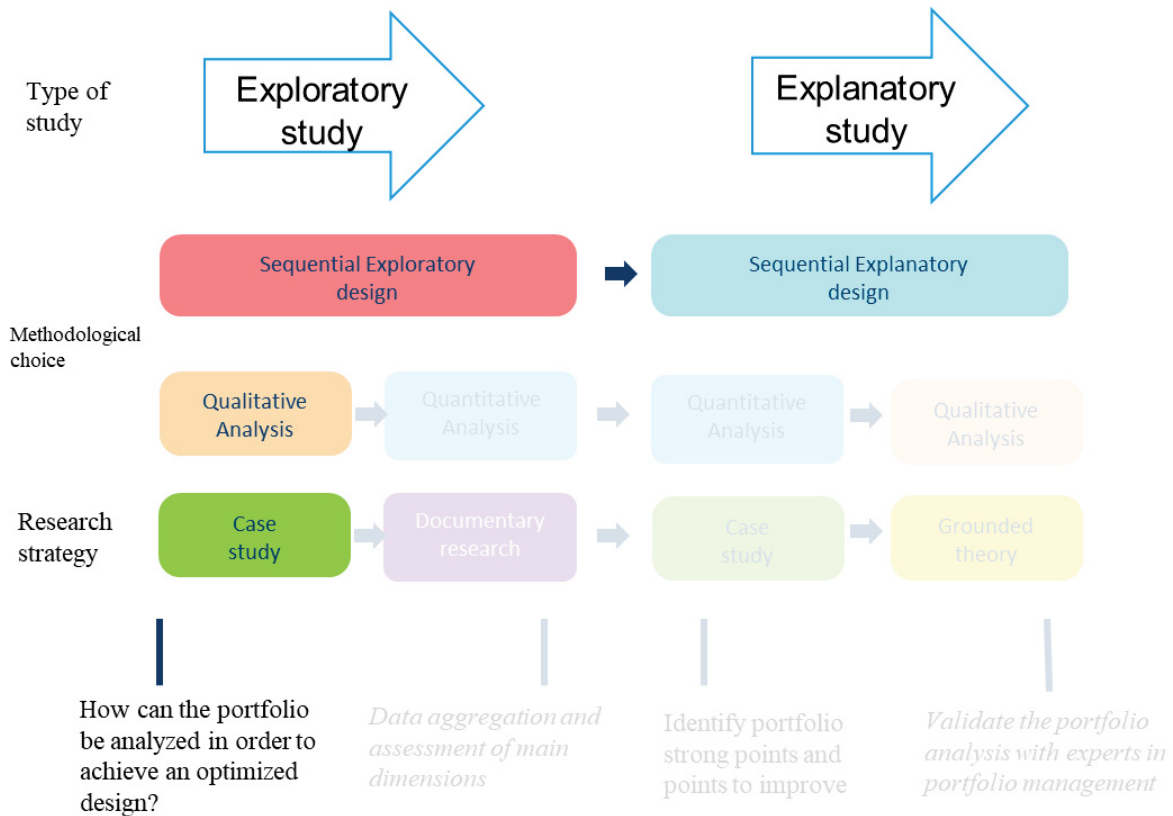


Figure 7 Use case portfolio evaluation phase

3.5.2. Aggregation of the portfolio components and numerical evaluation

Once we have the portfolio components evaluated, we shall aggregate them, so we have a value for the different companies for each of the major components. Furthermore, what is more important, in this stage, we can compare the different companies and evaluate how their portfolios are different. This is a crucial step, as this is one of the goals of this work was to be able to evaluate and compare the adaptation of different portfolios.

Although this phase does not include many numbers, we consider this phase a quantitative phase, as there are data ordered in a numerical way, and we proceed to order those categories, which would be considered a quantitative study. [54]

In our diagram, we would be evaluating this phase:

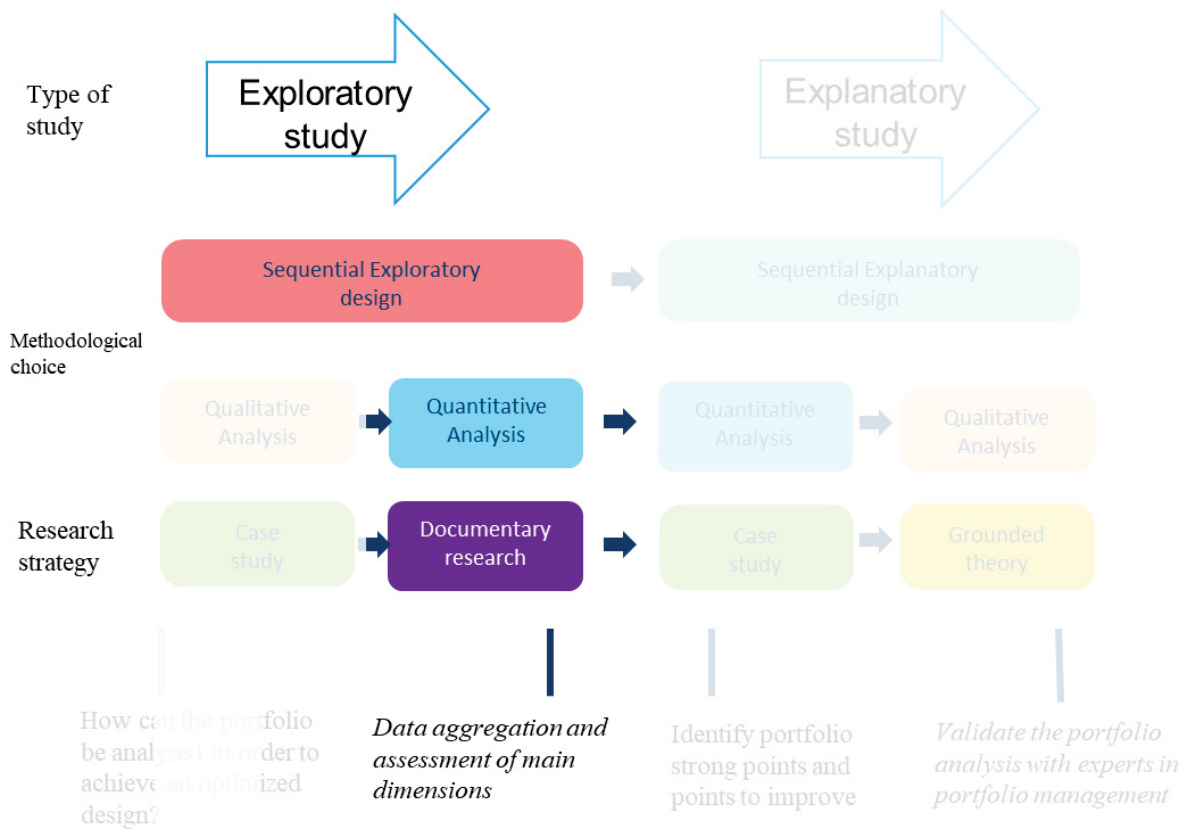


Figure 8 Aggregation of the portfolio components and numerical evaluation phase

3.5.3. Analyze the portfolio strong and weak points

As discussed before, once the aggregated evaluation of the product portfolio components is done, we can evaluate the portfolio's characteristics and spot strong points and points to be improved.

In this stage, we will evaluate the dimensions assessed and the individual parameters which would influence the overall score. With that evaluation, we can infer the conclusions of the points that could be improved.

Again, here as we have numeric data, we consider it a quantitative phase, although the amount of data collected will not be overwhelming. Also, it is essential to mention that we are already in the explanatory phase of our analysis, as we are not only evaluating the results but already analyzing them and trying to set the grounds for portfolio optimization.

If we represent the phase in our whole diagram:

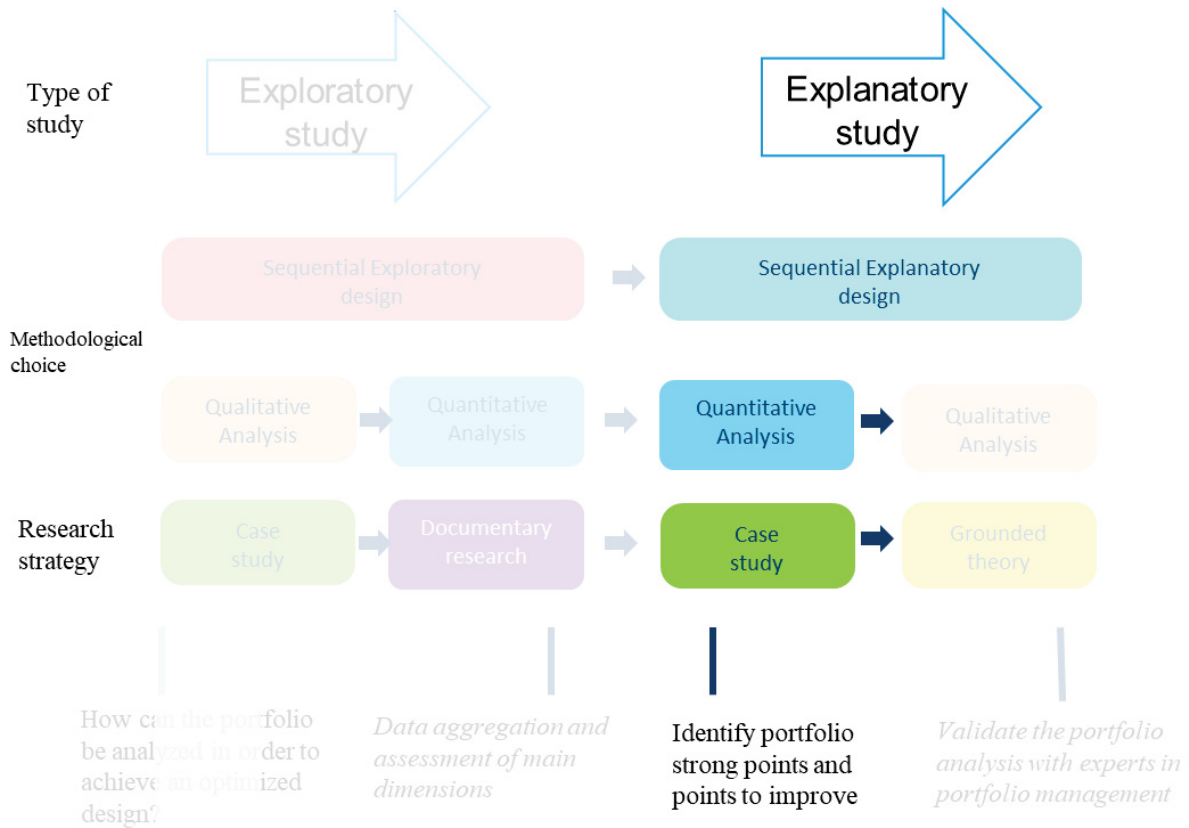


Figure 9 Evaluate the portfolio points for improvement results phase

3.5.4. Validate the methodology and results with experts

To plan our semi-structured interview, we need to define the themes to be covered and an interview guide.

From a general perspective, the goals of our interview are:

- Understand the importance of portfolio management
- Validate the portfolio parameters to be measured
- Verify the aggregation of the portfolio assessment
- Check the assessment of the portfolio week and strong points
- Validate our specific analyzed use case
- Generally, validate our methodology and current work

From those generic goals, we can develop our interview themes:

- The link of how a portfolio can be necessary for a company
- The essential parameters of a product portfolio
- The structure of those parameters within the portfolio structure

- The weight of those portfolio categories
- The importance of the single measurable portfolio parameter
- The validity of the studied example
- The extent to which our work covers those topics

From those themes, we can already develop the interview guide:

- To what extent the product portfolio connects with a company's success?
 - How can the portfolio affect the revenues and costs?
 - Can you support your answer with real-life examples?
- What are, in your view, the most critical parameters of a product portfolio?
 - Can you enumerate them?
- Are those parameters related in a hierarchical structure?
- Do you think it makes sense to structure those individual parameters and weigh them?
- Can we evaluate the suitability of a whole portfolio evaluating those individual parameters?
 - In what ways?
 - Do you have examples of it?
- What do you think about our practical example?
 - Are we covering the right parameters?
 - Is the structure well oriented?
 - Do the weights make sense?
 - Do you think the conclusions of our use case evaluation can be extrapolated?
 - Do you think that the thesis is well oriented?
 - What would you change?

As previously discussed, we would like to verify our conclusions with managers with deep and long experience managing product portfolios in different companies. We would need to already play with an established example and get more in-depth information to contrast our theories.

Therefore, the goal is to contrast if our analysis makes sense from a portfolio analysis point of view. Moreover, if we can convey a portfolio analysis in a specific market for some portfolio management experts, then the methodology would be acceptable. That is why the interest is not searching for cloud computing experts but experts in portfolio management and experience in as many different markets as possible. This would provide our analysis a wider reach.

In our examples, Massimiliano Mannelli is a director of product management in the mobile telecommunication services, Filippo Meloni is a senior product manager in the pharmaceutical industry and Peter Raser is head of products in a manufacturing company. We have three different experts in portfolio management in 3 very different industries.

Also, it is worth mentioning that the interviews' goal is not to collect answers from a wide range of people. However, we aim to speak with a few carefully selected and very experienced professionals in portfolio management with our unstructured interviews. The goal is not to have very few questions but a discussion that would provide us enlightening answers that would guide our analysis. From that point of view, we consider that having three interviews is suitable for our analysis.

In this case, it is a qualitative study as we will not have any numeric information but rather some subjective opinions.

In our diagram summary, we are in this phase:

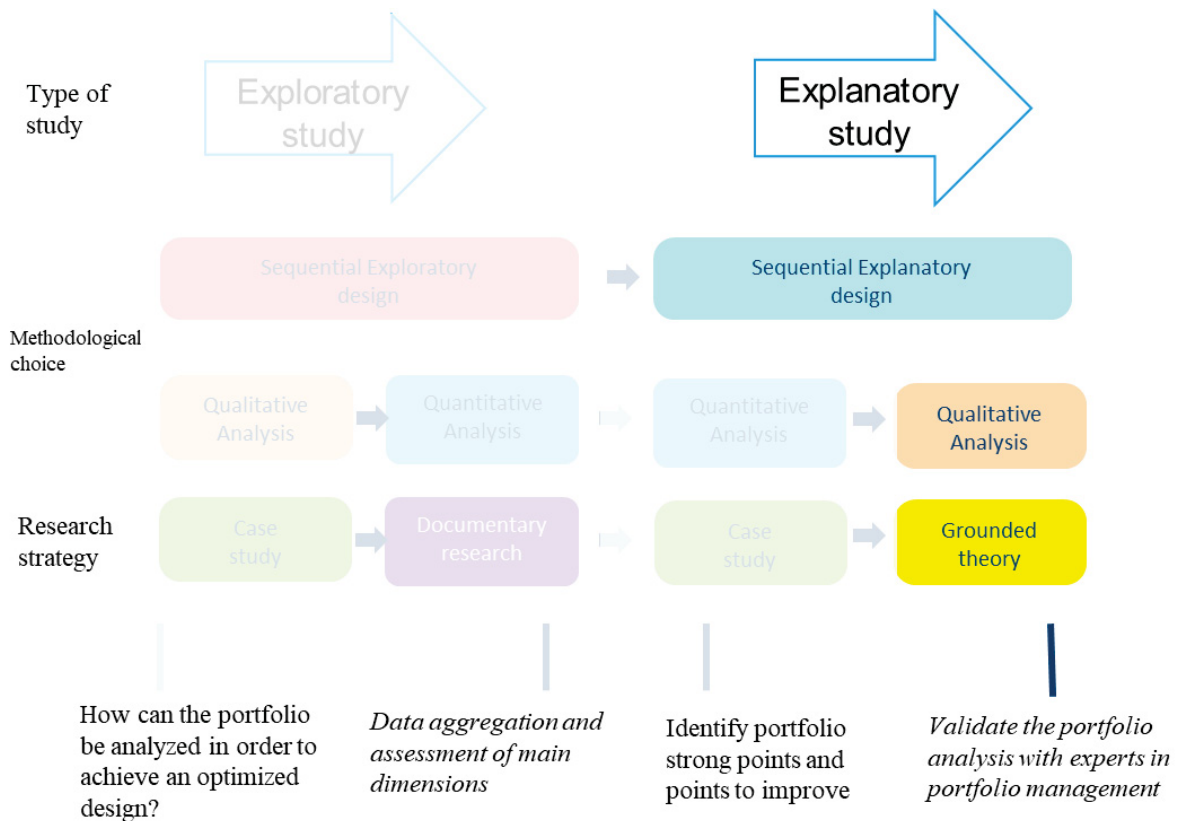


Figure 10 Methodology validation phase

3.6. Consequences / ethics

The principal output of the study would be to answer our research question. Therefore, we should understand how a product portfolio can be optimized, the hierarchical portfolio structure, and how we can measure and assess it. To express it differently, how can we enable better portfolio management.

Obviously, the degree to which we answer the question is based on our data's quality, and therefore we should be careful while generalizing from our specific example. If we investigate only a set of companies, we must ensure no bias in our sample set, and we should consider companies that are different from each other. That is why the company selection, as defined in the previous chapter, is essential.

To ensure our study's quality, we must force that we fulfill validity and reliability requirements. Reliability means that our conclusions can be applied to different samples, which we could evaluate by having a different sample, which we would use as a control set.

For validity, we must make sure that we measure things that are accurate for our purposes. In our case, we use information publicly available from several companies. To ensure that our data is relevant, we would need to make sure that we reach the same data following a different approach or source.

Finally, as we access publicly available data regarding ethics, there should not be particular concerns regarding ethical issues.

For the data acquired from specific companies, no confidential information would be disclosed.

The interviews were intended to make an in-depth analysis better to understand the study's validity from a broader perspective. That implies that the number of interviews will be limited, and in order to make it more practical, we chose participants in the interview that fulfill the requirements, i.e., broad experience in the product portfolio field and knowledge from different companies.

4. Empirical findings

4.1. Use case portfolio evaluation

Once there is a defined portfolio structure, the categories to be evaluated, and the rules to aggregate those categories, it would be possible to apply that methodology to a specific market to see how our theoretical structure applies to a practical example.

As discussed, we will evaluate the cloud computing market, and we will evaluate the three largest companies in the cloud computing market to evaluate their portfolios in the specific market. We will start evaluating the specific parameters of every company separately. At a later stage, we will aggregate the individual parameters for every company, and we will compare the different portfolios and identify weak spots in them. Afterwards, we will explain how the companies perform in the market and infer relationships between the portfolio and our evaluation, and the individual company performance.

So now we will proceed with the individual company parameter evaluation.

4.1.1. Amazon Web Services (AWS)

Amazon is, without any doubt, the early leader of the cloud computing market [55]. It is the precursor in cloud computing, and since Amazon launched AWS in 2006, all the other competitors strive to catch up. It has the most significant market share, and it is the reference for features and services [56].

As discussed in section 3.4.4, we would start by evaluating the individual categories for Amazon according to appendix 7.2, where we score every component individually. The easiest way to access Amazon Web Services' portfolio structure is to check the AWS website and browse through the different product offerings.

4.1.1.1. AWS portfolio initial analysis

We can see that Amazon is purely based on use cases:



Figure 11 Amazon Cloud online portfolio

The entry point to the portfolio is the fundamental question, "what do you want to do?". Therefore, a user may choose to develop a blockchain application, for example, and there is a use case for it. The portfolio covers the primary use cases like computation, data storage, and new technologies like Internet of Things or Virtual Reality.

The amount of use cases covered is impressive, and as well, inside every use case, several products are offered. Furthermore, for example, if we choose the use case media services, we see the following products available:

Analytics	Amazon Elastic Transcoder Easy-to-use scalable media transcoding
Application Integration	Amazon Kinesis Video Streams Process and analyze video streams
AR & VR	AWS Elemental MediaConnect Reliable and secure live video transport
AWS Cost Management	AWS Elemental MediaConvert Convert file-based video content
Blockchain	AWS Elemental MediaLive Convert live video content
Business Applications	AWS Elemental MediaPackage Video origination and packaging
Compute	AWS Elemental MediaStore Media storage and simple http origin
Containers	AWS Elemental MediaTailor Video personalization and monetization
Customer Engagement	AWS Elemental Appliances & Software On-premises media solutions
Database	
Developer Tools	
End User Computing	
Game Tech	
Internet of Things	
Machine Learning	
Management & Governance	
Media Services	
Migration & Transfer	
Mobile	
Networking & Content Delivery	
Quantum Technologies	

Figure 12 Amazon Cloud portfolio detail

As we can see in this concrete example about media services, there are nine different products to choose from and a brief description with a particular user need.

On one side, it looks positive to cover all the customer needs, but crunching some numbers, we have 25 different use cases and an average of 5 products per use case, so a total of around 125 different products. It feels like the product portfolio was growing, and many products were added ad hoc. Although the use cases streamline the portfolio, the number of options may be intimidating, and some users may get lost with the number of options.

However, the structure of the portfolio logically guides the customer, and it answers the questions logically that a customer may have sequentially:

1. What is your scope? What do you want to achieve?
2. What exactly do you want to do?

3. Here you are the product you need

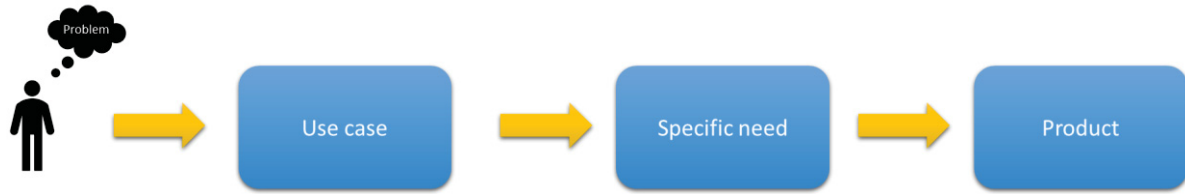


Figure 13 Amazon Cloud portfolio representation

With that approach, we can already fill in a table with the Amazon evaluation.

4.1.1.2. AWS individual parameter assessment

According to appendix 7.2, we will start with the product evaluation.

Table 5 Amazon Cloud portfolio evaluation product part

Parameter	Evaluation	Comment
Number of products	★★☆☆☆	Too many products that would make some customers hardly understand the differences
Structure of the portfolio	★★★★☆	Very structured portfolio with very well-defined use cases. The missing star is because of the elevated number of use cases, which may confuse some users
Technical quality	★★★★☆	Very good technical quality that would satisfy most of the users
Investment in the product	★★★★★	Amazon is the oldest in the market and a reference in the market. AWS was even split into a separate company from Amazon to have more financial independence. Substantial past investment and there is a full assurance that the financial support will continue in the future
Integration of the portfolio/cross-selling	★★☆☆☆	Amazon's core businesses are difficult to offer together with the cloud service. It is not only one star because there are multiple cross-selling options

		within the AWS portfolio. Overall poor cross-selling possibilities
--	--	---

Now we can evaluate the industry-related evaluation:

Table 6 Amazon Cloud portfolio evaluation market part

Parameter	Evaluation	Comment
Potential growth of the industry	★★★★★	Cloud computing is one of the fastest-growing industries, around 30% [17], and AWS covers all the areas
Market share of the product	★★★★★	AWS is the biggest player in the market with above 30% of market share [18]
Products adaptation	★★★★☆	Generally, AWS covers the use cases of the typical customer. However, there is a portion of the market and use cases not covered by AWS
Broadness of the portfolio	★★★★☆	AWS covers most of the use cases.
Comparison with competitors	★★★★☆	The customers generally perceive AWS as of above quality compared to competitors
Price	★★★★☆	AWS sets the prices, and the competitors follow. The customers perceive AWS as of good price
Profitability / cost	★★★★☆	AWS is now an independent company very successful and growing steadily. Although the figures are publicly shared, we can consider that AWS margins are very good

Now we evaluate the corporate-related parameters:

Table 7 Amazon Cloud portfolio evaluation corporate part

Parameter	Evaluation	Comment
Marketing	★★★★☆	Firm name due to the position in the market which addresses most of the customers
Delivery	★★★★☆	That also comes with the technical solution, one of the most advanced in the market. A delivery that satisfies most of the customers

Support	★★★★☆	Adequate level that satisfies the average customer, but it loses grip with the business market
Life cycle management	☆☆☆☆☆	Inferior life cycle management, the products are hardly discontinued, and they pile on top of each other, and that contributes to the huge portfolio
Financial stability	★★★★☆	Independent, strong company and committed to the market in the future, very good overall

4.1.2. Microsoft Azure

Microsoft, the big giant of the computing software, entered late in the cloud computing market. Even more important than Microsoft got into late in the market, it did not start seriously investing in it since much more recently.

To put it in some numbers, Azure was launched in 2010, and until 2012 did not offer virtual machines, which is probably the most basic offering of cloud computing.

Since 2016 Microsoft has consolidated as a healthy number 2 in the market, and it supports its gain with the cross-selling and synergies with the rest of the Microsoft products, namely Operating Systems (Windows) and enterprise software (SQL server and Dynamics among others) [18].

Also, Microsoft is getting a very intense focus in the market for big business / corporate accounts.

4.1.2.1. Azure portfolio initial analysis

If we start checking the Azure portfolio, there is a surprise, as it looks astonishingly similar to AWS. There are first use cases, and then products:

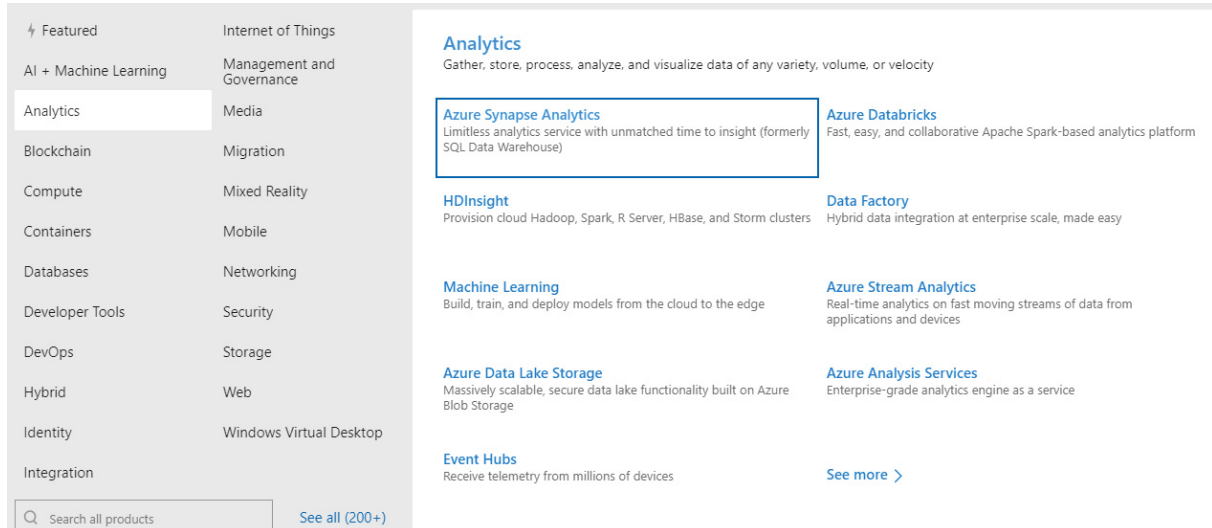


Figure 14 Microsoft Azure portfolio

There are a vast number of products, and it is so similar to AWS that it could make a user think that Azure is a follower that mocks up the leader (AWS portfolio is set up before Azure).

However, it is noticeable that the Azure portfolio has changed in the latest years. Back in 2015, the portfolio was looking very different [57]:

Infrastructure Services

Provision Windows and Linux Virtual Machines and applications in minutes. Microsoft's hybrid consistency enables you to use the same VMs and management tools in Azure that you use on-premises.



[Virtual Machines](#) ▶



[Storage, Backup, and Recovery](#) ▶



[Big Compute](#) ▶

Develop Modern Applications

Build modern applications that take full advantage of the cloud. Azure enables you to build and deploy a wide variety of applications – including web, mobile, media and line-of-business solutions. Built-in AutoScale features enable you to dynamically scale up and down to meet any needs.



[Web](#) ▶



[Mobile](#) ▶



[Media](#) ▶



[Integration](#) ▶



[Dev-Test](#) ▶

Insights from Data

Get insights from any data, big or small. Azure provides managed SQL and NoSQL data services, and built-in support for analyzing and helping you gain insights from your data. Leverage the full power of SQL Server in the cloud as well as use HDInsight to build Hadoop clusters to analyze data.



[SQL Databases](#) ▶



[HDInsight](#) ▶

Identity and Access Management

Enterprise level identity and access management for all your cloud apps. Windows Azure Active Directory is a comprehensive identity and access management cloud solution. You can manage user accounts, synchronize with on-premises directories, get single sign on across Azure, Office 365 and hundreds of popular SaaS applications like Salesforce, Workday, Concur, DocuSign, Google Apps, Box, ServiceNow, Dropbox, and more.



[Active Directory](#) ▶



[Multi-factor Authentication](#) ▶

Figure 15 Microsoft Azure portfolio in 2015

It then had a very slim design with four areas: infrastructure, applications, data, and access management (this is instead a use case). So, from a clean and tidy portfolio, Azure became a similar monster as AWS.

Nevertheless, there is a subtle difference in the Azure case. While for Amazon, the interest always goes to use cases, in Azure, the industries focus is very prominent.

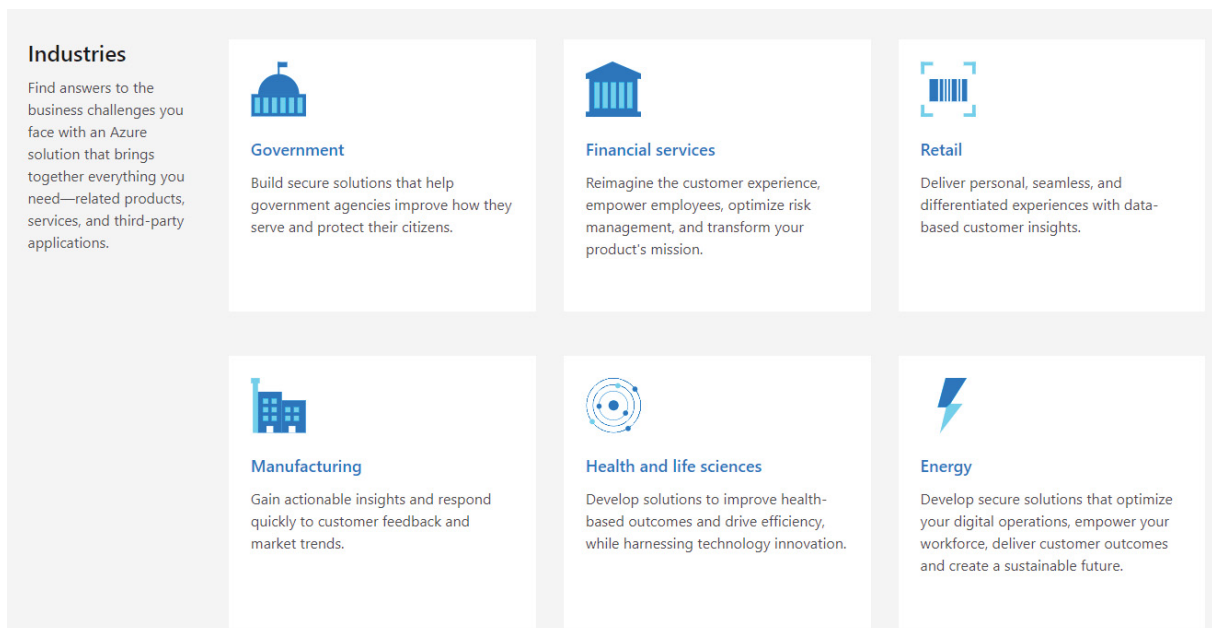


Figure 16 Microsoft Azure industry orientation

This would be a new entry point to the customer, that instead of choosing from a range of use cases, now the user can start from an industry and from there, the user can build his own solution.

Also, there is a third entry point for users willing to enter the cloud market from a regular IT infrastructure.

These two alternatives push Microsoft as a corporate favorite, and it uses its stable position in the software market to build a very compelling cloud offering and a straightforward and seamless migration into the cloud market.

From a graphical perspective, Microsoft portfolio presentation could look something6 like this:

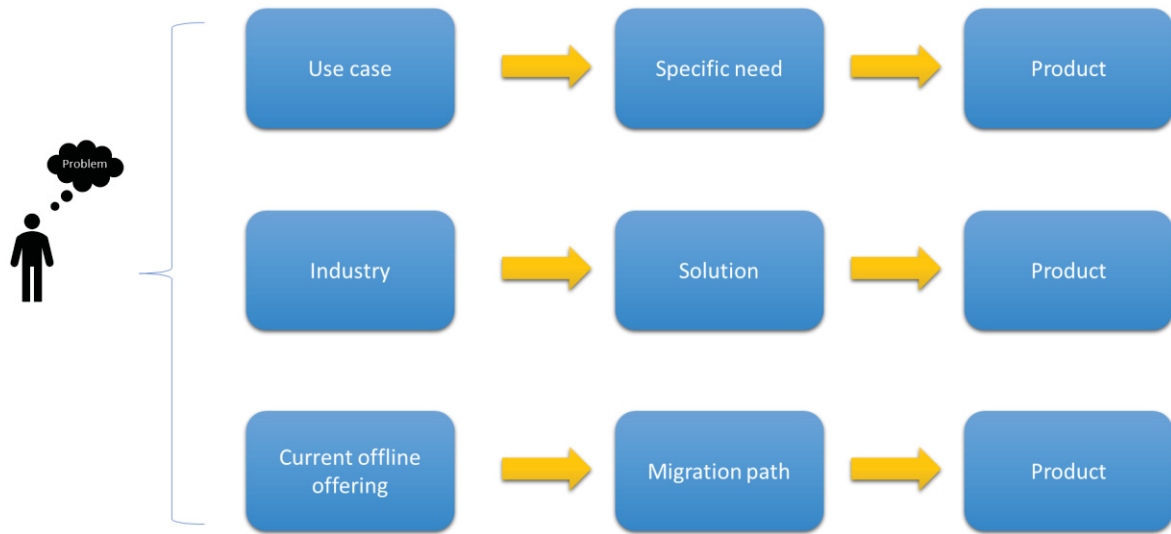


Figure 17 Microsoft Azure portfolio representation

4.1.2.2. Azure individual parameter assessment

With this brief analysis, we can already start filling the evaluation charts for Microsoft Azure. As we did before, the evaluation of the parameters will be done according to appendix 7.2.

We start with the product evaluation:

Table 8 Microsoft Azure portfolio evaluation product part

Parameter	Evaluation	Comment
Number of products	★★☆☆☆	It is hardly understandable as it has too many products, but the solution builder makes it bearable for some customers (not the majority)
Structure of the portfolio	★★☆☆☆	The structure would confuse a big part of the customers. It looks like an AWS copy with several flaws. The original portfolio in 2015 offered a clearer architecture
Technical quality	★★☆☆☆	The quality contains several major flaws that would affect most of the users. [58] [59]
Investment in the product	★★★★☆	Microsoft made a disappointing investment in

		Azure till 2018, although now Microsoft seems committed to the future with Azure, however, it is unclear how much Microsoft will support the cloud products if the results are negative [60]
Integration of the portfolio/cross-selling	★★★★★	This is a differentiator in Microsoft. The cloud products are seamlessly integrated into the whole Microsoft portfolio. Overall excellent cross-selling with Microsoft Software business.

Now we can evaluate the industry parameters:

Table 9 Microsoft Azure portfolio evaluation market part

Parameter	Evaluation	Comment
Potential growth of the industry	★★★★★	Azure is present in the fields in the cloud computing market growing more than 30% [17]. Azure is more selective than Amazon to enter a submarket
Market share of the product	★★★★☆	Strong number 2 with a firm grip in corporate customers, in Q4 2019 Azure accounts for 17.9% of the market [18]
Products adaptation	★★★★★	Products are selectively adapted to markets with strong growth and safe revenues. In their submarkets, Azure exceeds customer expectations in terms of features
Broadness of the portfolio	★★★★☆	Azure is covering the gaps where it was a bit weak. Now it is present in the critical features for its customers. Azure has a broad portfolio that can address most the customer use cases
Comparison with competitors	★★★★☆	In Azure's selected primal submarket (corporate customers), it is considered

		better than the competition. Very well integrated with the portfolio and problem-free for corporate accounts [58]
Price	★★★★☆	Azure has interesting plans for corporate businesses and proposes easy migrations. It is generally perceived from corporate accounts as having very good pricing and very well documented [61]
Profitability / cost	★★★★★	Microsoft can leverage Software costs, and here has a big advantage compared to Amazon, as Amazon must pay Microsoft licenses. Overall excellent margins, although not publicly disclosed

Now we can evaluate the corporate factors:

Table 10 Microsoft Azure portfolio evaluation corporate part

Parameter	Evaluation	Comment
Marketing	★★★★★	Excellent promotion known to most of the potential customers and through the already in place Microsoft channels. Very targeted marketing to corporate customers and a very extended sale force
Delivery	★★★★☆	Good product delivery that satisfies standard customers although a bit tedious, it fulfills the task
Support	★★★★☆	Leveraging Microsoft support, a very good support level that satisfies most of the customers. Integrated within Microsoft portfolio and fulfilling corporate requirements
Life cycle management	★★★★☆	Microsoft will stop products and create products very dynamically, adapting to the market. Overall, very good

		management with fast creation of products and fast discontinuation
Financial stability	★★★★☆	Microsoft is a strong corporation financially, but its commitment to Azure is questionable; however, it is assured as the market goes well. Overall good stability.

4.1.3. Google Cloud

Google comes as the third biggest supplier in the cloud computing space. It has a very prominent name in the IT industry. However, in the cloud, Google is instead the small (out of the big) guys. [18]

Google started in the cloud computing business in the early stages, in 2008. However, it never really got a breakthrough as AWS or Microsoft did, always considering it in perspective, as Google is still a big player.

The strategy at the beginning was to combine the growth in the cloud business with a mix of upselling the Google office suite (as Microsoft did) with the Google technical knowledge in big data to offer solutions in that space. The reality is that the Google office suite never became a leader, so that part of the business never bloomed, while the analytics section grew well. However, Google never developed the whole portfolio, and it is still offering bits and pieces and not a holistic approach. [62]

4.1.3.1. Google Cloud portfolio initial analysis

If we check the portfolio offering as we did for the others, we see a similar structure unsurprisingly:

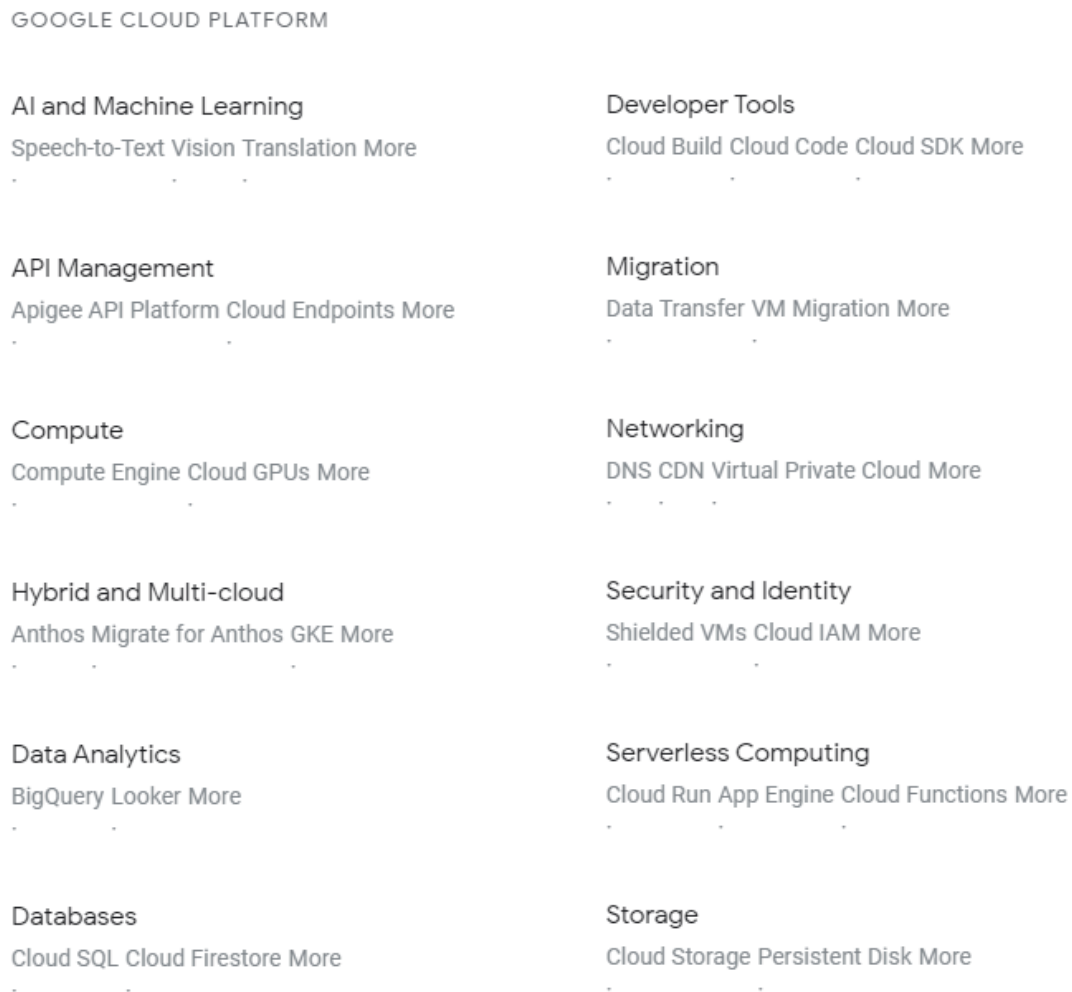


Figure 18 Google Cloud portfolio

We see a set of use cases again, and if we appreciate a leaner offering compared to Microsoft and AWS, it is because Google does not have such a broad portfolio as the competitors. However, still, we see the flaw of mixing pure services, such as “storage”, with pure use cases such as security and identity.

An exciting flip is the presentation of the solutions section:

BY TECHNOLOGY		BY INDUSTRY	
Infrastructure Modernization VM Migration SAP more	Artificial Intelligence Contact Center AI Document AI more	Retail	Manufacturing
Data Management Database Services Database Migration more	Security Security Analytics & Ops Application Security more	Financial Services	Energy
Application Modernization Anthos Serverless DevOps more	Productivity & Collaboration Work Transformation Chrome Enterprise more	Healthcare & Life Sciences	Government
Smart Analytics Data Warehouse Modernization		Media & Entertainment	Education
Data Lake Modernization more		Telecommunications	Small Businesses
		Gaming	

Figure 19 Google Cloud solution-oriented portfolio

The solutions are split by technology or by industry. While the technology section is self-explaining and straightforward, the technology seems another flavor of the use cases.

All in all, there are many possibilities, and Google tries to do a bit of everything, but it seems to miss a defined organization. The portfolio organization seems to say, “we are not a top player, and we do not want to innovate”.

4.1.3.2. Google individual parameter assessment

After this short introduction, we can review the portfolio parameters' assessment, and we can start with the product evaluation. We start with the product evaluation:

Table 11 Google Cloud portfolio evaluation product part

Parameter	Evaluation	Comment
Number of products	★★☆☆☆	Too many products, and not equally weighted. Hardly understandable by an average customer
Structure of the portfolio	★☆☆☆☆	It is neither a copy nor an innovation. The portfolio misses a clear structure. Hardly any new customer could understand the portfolio, very granular in some cases and missing basic services
Technical quality	★★★★☆	The analytics and big data solutions are very competitive.

		Overall an average customer would be satisfied
Investment in the product	★★☆☆☆	Google still does not have a complete offering. Although it does some steps there, there is no clear strategy. A low investment prevents Google to try to reach position one without a clear investment target
Integration of the portfolio/cross-selling	★★☆☆☆	The integration with G suite did not really ramp up, and the integration is mostly within the Google Cloud offering. Overall poor cross-selling capabilities

We can now evaluate the industry:

Table 12 Google Cloud portfolio evaluation market part

Parameter	Evaluation	Comment
Potential growth of the industry	★★★★★	Google is present in the big data, which is a growing sector, more than 30% [17]
Market share of the product	★★★☆☆	Number 3 in the market followed very close by Alibaba Cloud. Market share of 6% [18]
Products adaptation	★★★☆☆	The big data platform is solid. It could work as a good niche market strategy, but some use cases are not covered. Overall good adaptation for typical use cases
Broadness of the portfolio	★★☆☆☆	Google misses certain basic cloud offering services. Overall, Google cannot address a big portion of the use cases [58]
Comparison with competitors	★★☆☆☆	It can only compete in particular areas. Overall, Google is not considered a

		strategic cloud partner as AWS or Azure [58]
Price	★★☆☆☆	Google still misses a business adapted pricing, which pushes customers away. Generally perceived as worse pricing by big corporations [63]
Profitability / cost	★★★★☆	Google's own cloud is established and helps them to keep the costs down. However, it cannot scale up as competitors. Although we do not know the margins, we can consider them as good [63]

We do now the corporate evaluation:

Table 13 Google Cloud portfolio evaluation corporate part

Parameter	Evaluation	Comment
Marketing	★★★★☆	Google has a very strong name in the market regarding big data. However, its sales network is not as big. Overall, Google Cloud is known to most of the customers
Delivery	★★★★☆	Adequate in the market that satisfies a typical user, although there is potential to improve [63]
Support	★★☆☆☆	Google has a lack of business company adapted support. Also, it did have major issues, overall disappointing level of support [64]
Life cycle management	★★☆☆☆	Some products were discontinued, but there is no clear strategy. Disappointing life cycle management [63]
Financial stability	★★★★☆	While Google is financially strong, and the analytics portfolio is well backed up, the rest may just be abandoned from one day to the next based

		on the results. Overall good financial stability and there is a reasonable level of commitment for the future [63]
--	--	--

4.2. Aggregation of the portfolio components and numerical evaluation

Currently, we have an assessment of all the categories for the specific parameters for the selected companies. As discussed in section 3.4.3, to extrapolate conclusions or evaluate the parameters in an easier way, the goal would be to aggregate the individual components into a higher-level dimension, which is easier to understand. The aggregation will be performed according to eq. 1, and the calculations are summarized in appendix 7.3.

To proceed with the calculations, we can summarize the different individual scores in an aggregated table to have all the assessments next to each other. We proceed here to show the evaluation tables for every category, separate into different dimensions: product, industry and corporate. We will also add to the tables the importance or weight of every category as calculated in section 3.4.2.

We start with the summary of the product evaluation for all the companies:

Table 14 Global assessment for the product parameters of the portfolio

Parameter	Importance	Amazon AWS	Microsoft Azure	Google Cloud
Number of products	Low	★★★★☆ 2	★★★★☆ 2	★★★★☆ 2
Structure of the portfolio	Medium	★★★★☆ 4	★★★★☆ 2	★★★★☆ 1
Technical quality	High	★★★★☆ 4	★★★★☆ 2	★★★★☆ 3
Investment in the product	Medium	★★★★★ 5	★★★★☆ 3	★★★★☆ 2
Integration of the portfolio/cross-selling	Medium	★★★★☆ 2	★★★★★ 5	★★★★☆ 2
Aggregation*		★★★★☆ 3.6	★★★★☆ 2.8	★★★★☆ 2.1

*The aggregated values are calculated according to equation 1 and summarized in appendix 7.3.

We proceed in the same way for the industry parameters, and we show in a table all the individual assessments for the three evaluated companies:

Table 15 Global assessment for the industry parameters of the portfolio

Parameter	Importance	Amazon AWS	Microsoft Azure	Google Cloud
Potential growth of the industry	High	★★★★★ 5	★★★★★ 5	★★★★★ 5
Market share of the product	Medium	★★★★★ 5	★★★★☆ 4	★★★☆☆ 3
Products adaptation	High	★★★☆☆ 3	★★★★★ 5	★★★☆☆ 3
Broadness of the portfolio	Medium	★★★★☆ 4	★★★★☆ 4	★★★☆☆ 2
Comparison with competitors	Medium	★★★★☆ 4	★★★★☆ 4	★★★☆☆ 2
Price	Medium	★★★☆☆ 3	★★★★☆ 4	★★★☆☆ 2
Profitability / cost	Low	★★★★☆ 4	★★★★★ 5	★★★☆☆ 3
Aggregation*		★★★★☆ 4.0	★★★★★ 4.5	★★★☆☆ 3.0

*The aggregated values are calculated according to equation 1 and summarized in appendix 7.3.

To finish the evaluation per dimensions, now we summarize the assessments for the corporate parameters for every company:

Table 16 Global assessment for the corporate parameters of the portfolio

Parameter	Importance	Amazon AWS	Microsoft Azure	Google Cloud
Marketing	High	★★★★☆ 4	★★★★★ 5	★★★★☆ 4
Delivery	Low	★★★★☆ 4	★★★☆☆ 3	★★★☆☆ 3

Support	Medium	★★★★☆ 3	★★★★☆ 4	★★☆☆☆ 2
Life cycle management	Medium	★★☆☆☆ 1	★★★★☆ 4	★★☆☆☆ 2
Financial stability	Low	★★★★☆ 4	★★★★☆ 3	★★☆☆☆ 3
Aggregation*		★★★★☆ 3.1	★★★★☆ 4.1	★★☆☆☆ 2.9

*The aggregated values are calculated according to equation 1 and summarized in appendix 7.3.

4.2.1. Aggregation Summary

We already evaluated all the companies' individual components, and we performed the aggregations of the different dimensions, now we can summarize the results.

We can represent in a chart the obtained results:

Table 17 Cloud portfolio comparison

Company	Product	Industry	Corporate / internal
Amazon AWS 	★★★★☆ 3.6	★★★★☆ 4	★★☆☆☆ 3.1
Microsoft Azure 	★★★★☆ 2.8	★★★★★ 4.5	★★★★☆ 4.1
Google Cloud 	★★☆☆☆ 2.1	★★★★☆ 3.0	★★☆☆☆ 2.9

4.3. Portfolio strong and weak points evaluation

Once the different dimensions are aggregated, we can compare the performance and benchmark the weak and strong points of every portfolio. The detailed analysis of the portfolio, however, will be done in chapter 5.

An excellent way to visualize the dimensions is to assume that the market is composed only of these three players (not far from reality, as these are the three most prominent players and account for 50%

of the total market). In that way, we can see who the leader in every category is and identify how far the competitors are in every dimension:

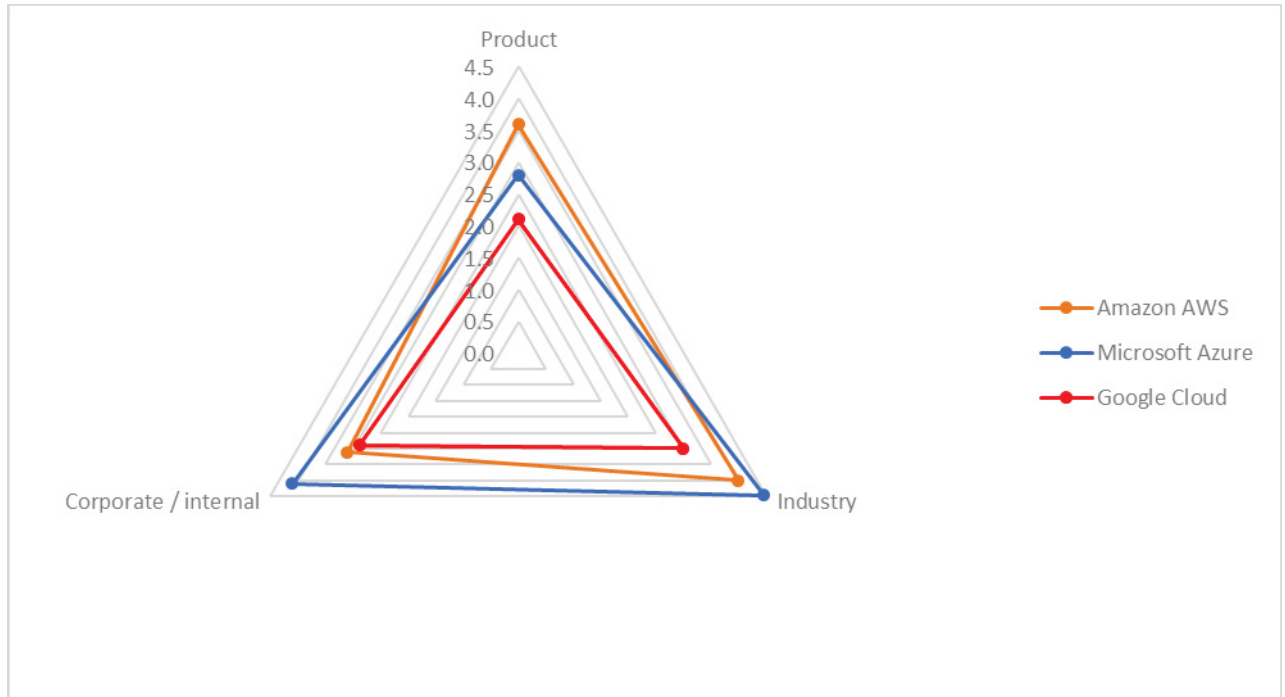


Figure 20 Cloud portfolio global evaluation

Amazon has leadership in the product area with a stronger portfolio in that category, meaning that the product itself is better than the competition. On the other hand, Microsoft is slightly more robust in the portfolio adaptation to the industry, meaning that the portfolio connects better with its market. Also, the portfolio is better supported by corporate and internal processes. Here Microsoft leads by a larger amount.

Finally, Google is behind the competition in all aspects.

As a follow-up on the portfolio evaluation, we can assess all the three companies' performance in the last year and analyze the results and if they match what we evaluated as the stronger portfolios. A logical outcome would be that the companies with a more robust portfolio would have better results.

4.3.1. Results evaluation of the example case

If we monitor the results from the last year and the evolution of the results, we have the following values: [18]

Table 18 Cloud computing market results

Cloud service provider	Q4 2019 USD billions	Q4 2019 Market share	Q4 2018 USD billions	Q4 2018 Market share	Annual growth
AWS	9.8	32.4%	7.3	33.4%	33.2%
Azure	5.3	17.6%	3.3	14.9%	62.3%
Google Cloud	1.8	6.0%	1.1	4.9%	67.6%

An important note is that a company's results are highly dependent on the past and on which company had a bigger footstep in the market earlier. Logically speaking, an early comer would have a bigger share, although that is not always the rule. [65] However, in this case, as the incumbent, AWS starts from a much higher market share than the competitors, and that is a position achieved over time, while in this case, we studied the portfolio in a specific moment of time.

Therefore, an excellent figure to analyze the market is the annual growth. However, checking the percentual growth may benefit the smaller players, making it “easier” to grow significantly. So, we can consider the absolute increase as a better figure to understand how much every company is growing.

As a note, we must also consider that the cloud market is growing strongly, so there is room for all the players to increase.

Amazon has a nearly double market share more than Microsoft and grew 33% or 2.5 billion per quarter.

Microsoft is growing at a much higher pace, nearly doubling Amazon’s growth rate. Although in absolute terms, Amazon increased 2.5 billion USD per quarter, while Microsoft only captured 2 billion per quarter of new businesses. If Microsoft keeps growing at its given pace, it may come closer to Amazon, and within mid-term, Microsoft can have the objective of becoming the industry leader.

Google has a third of business compared to Microsoft, and the percentual growth rate is very similar to Microsoft. The absolute increase of quarterly revenues for Google is just a third of how much Microsoft increased (2 billion vs. 0.7 billion). Within that perspective, Google will not catch up with Microsoft anytime soon.

We can examine together the portfolio evaluation and the financial results. According to our evaluation, both companies with the most robust portfolio: AWS and Azure, are growing faster than Google that has a poorer portfolio, according to our study. In principle, there seems to be a correlation between the portfolio strength and the company results that could corroborate our portfolio analysis, but that is not our study's primary goal.

4.4. Use case analysis conclusion

Based upon our initial assumptions, we distributed the portfolio assessment in three different categories.

The first category is the product, which is the internal measurement of how well our products within the portfolio are adequate in an isolated way. That means that we consider neither the industry nor the customers.

The second category is the industry adaptation of the portfolio, how well the portfolio is adapted to the market's current needs. Here we measure the synergy of the portfolio, how well it connects with the ecosystem in which it competes.

The last category is the corporate or internal category. It reflects how well the corporate organization can support the portfolio and maintain it. This would also be a measure of how well the portfolio connects with internal capabilities. To explain it with an example, we could have a portfolio with great products and adapted to the industry, but if the company cannot sell or deliver, then the portfolio will fail, so the corporate factors are a catalyzer of the portfolio strength.

To measure each category, we set different parameters to quantify them in a measurable way, as stated in appendix 7.2. Then aggregating those results, we could assess which company is more robust in a product portfolio category.

The goal was to apply our premises in the market of cloud computing, which is still young, dynamic, but already sizeable and with already big players. We applied our portfolio characterization methodology to this market, and we focused on the three most prominent players, namely Amazon, Microsoft, and Google.

In our example, we concluded that Amazon has a more robust product portfolio. However, Microsoft has an organization that supports the portfolio better, and also Microsoft's portfolio is slightly better adapted to the market.

While trying to validate the market positions' efforts, we see that Amazon is the market leader. Microsoft is in a strong second position and gets closer to Amazon, which seems to validate our premise.

Lastly, Google seems behind in all the categories, and Google is far from competing with Microsoft or Google, and its third position in the market could be at risk. So again, it seems that this use case validated our premises.

After evaluating the specific use case, in the next step, we would need to verify our hypothesis with experts in the field of product management.

4.5. Hypothesis validation through interviews

As discussed previously, one of the critical factors to corroborate the work would be to get some evaluation from third party people who are not in touch with the thesis and can provide an opinion on the whole structure.

The interviews' full transcription is recorded in the appendix, 7.4, 7.5 and 7.6, although here we will summarize the most important points raised during the interviews.

The first interview took place with Massimiliano Mannelli, who has a long experience as a portfolio director in different telecommunication industry companies supplying services and products.

4.5.1. Interview with Massimiliano Mannelli

For Mr. Mannelli, it is evident that the portfolio is a crucial factor in a company's results. In the current view in the business world, according to Mr. Mannelli, there is a narrow vision of the product portfolio, that it is only considered as the products themselves (the part which is usually under the control of the product managers). However, there is a broader view of the product portfolio that is generally only regarded by top management and not by the product managers. Mr. Mannelli considers that this methodology shows an excellent design because it considers that broader view of the portfolio. This can be seen in this work with the effort of adding the dimensions of the product and as well, the industry and the corporate or internal factors.

This has been exposed in many classical works, like the Boston Consulting Group and its matrix [39], where the portfolio is not just a constellation of products, and there are other critical factors involved. The pure "product" portfolio is just a catalyzer of the corporate and market synergies, and it can help to boost the performance of a company.

In that sense, Mr. Mannelli raised a couple of good examples. One typical example is the case of Kodak and its collapse. There is an obvious question “did the people stop doing pictures?”.

Of course, people did not, so the market or the use case was still there, and probably the technical quality of the Kodak photographic paper was better than the competitors. However, the market evolved into a new use case, digital photography, where Kodak was not prepared to reach that new use case.

The problem with Kodak was not only because of the products themselves or their quality but how the portfolio links with the use case. This validates the importance of the market adaptation of the portfolio.

Another example referred to the company Swissqual AG, for which Mr. Mannelli was working. The company was a small family-owned business with 100 employees working in a particular market. In 2012 the company was acquired by the Rohde & Schwarz group, and afterwards, the next following three years, the company's results grew substantially.

Mr. Mannelli was questioning that there were no determinant changes in the product portfolio in those three years or in the market. The reason for the abnormally good results can be found in the support of the Rohde & Schwarz group, a better name with a stronger marketing, a wider sales force, and a better financial stability. So, this proves that a strong corporate support can boost the portfolio performance.

So, one conclusion is that several factors affect the company's financial success relative to the portfolio, but the proposed way of analyzing: 1) the product, 2) the market and 3) the corporate seems to reflect very well the most critical parameters. Those categories match the dimensions taken in our example.

Given those basic dimensions, it would probably be a good idea to go one level more in detail and try to identify more specific or measurable parameters to assess the portfolio in a more structured way.

In that sense, Mr. Mannelli believes that the selected parameters to be measured are a good starting point. Although different industries would have differences, and potentially how we analyze a global B2B market is not related to evaluating the product for a consumer food company, for instance. However, it still makes sense to think that there are a set of “universal” indicators that could be measured to assess the different categories, in our case, the product, the market and the corporate factors.

This becomes more obvious when we consider the weighting of those parameters. In that regard, Mr. Mannelli pointed out some noticeable differences with different markets. While in B2B technical markets, like those where he is currently working, the most critical factor is the quality of the delivered product. However, there are other markets where the quality is not so important, and the other factors are more critical (like B2C markets).

Another interesting point regarding the weighting of the parameters is that those parameters cannot be considered isolated, and they all work together towards the company's success. We can say that those parameters are interlinked, and Mr. Mannelli explained that case with another enlightening example.

In the consumer market for portable music players, Sony had probably the product with the richest set of features, and surprisingly a competitor absolutely succeeded in the market and eventually threw away Sony out. That competitor was the iPod by Apple.

To find the reasons for that apparent illogical fact is that Apple had better marketing, and they created a product designed around the user. So, it connected better with the market, and in the overall picture, the portfolio was more appealing to the customers, even with a probably worse set of features.

A critical factor in the portfolio evaluation for Mr. Mannelli is not so much the different parameters to be evaluated but the different weights applied to the categories while doing the aggregation.

For example, in some commodities markets, i.e., the nail market, the price would be the most crucial variable, while in others, like very technical environments, the price is not as important. Those differences can also be perceived in some very regulated markets where the product difference is minimal. Let us say, for example, X-ray machines approved to be used in hospitals. While other markets like the food industries are very local, and every country would have different products with different brandings and other differentiator factors. So, in this case, the methodology should adapt to those different market conditions.

In our case, the portfolio evaluation makes sense and the evaluated parameters are relevant for different industries. Moreover, in our example for cloud computing, the results look very promising. As an expert in Product Management, this work is an excellent way to get an overview of a new market concisely and measurably.

Overall, the feedback from Mr. Mannelli is that our methodology makes sense, and it is a good idea as it tries to quantify things that before were only considered from a qualitative perspective.

The basic structure of the product, market and corporate dimensions finds support in the product management in real-life examples and probably reflects well most industries, and the selected parameters make sense to be evaluated. Also, the current way to aggregate parameters with different weights can help understand the portfolio easier.

However, as previously mentioned, the key for Mr. Mannelli to evolve the methodology would be to evaluate more markets and, if possible, very different ones. That would make the methodology evolve.

In this point, Mr. Mannelli had some nice words as he pointed that the methodology would need an evolution, but that is actually a good sign, that all the good initiatives always bring good follow-ups, while if there is an initiative without any follow-up action, that is already a worrying point.

4.5.2. Interview with Filippo Meloni

The next interview was performed with Mr. Filippo Meloni, a product management director with extensive experience in different industries and currently working in the pharma industry.

Mr. Meloni's opinions go in the same direction as the other interviews, and the first impression is that it is evident that the portfolio is one of the critical parameters that influence a company's performance. According to his experience, it often does not receive enough importance in the business world as it should.

Within the approach followed in this thesis, Mr. Meloni generally agrees on the different categories to evaluate the portfolio. He also evaluated positively the perspective of considering the portfolio on a broader scope, with the product view, the market view, and the corporate view.

Mr. Meloni sees the need to consider product-related features and market parameters, and in that regard, he connected immediately to the classical methods like the BCG matrix or the Ansoff matrix [24], where those features are correlated to give an idea of the product life cycle stage.

However, he related to his own experience to point out that the corporate factors are fundamental to achieve success with a portfolio. Therefore Mr. Meloni thinks that adding the corporate factors is an excellent decision that opens a broader perspective.

Moreover, those corporate factors are often not considered part of the product manager's responsibilities, which causes the portfolio management department to fail because of not considering the big picture.

Therefore, the split of a portfolio into different branches is appropriate, and the selected main branches sound in principle acceptable for Mr. Meloni. In the interview, there was no individual analysis of the single parameters to be considered to evaluate. However, one of the outcomes is that it is vital to consider the contingency and that different conditions would require adaptations in the evaluation.

Some different markets and situations would require different approaches. Also, different industries would have different requirements.

Still, an attractive joint agreement was that even if the conditions and industries were different, it would still be possible to find some similarities. Therefore, related to this thesis, a general methodology could be doable. Furthermore, Mr. Meloni agreed that the dimensions of product, market and corporate are right, and they are general to evaluate different markets.

Within this general methodology, to consider the different conditions, it would be critical that the methodology be flexible and adapt to the different conditions.

It is essential for Mr. Meloni to consider the methodology's adaptations to the specific conditions, and a weighting model of the different parameters is needed. In that sense, a sort of normalization of the methodology according to the different conditions would be needed to attain the desired general application.

Another critical point that is a conclusion from the discussion is that the market's maturity level is another crucial parameter to adapt the methodology. It would not be the same to compare a completely new market without competitors, with a very established market where the whole ecosystem is established, as it is rather a matter of continuity to deliver performance. In contrast, in other conditions for new markets or companies, we need a somewhat disruptive strategy.

Another point raised by Mr. Meloni was regarding the interest of having a measure of the Product Portfolio in a similar way as we are doing in the thesis. The topic is interesting for Mr. Meloni, but an apparent output of the discussion is that the score would be more relevant if applied to different companies in the same market, rather than comparing companies in different markets. So, a score of X points would be applied to a specific company in a specific market, while even with weights, it would be different from applying a benchmark of scores among companies in different markets.

So, Mr. Meloni finds very illustrative the case of the cloud computing market, where it is shown in an easy way, the positions for different competing companies within an industry.

One of the most exciting points of the methodology for Mr. Meloni is the actionability of the results. So, the methodology can assess the different portfolio structures and identify weak points and trigger corrective actions.

Also, a fascinating point would be to extract conclusions of how the portfolio or individual parameters can affect the company's performance. For that purpose, it would be imperative to collect as much data as possible from different companies and different markets to create a broader methodology. The idea was that, given that the methodology must be flexible, it would be an excellent idea to apply a

Machine Learning algorithm to adapt the weights dynamically to the new information. That would make the methodology fully flexible and allow adaptation to work with an immense amount of data.

In general, the feedback by Mr. Meloni is that the idea of the thesis is interesting, and it proposes exciting contributions that can be already now considered of use as proven in the cloud computing market analysis

Also, Mr. Meloni mentioned that if he were involved in consultancy for portfolio evaluation, a tool like the proposed methodology in this thesis would be beneficial.

4.5.3. Interview with Peter Raser

Peter Raser is the Head of the Products group in BTG. The BTG Group is a multinational provider of integrated, highly specialized process solutions for the global pulp and paper industry. It helps customers achieve sustainable gains in business performance via an advanced product portfolio. This includes world-leading rods and beds for film-metering size presses, high-performance ceramic and cermet coating blades, high-performance tissue creping doctors and doctor holders, inline and online measurement instruments. BTG employs more than 580 professionals worldwide and operates four manufacturing sites, three research centers and several regional application centers. The BTG Group is an operating unit of Voith Paper, which is based in Heidenheim, Germany.

Mr. Raser has an opinion that a portfolio is linked to financial success. We tend to that a portfolio covers customer's demands. It should be creating a successful business and differentiate it from others. It must allow sustainable pricing and margins. He is leading a product group with five product managers and approximately twenty-five different solution products. If we look at yearly revenue, then approximately 90% of revenue comes from five to seven products. However, to support these products' sales, we must maintain a product portfolio that contains twenty low selling products.

He mentions making product portfolio sales effective. It needs to fulfill market demand effectively in comparison to other solution providers. It is also essential to plan a technology or market launch of the new product. This is part of product portfolio management.

As he pointed out, we need to find a way to support most selling product sales using other products for long-term success. It is crucial in practical portfolio management to take out single products and analyze sales numbers and individual products' contribution. Sometimes, having a low selling or less margin product in the portfolio can be decisive in the sales of many other products. It will be more effective if different products complement each other as a complete solution provider to fulfill market demand. Mr. Raser gave an example in his interview on how kappa measurement product portfolio development helps the company be more successful in this domain.

In section 3.4.2, product portfolio categories weighting, we have listed out different parameters to point out their importance in product portfolio management, like that Mr. Raser gave very high importance to market demand. According to him, a portfolio should be as per customer requirements. It should contain several products that reach out with a complete solution to the customer. Those products can have variations as per technology and their results, but they should complement each other when providing a solution.

Mr. Raser points out an important parameter, the balance between high and low sales products in the portfolio. We have also kept this point as a measure in our thesis work. There can be few products on meager sales, but it is essential to have them in the portfolio to support other products' sales. In a complete portfolio, every product has a contribution margin that differs from each other. So, products generate high and some low margin. A company's financial success depends on how a margin or profit is distributed in the product portfolio. For example, if a low selling product will have less margin and

high selling a right margin, then the overall profit will be high. However, if it is vice versa, it will end as a less financially profitable product portfolio. Development and high maintenance cost for the individual product in the complete portfolio also needs to be managed effectively.

Peter points out the number of parameters that are important to design a financially successful portfolio. For the thesis work, we have categorized different parameters in low, high, and medium. This will help us to judge the importance and make prioritization. Also, to keep in attention, our thesis provides a general statement for all industries interested in product portfolio management, where Mr. Raser has BTG in focus when answering the interview.

He agrees with us to structure all these parameters and do an evaluation. As he thinks it will help in decision making, point out priorities in terms of useful parameters. As an example, he mentions that business cases do not only rely on a single product calculation but also investigate the impact on the portfolio. He mentions that his company is working on a digital solution product that required physical products for measurement. This is one way of strengthening the current product portfolio and generate new solutions or products to market.

At the end of the interview, we have asked a few questions about our thesis work and its methodology to analyze product portfolio importance in financial success. As per Mr. Raser's statement, the method fits the presented example well, even if the evaluation is difficult. We have realized that as well, it is not easy to prepare one methodology that fits all cases. In the thesis work, our focus is to provide a general and optimal fit for all statements. He has also mentioned that we have a well-oriented thesis structure. Also, he supports our weighting system (low, high, and medium) in the methodology. As per him, without weighting, this methodology will not be useful.

He has also mentioned the conclusion of this thesis can generalize for all types of industry. However, it will differ as per the market, products, and the user of the products. He also mentions that we are well oriented in our thesis work and presented method. It is challenging to define a model that fits all, but it can help show the methodology's widespread impact and linkage.

We are thankful to Mr. Raser for his time and support of our thesis work. In general, he mentions that the thesis's idea is exciting and has a direct correlation between the industrial world and theoretical explanation. Any individual industry can take this thesis as a baseline and build its own product portfolio management methodology.

5. Analysis

5.1. Analysis overview

In the empirical findings, we ran two different research types as previously discussed in the methodology, in figure 3.

First, we have a qualitative analysis where we identified the main characteristics of a portfolio analysis. In this phase, we defined a group of dimensions and characteristics that can be evaluated and provide a holistic summary of the portfolio structure.

The most important outcome in this phase is the identification of the dimensions within a portfolio, as we called them, the three pillars of the portfolio: 1) the product perspective of the portfolio, 2) the market perspective of the portfolio, and 3) the corporate or internal perspective of the portfolio.

We went into detail in the specific characteristics within those main groups that could be identified to measure the portfolio in a quantitative way. Those characteristics were identified in appendix 7.1. We also defined a process on how to evaluate those individual components objectively and described in appendix 7.2.

That hierarchical and holistic structuration of the portfolio is one of the critical challenges that we face in our research. It is as well one of the key differentiators with the available literature. There are multiple analyses to evaluate portfolios in a qualitative way for specific parts, but there is no abundance of quantitative studies assessing the whole portfolio.

In this study, the portfolio analysis was executed for a specific industry, and we chose cloud computing, where we performed the portfolio evaluation of the biggest companies. So, we applied our approach to the cloud computing market.

Once the different characteristics of the portfolio are evaluated, the next step is to aggregate the values to have precise primary assessments of the main dimensions. This was performed in the second phase of the methodology. From the evaluated parameters, we aggregate them according to the weights defined in chapter 3.4.2.

In phase 3, once the dimensions are distributed and assessed with a single score, we compare the different competitors and benchmark which companies are weaker or stronger in different areas. From a general perspective, it would be possible to identify which competitor has a higher portfolio score. The following step was to verify if the companies' performance is correlated with the strength of the portfolios.

At the end of phase 3, we already evaluated the different companies' portfolios, and we could understand their main differences. In phase 4, the final step would be to validate the results and the whole process with portfolio management experts. If experts in product management and without experience in cloud computing can understand and follow our evaluation and get an idea of the specific market, that would prove that our process is well structured.

5.2. Competitors positioning evaluation

Based on the portfolio evaluation results, a good try would be to evaluate the different companies' positioning according to our analysis and the market data. If we follow a classical evaluation of a company's possible positions, a company can be either leader, challenger follower or niche.

We can evaluate this position according to the attitude of the company: [66]

Table 19 Positioning of a company according to the attitude

	Company focused	Competition focused
Pushes the boundaries	Leader	Challenger
Stays within boundaries	Niche	Follower

The portfolio is an excellent way to evaluate the company's attitude if it aims to push its limits or stay within the boundaries. As well, it would be possible to understand if the company is focused or on the competitors.

According to our portfolio evaluation, we can say that both AWS and Azure push the boundaries and have a clear goal to lead the market. On the other hand, Google seems to rather stay within its boundaries, and it does not develop a full portfolio to cover all the use cases.

Regarding the focus of the companies, AWS has the lead in the product and technical evolution. Therefore, it can be considered the market leader, while Azure, although trying to challenge position 1, is still behind AWS in the product dimension, and there it is still trying to build up a competitive product. The big differentiator of Azure is preferably on the corporate dimension, where Azure can offer outstanding solutions to the big corporations, which is indeed a very important submarket.

In any case, we can say that AWS is the market leader, and Azure is the follower.

Regarding Google, it is clear that although it keeps an eye on the competition, Google focuses on the big data and AI / ML markets to differentiate from competitors so that Google would be a niche. [63]

We can represent the position in the previous graph:

Table 20 Positioning of a company according to the attitude

	Company focused	Competition focused
Pushes the boundaries	Leader AWS	Challenger Azure
Stays within boundaries	Niche Google cloud	Follower

5.3. Individual company recommendations

Based upon the analysis of the three identified dimensions of the portfolio, specific trends can be identified in the company portfolios. Under appendix 7.7, we developed some examples with the most typical configurations that will be used in this section to make recommendations.

Going into detail into the different company evaluations, the next step would be to evaluate each company sequentially and propose improvements.

5.3.1. Amazon portfolio recommendations

Amazon has the best product of the portfolio aspect. Obviously, Amazon should aim to maintain position number 1 in that field. However, Amazon should improve the industry part of the portfolio and the corporate internal factors as Azure is better, and therefore getting stronger.

If we compare the Amazon radar chart in figure 22 with the examples in appendix 7.7, then we can see that the most similar figure is the mouse in the cellar. It presents relatively stronger industry and product dimensions and a weaker corporate dimension.

Of course, Amazon's chart is not as extreme as our examples, but this would point that AWS is in potential danger unless they strengthen the corporate position. Given the good product and the industry categories, the recommendation would be to accumulate the market's profit to get a more substantial corporate factor.

That is the first recommendation for Amazon. However, it may be a bit generic, so we can benchmark the specific categories for all the companies to spot Amazon's pain points.

According to table 15, where we reviewed the industry parameters for all the companies, there are two main points where Amazon is behind Azure: market adaptation and price/cost.

The product adaptation of Amazon is scored as the poorest among all the companies, as Amazon has an exhaustive approach and tries to cover all the use cases with multiple different products. The competitors have created a more targeted portfolio.

So, a recommendation would be that the portfolio should adapt better to the market needs. As this may still be a bit broad and it would be difficult to achieve, a more concrete recommendation is to cover at least some specific use cases or needs with a very streamlined product offering., what Azure and Google offer as their use cases.

Again, here going one level further in the recommendation, we can propose that Amazon can cover a new growing use case, which is poorly covered by the competitors (e.g., a global blockchain system in a private cloud). That would be an offensive strategy to create a new use case and cover it better than the competitors.

A defensive approach to cover the position, especially from Azure, would be to address better the use cases where Azure is most successful. Here the most obvious case where Azure is really making a difference is adapting the portfolio to corporate customers. A recommendation would be to create packages, especially for these customers, and provide all the additional bundles and assistance that Azure is already providing.

The other pain point of Amazon in the market adaptation is the pricing and cost issues, which probably are both related. The cost issue is due to the strong alliance between Intel and Microsoft, which puts intense pressure on Amazon and the prices for Microsoft Software needed in the Amazon cloud. On the one hand, the obvious recommendation to Amazon would be to create strong alliances with Hardware partners to bring down their costs. Also, to protect from Microsoft, Amazon should investigate alternatives regarding software, especially in Operating Systems. So, a wise solution for Amazon would be to push Linux (as an alternative to Microsoft Operating Systems) as much as possible.

Regarding pricing, once the cost part is already addressed, it would be easier to tackle. However, a self-explanatory recommendation is to match the prices for the use cases where Azure is becoming very strong, again in the corporate market. So, very much related to the first recommendation, Amazon should try to address the corporate use case or niche market better. An essential part of it is definitely developing a price model with bundles that is competitive with Azure prices.

Once we addressed the market dimension, the next step would be for Amazon to evaluate what can be done in the portfolio's corporate group.

In the corporate section of the portfolio summarized in table 16, the main parameters where Amazon is behind are the marketing, support, and life cycle management. For the recommendations, we can bundle the marketing and support on one side. Once again, making an unequivocal recommendation is to cover the points where Azure is solid, the corporate sector.

Azure has a powerful marketing and sales force and a support division for corporate accounts. Amazon should try to replicate this success with more focus on that customer line and potentially create a department managing those customers and providing the services that Azure is exceeding.

Regarding life cycle management, Amazon needs to start cleaning its product portfolio and terminating many product lines.

These were the recommendations for Amazon in the corporate and market branches. The hypothesis is that by applying these recommendations, Amazon would neutralize Azure's success and would reinforce its number one position in the market.

5.3.2. Azure portfolio recommendations

It was already clear that the weak part of Azure was the product perspective, so we can analyze in that regard and propose some recommendations to balance Azure's position.

If we compare Azure's radar chart in figure 22 with the examples in appendix 7.7, we can identify Azure as an eagle with the fear of heights, having strong corporate and industry ratings.

As in the example, the point is that the company is strong and has the muscle to invest, and they have spotted the right industry. So, the recommendation is to invest the money into that industry to get the product's right technical development.

We can do a more detailed analysis of the product dimension.

According to table 14, we can see that Azure is behind mainly in 3 categories, the structure, the technical quality, and the investment in the portfolio. Again, to simplify, we will bundle them, and we will analyze the technical quality and the investment together. Obviously, it would not be possible to improve the technical quality without more significant investment to get closer to Amazon. Therefore, an obvious recommendation for Microsoft is that if they trust the cloud market, they should aim to be number one and increase the investment and try to be an innovator in the technology and not a follower. This would be again an offensive strategy.

On the other hand, there is a slight relation with the previous point in the portfolio structure, and Microsoft could change the strategy, and instead of aiming to be a challenger, they can try to be leaders. The follower position indicates that Microsoft's portfolio structure is just a copy of that of Amazon. In the whole offering, there is still a vision that Amazon is the leader (it is currently), and there is not enough assertiveness in Microsoft to try to gain that position. If Microsoft wants to be number one, they should create their own structure, focus on the use cases (which are very strongly covered in the market and corporate structure) and stop looking at the competition while structuring the portfolio. Instead of looking at the competition to structure the portfolio, the recommendation would be that Microsoft checks its own strengths (mostly in the market and corporate fields) and organize the portfolio around those strengths.

5.3.3. Google portfolio recommendation

If we compare Google's radar chart with the examples in appendix 7.7, although we see that the scores are smaller than the competition ones, the picture also looks like an eagle with fear of heights. That

means strong industry and corporate factors and a relatively weaker product. So, the recommendation would be to leverage the strong corporate and industry factors to improve the product.

Also, from a direct comparison between google and AWS and Azure, one may say that Google cannot compete in equal conditions with Amazon or Microsoft, and that is not a bad summary. Google is way behind in all the categories, and improvement in all of them is not feasible in the short term.

Google is clearly the third party, so the adequate recommendation here is to be opportunistic in the market and look for their niche. Google can profit from the Amazon and Microsoft war and profit from their own advantages.

In this strategy, it would be needed that Google sets a clear goal and a clear differentiator with Microsoft and Amazon. It could be price, but it could be also focus on some niche markets like Artificial Intelligence, where google is powerful. However, it is useless that google tries to replicate Amazon or Azure. Google should set its own strategy and focus on some differentiators. It is unfeasible to reach a leader position as they are doing now. They should scale down (saving costs then) and focus on the submarkets where Google could make a difference.

5.4. Interview analysis

Finally, once we derived some hypotheses from our methodology, the last phase, phase 4, involves the validation of our premises with some experts in the market.

This analysis is fascinating as it provides a new dimension to the study, and most importantly, it supplies different points of view.

The interviews' primary outcome is that the whole study, in a general way, makes sense, and it can be something useful and has possibilities to be expanded. This is very important as independent parties in the portfolio management agreed that the methodology is new and ambitious. However, every one of the interviewees mentioned that it is something useful and creative.

One of the points raised in the interviews as potential improvement is that the methodology can be adapted for different use cases for different markets. From that perspective, the best-discussed outcome would be to implement some general dynamic parameter weightings that would adapt the methodology to different use cases and industries.

Also, there was some feedback regarding some additional parameters that could be added, but those are smaller changes.

Furthermore, the interviews' significant outcome is that the methodology is useful and is the right approach, but it requires validation in the field with further studies. This methodology aims to provide a starting point for future evaluations and sequentially adapt it to the different requirements in different conditions.

6. Conclusions

This paper aims to provide a holistic and structured methodology to evaluate product portfolio management and look at the cloud computing market and review Amazon, Google, and Microsoft's product portfolio structure.

The research widely accepted that product portfolio management has great importance in the company's financial success. Therefore, it is clear that the effort to optimize the product portfolio is needed to improve the company's results. Consequently, there are multiple studies on improving specific areas of the product portfolio in some circumstances.

However, from a systematic point of view, it sounds logical first to have an overview of the portfolio, identify its most critical point, and start optimizing it. We have found that there are not many research efforts on characterizing the portfolio before performing a portfolio optimization.

That is precisely the space that this work tries to fill. We have approached the task of defining a methodology to characterize the product portfolio hierarchically. We can apply that characterization to several competitors in the same market and then identify strong and weak points of the portfolios of those different companies, which we believe is crucial before starting a product portfolio optimization work.

The product portfolio is a very broad topic, and sometimes it is a very technical question. Therefore, it is not easy to provide a methodology that can be applied in any circumstance. However, the classic literature (namely Ansoff and BCG matrix) attempted to define the portfolio based on general conditions, which can be applied to several circumstances. So, the idea here is to take that effort and update it according to several newer research studies. Given that the work is very complex, we split the task into four different phases.

The first phase would be to define the portfolio dimensions to be evaluated. In classical studies, the evaluated dimensions were related to the products themselves and their performance and the correlation with the company's industry. That analysis works when we compare products within the same company, but if we benchmark different companies, we need to consider a third dimension, the corporate factors, which will also influence the market's portfolio success.

We then have three identified dimensions: product, industry and corporate. Nevertheless, the question is not over, as it is not merely to evaluate those categories directly. We defined a set of smaller parameters that can be easily identified, which will help us assess the initial dimensions.

The second phase consists of how to weigh those individual parameters to evaluate the specific product portfolio dimensions. It is evident that not every parameter would have the same importance.

In the third phase of our thesis, we already have a set of parameters to be assessed to characterize the product portfolio, and we have those parameters ordered by importance. We can already have information, or ideally a score for each of the main dimensions, so if we compare different companies, we can already identify the weak and strong points of the portfolio. At this point, we can already highlight the areas in the portfolio that require attention. Furthermore, given that we have a hierarchical structure of those dimensions, we can identify smaller characteristics that can be causing a suboptimal portfolio.

In the fourth and last phase, we evaluate the job. Furthermore, in general, validate if such a methodology is useful for the current product portfolio work. The followed approach was to conduct open interviews with experts in portfolio management to validate such a new perspective. If we can

present a methodology to characterize the portfolio to experts who are currently doing the job, it would be the best way to understand the real value of the work and how the research can evolve in the future.

A vital requirement for a methodology is that it can be applied in real cases. We decided to apply the methodology that we developed to a specific industry and benchmark the leading players' portfolios.

In principle, we could have selected any industry, but we decided to evaluate the cloud computing market as it has several characteristics that make it interesting for our portfolio analysis. On the one hand, the market is relatively young and growing at a high pace, which would imply that the product portfolios are still dynamic. Also, this market has a high concentration of supply, with three companies accounting for more than 50% of the total revenues. That makes it easier to analyze the portfolios of those dominating companies.

We can apply the methodology that we developed to the example industry that has desirable characteristics for our analysis. We proceed with the discussed phases in this example.

First, we evaluate the individual parameters for the portfolios for all the companies. We aggregate those parameters, and at the end, we have three scores, one per dimension, for all the evaluated companies. In that way, we can compare the portfolios and identify potential improvements.

Not only we can evaluate the absolute scores of the portfolio dimensions, but also, we can establish the link with the classic examples in the portfolio analysis. We can identify the relations among the three evaluated dimensions to identify which company emphasizes the product dimension, for example. Moreover, we can highlight which of them is the weakest one.

In that regard, AWS is the market leader, but it has only the strongest portfolio score in the product dimension, while Azure is stronger in the industry and corporate dimensions. Checking AWS relative dimension strengths, Amazon is strong in the product and industry dimensions but weaker in the corporate dimension. That means that the priority of Amazon's portfolio should be set to improve the corporate factors, such as the sales channels or the support. It is noticeable that thanks to our structure, we can go so in-depth in our recommendations.

Microsoft is a strong follower in the market, and as already mentioned, it has the absolute top scores in the industry and corporate dimensions. If we compare the dimensions relatively, we see that Microsoft is strong in the industry and corporate dimensions but suffers in the product dimension. Therefore, the recommendation would be to invest more in the quality of the product. Microsoft is reducing the distance with Amazon, which seems to validate the premise that the portfolio is important for the company's profitability and that Microsoft has a slightly better portfolio.

The last analyzed company, Google, has a weaker portfolio in all of the dimensions. It does not sound sensible for Google to compete directly with either Amazon or Microsoft, and the most reasonable solution would be to differentiate. This can be achieved by focusing on a niche market or by reducing the prices.

This full set of results was shared in the interviews to validate the methodology, and a significant takeaway is that this paper provides a methodology that can help understand the product portfolios for different companies.

This thesis demonstrates a mixed methodological approach to assess product portfolio management. To complement our methodology and arguments, we applied our approach to a real market to validate its validity. We can highlight three points in our work. First, our methodology seems to apply well to the market example, and it helps analyze the different competitors in this specific business segment.

We analyzed a benchmark of those different portfolio structures of different companies in the cloud computing market. Second, it is possible to identify the specific parameters that differentiate the portfolios of different companies. This is a very significant step, as it can enable us to compare different company strategies or spot suboptimal problems in the product portfolio in particular categories. Third, the methodology helps to characterize different companies, but it also helps spot the weak and strong points of the different companies. Therefore, the methodology can also help to provide some guidelines for portfolio management.

Our thesis is focused on specific parameters to support effective product portfolio management over the lifecycle. The focus is more on the necessary foundations. The roles of data, processes, or information systems can be considered for further research work. Also, how company supply chain logic may affect the product is not analyzed. Our work provides only an example in terms of the number of analyzed companies and interviewees. The proposed product design logic was accepted by responsible company representatives to be used in ongoing efforts to enable real-time analysis of products and the portfolio.

Also, the focus was limited to certain product lines and a market segment. Hence, further studies are needed to include evidence from various industries and companies and study the relation to established concepts such as module product solutions and platforms. Product master data and business process-related data and the role of different business processes and IT systems could also provide an exciting context to analyze the role of product portfolio design further.

In summary, given the good results obtained, this methodology can be considered a first step in developing and validating a structure to evaluate portfolios. However, it would be of great value to apply the methodology to a different marketing segment and in different market conditions as a next step. This methodology can help to analyze the impact and correlation to the financial results across time.

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Appendix

7.1. Factors to be evaluated in the portfolio evaluation

Based on the multifactor GE matrix, [41], the parameters to be evaluated are:

From the industry perspective:

- Industry size
- Industry growth
- Market profitability
- Pricing trend
- Competition intensity
- Overall risk and returns in the industry
- Opportunity to differentiate products and services
- Distribution structure

From the product strength perspective:

- Strength of assets and competencies
- Relative brand strength
- Market share
- Customer loyalty
- Relative cost position
- Distribution strength
- Record of technological or other innovation
- Access to finance and other investment resources

From the BCG analysis, these parameters were proposed [39]:

- Resources and Resource Usage
 - Investment/revenue
 - Plant and equipment newness
 - Capacity utilization
 - Capacity/market size
 - Sales/employee
- Working Capital Management
 - Receivables/revenue
 - Inventory/revenue
- Domain
 - Relative product line breadth
 - Relative customer type breadth
 - Relative number of customers
 - Customer fragmentation
- Vertical Integration
 - Value/added revenue
 - Relative integration backward
 - Relative integration forward
- Expense Structure
 - Manufacturing/revenue
 - Product R&D/revenue

- Process R&D/revenue
- Salesforce/revenue
- Advertising and promotion/revenue
- Competitive Devices
 - Sales from new products
 - Relative sales from new products
 - Relative prices
 - Relative direct costs
 - Relative image
 - Relative services
 - Relative advertising expenses
 - Relative promotion expenses
 - Relative sales force expenses

From the broad BCG analysis [4]:

- industry attractiveness
 - market size
 - growth, profitability
 - cyclicalities
 - ability to recover from inflation
 - world scope
- business strengths
 - market position
 - domestic market share
 - world share
 - share growth
 - share compared with the leading competing brand
 - competitive strength
 - quality
 - technology
 - cost
 - marketing
 - relative profitability

Based on this data, the selected parameters to be analyzed are the following:

- Purely product related
 - Number of products
 - Structure of the products within the portfolio
 - Technical quality
 - Investment in the product
 - Integration of the portfolio/cross-selling
- Industry-related evaluation
 - Potential growth of the industry
 - Market share of the product
 - Product adaptation
 - Broadness of the portfolio
 - Comparison with competitors
 - Price
 - Profitability / cost
- Corporate internal factors

- Marketing
- Delivery
- Support
- Life cycle management
- Financial stability

7.2. Likert scale scoring rules

The rules and scoring criteria for the Likert scale will be defined in this section. The main category specifies the rules.

Regarding the actual score, when it is subject to subjective evaluation, we will use independent online analysis in order to set the scores based on a professional assessment [67] [58] [62].

Table 21 Product related Likert evaluation criteria

Parameter	What we measure?	Score	Criteria
Number of products	Is the number of products too big or too small?	★★★★★	Excellent choice of the number of products. It provides a good granularity to collect the different use cases, but it is also easy to understand
		★★★★☆	Very good choice of the number of products. It provides an adequate granularity to collect the different use cases and understandable by the customers
		★★★☆☆	Good choice of the number of products. It provides just enough granularity to collect the different use cases, and some customers could understand it
		★★☆☆☆	Disappointing choice of the number of products. It provides not enough granularity to collect the different use cases, or it is hardly understandable by some customers
		★☆☆☆☆	Very bad choice of the number of products. There is no granularity level to collect the different use cases, or it is understandable by customers
Structure of the portfolio	How well are the products arranged within the portfolio?	★★★★★	Excellent product structure. It makes it very easy for any customer to understand the portfolio structure and select an adequate item
		★★★★☆	Very good product structure. It makes it easy for most customers to understand the portfolio structure and select an adequate item

		★★★★☆	Good product structure. It makes it easy for the average customer to understand the portfolio structure and select an adequate item
		★★★☆☆	Disappointing product structure. It makes it hard for most customers to understand the portfolio structure and select an adequate item
		★★☆☆☆	Very bad product structure. Hardly any customer could understand the portfolio structure and select an adequate item
Technical quality	How well is each product designed to achieve the design goal?	★★★★★	Excellent design of the product that exceeds most customer requirements
		★★★★☆	Very good design of the product that fulfills most customer requirements
		★★★☆☆	Good design of the product that fulfills average customer requirements
		★★☆☆☆	Disappointing design of the product that does not fulfill a majority of customer requirements
		★☆☆☆☆	Very bad design of the product that hardly fulfills any customer requirements
Investment in the product	How much has the company invested in a product?	★★★★★	Very strong investment in the past that could provide all the required resources to develop the required solution and on top there is the certainty of future investment
		★★★★☆	Strong investment in the past that could provide the required resources to develop the required solution, and on top, there is a promise of future investment
		★★★☆☆	Sufficient investment in the past that could provide just enough resources to develop a basic solution and on top, there is some continuity in future investment

		★★☆☆☆	Disappointing investment level in the past that could not provide enough resources to develop a competitive solution, and on top, there is uncertainty in future investment
		★☆☆☆☆	Very poor investment level in the past that was not sufficient resources to develop any competitive solution, and there is no plan for future investment
Integration of the portfolio/cross-selling	How well the different products in the portfolio interact with each other to provide a rich solution offering?	★★★★★	Excellent cross-selling capabilities within the portfolio
		★★★★☆	Very good cross-selling capabilities within the portfolio
		★★★☆☆	Good cross-selling capabilities within the portfolio
		★★☆☆☆	Poor cross-selling capabilities within the portfolio
		★☆☆☆☆	Very bad cross-selling capabilities within the portfolio

Table 22 Market / Industry related Likert evaluation criteria

Parameter	What we measure?	Score	Criteria
Potential growth of the industry	How much we expect the product target industry to grow?	★★★★★	More than 25% of expected market growth
		★★★★☆	More than 15% but less than 25% of expected market growth
		★★★☆☆	More than 5% but less than 15% of expected market growth
		★★☆☆☆	Market growth between 0 and 5%
		★☆☆☆☆	Either no or negative market growth
Market share of the product	How much market share does the product currently have?	★★★★★	More than 30% of market share
		★★★★☆	Market share between 15 and 30%

		★★★★☆	Market share between 5 and 15%
		★★☆☆☆	Market share below 5%
		★☆☆☆☆	No market share
Products adaptation	How much are the products adapted to the customer's need from a market perspective?	★★★★★	Excellent customer adaptation for most customer use cases
		★★★★☆	Very good customer adaptation for most customer use cases
		★★★☆☆	Good customer adaptation for the typical customer use cases
		★★☆☆☆	Disappointing customer adaptation that does not satisfy a majority of the customer use cases
		★☆☆☆☆	Very bad customer adaptation that hardly satisfies any of the customer use cases
Broadness of the portfolio	Are the products only adapted to specific use cases, or are they generic?	★★★★★	Very broad portfolio that can address all the relevant use cases
		★★★★☆	Broad portfolio that can address most of the relevant use cases
		★★★☆☆	Broad portfolio that can address the average or the relevant use cases
		★★☆☆☆	Poor portfolio broadness that cannot address an important portion of the relevant use cases
		★☆☆☆☆	Very poor portfolio broadness that can hardly address any relevant use cases
Comparison with competitors	How good are our products compared with our competitors?	★★★★★	The customers perceive the product as of much superior quality compared to the competitors
		★★★★☆	The customers perceive the product as of better quality compared to the competitors
		★★★☆☆	The customers perceive the product as of comparable quality compared to the competitors
		★★☆☆☆	The customers perceive the product as of worse quality compared to the competitors

		☆☆☆☆	The customers perceive the product as of much worse quality compared to the competitors
Price	How much does the user perceive the price of our solutions?	★★★★★	The customers perceive the product as of excellent price
		★★★★☆	The customers perceive the product as of very good price
		★★★☆☆	The customers perceive the product as of good price
		★★☆☆☆	The customers perceive the product as of poor price
		★☆☆☆☆	The customers perceive the product as of very poor price
Profitability / cost	What are our margins for a given product?	★★★★★	Excellent margins (more than 90%)
		★★★★☆	Very good margins (between 70 and 90%)
		★★★☆☆	Good margins (between 40 and 70%)
		★★☆☆☆	Poor margins (between 20 and 40%)
		★☆☆☆☆	Very poor margins (below 20%)

Table 23 Corporate / internal related Likert evaluation criteria

Parameter	What we measure?	Score	Criteria
Marketing	How well are the products promoted?	★★★★★	Excellent promotion of the products known to most of the potential customers
		★★★★☆	Very good promotion of the products known to a majority of the potential customers
		★★★☆☆	Good promotion of the products known to the average of the potential customers
		★★☆☆☆	Disappointing promotion of the products not known to a majority of potential customers
		★☆☆☆☆	Very bad promotion of the products hardly known to any of the relevant potential customers
Delivery	How easily can we deliver our products?	★★★★★	Excellent product delivery that satisfies most of the customers

		★★★★☆	Very good product delivery that satisfies a majority of the customers
		★★★☆☆	Good product delivery that satisfies a the typical the customers
		★★☆☆☆	Disappointing product delivery that does not satisfy most of the typical the customers
		★☆☆☆☆	Very bad product delivery that hardly satisfies any of the relevant customers
Support	What is the support level offered by the company?	★★★★★	Excellent support level that exceeds most customer requirements
		★★★★☆	Very good support level that fulfills most customer requirements
		★★★☆☆	Good support level that fulfills average customer requirements
		★★☆☆☆	Disappointing support level that does not fulfill a majority of customer requirements
		★☆☆☆☆	Very bad support level that hardly fulfills any customer requirements
Life cycle management	How easy is it for the company to change products, discontinue or create new products?	★★★★★	Excellent life cycle management, the products are introduced when needed and terminated in the perfect moments
		★★★★☆	Very good life cycle management, most of the time the products are introduced when needed and terminated in the perfect moments
		★★★☆☆	Good life cycle management, normally the products are introduced when needed and terminated in the perfect moments
		★★☆☆☆	Disappointing life cycle management, either the products are not introduced when needed or terminated in the perfect moments
		★☆☆☆☆	Very poor life cycle management, the products

			are hardly introduced when needed or terminated in the perfect moments
Financial stability	How stable is the company within a specific market?	★★★★★	Excellent support from a very stable company with very good perspectives in the future
		★★★★☆	Very good support from a stable company with good perspectives in the future
		★★★☆☆	Good support from a relatively stable company and the perspectives for the future are satisfactory
		★★☆☆☆	Poor support from a company that is not very constant with no clear perspectives in the future
		★☆☆☆☆	Very bad support from a company that it is either not stable or does not invest in the product line and the perspectives in the future are very bad

7.3. Portfolio scores aggregation

In this section, we copy the needed calculations used in section 4.2. We will use the eq. 1 with every category for all the analyzed companies.

First, we summarize the product category, and at the beginning, we analyze Amazon:

$$\begin{aligned} AWS_{ProductAggregation} &= \frac{x_{z1}W_{z1} + x_{zs}W_{zs} + \dots + x_{zN}W_{zN}}{W_{z1} + W_{zs} + \dots + W_{zN}} = \dots \\ &= \frac{2 * 1 + 4 * 2 + 4 * 3 + 5 * 2 + 2 * 2}{1 + 2 + 3 + 2 + 2} = 3.6 \end{aligned} \quad (3)$$

Where x_{zn} denotes the Likert evaluation of component n in category z , and W_{zn} denotes the weight of component n in category z .

We can proceed in the same way for the product category for Microsoft:

$$\begin{aligned} Azure_{ProductAggregation} &= \frac{x_{z1}W_{z1} + x_{zs}W_{zs} + \dots + x_{zN}W_{zN}}{W_{z1} + W_{zs} + \dots + W_{zN}} = \dots \\ &= \frac{2 * 1 + 2 * 2 + 2 * 3 + 3 * 2 + 5 * 2}{1 + 2 + 3 + 2 + 2} = 2.8 \end{aligned} \quad (4)$$

And finally, the product component for Google:

$$\begin{aligned} Google_{ProductAggregation} &= \frac{x_{z1}W_{z1} + x_{zs}W_{zs} + \dots + x_{zN}W_{zN}}{W_{z1} + W_{zs} + \dots + W_{zN}} = \dots \\ &= \frac{2 * 1 + 1 * 2 + 3 * 3 + 2 * 2 + 2 * 2}{1 + 2 + 3 + 2 + 2} = 2.1 \end{aligned} \quad (5)$$

Now we summarize the industry assessment for every company. We start with Amazon:

$$\begin{aligned} AWS_{IndustryAggregation} &= \frac{x_{z1}W_{z1} + x_{zs}W_{zs} + \dots + x_{zN}W_{zN}}{W_{z1} + W_{zs} + \dots + W_{zN}} = \dots \\ &= \frac{5 * 3 + 5 * 2 + 3 * 3 + 4 * 2 + 4 * 2 + 3 * 2 + 4 * 1}{3 + 2 + 3 + 2 + 2 + 2 + 1} = 4.0 \end{aligned} \quad (6)$$

We proceed in the same way for Microsoft:

$$\begin{aligned}
Azure_{IndustryAggregation} &= \frac{x_{z1}W_{z1} + x_{zs}W_{zs} + \dots + x_{zN}W_{zN}}{W_{z1} + W_{zs} + \dots + W_{zN}} = \dots \\
\dots &= \frac{5 * 3 + 4 * 2 + 5 * 3 + 4 * 2 + 4 * 2 + 4 * 2 + 5 * 1}{3 + 2 + 3 + 2 + 2 + 2 + 1} = 4.5
\end{aligned} \tag{7}$$

And finally, for Google:

$$\begin{aligned}
Google_{IndustryAggregation} &= \frac{x_{z1}W_{z1} + x_{zs}W_{zs} + \dots + x_{zN}W_{zN}}{W_{z1} + W_{zs} + \dots + W_{zN}} = \dots \\
\dots &= \frac{5 * 3 + 3 * 2 + 3 * 3 + 2 * 2 + 2 * 2 + 2 * 2 + 3 * 1}{3 + 2 + 3 + 2 + 2 + 2 + 1} = 3.0
\end{aligned} \tag{8}$$

We proceed to aggregate the individual components in the corporate dimension. We start with Amazon:

$$\begin{aligned}
AWS_{CorporateAggregation} &= \frac{x_{z1}W_{z1} + x_{zs}W_{zs} + \dots + x_{zN}W_{zN}}{W_{z1} + W_{zs} + \dots + W_{zN}} = \dots \\
\dots &= \frac{4 * 3 + 4 * 1 + 3 * 2 + 1 * 2 + 4 * 1}{3 + 1 + 2 + 2 + 1} = 3.1
\end{aligned} \tag{9}$$

We also aggregate for Microsoft:

$$\begin{aligned}
Azure_{CorporateAggregation} &= \frac{x_{z1}W_{z1} + x_{zs}W_{zs} + \dots + x_{zN}W_{zN}}{W_{z1} + W_{zs} + \dots + W_{zN}} = \dots \\
\dots &= \frac{5 * 3 + 3 * 1 + 4 * 2 + 4 * 2 + 3 * 1}{3 + 1 + 2 + 2 + 1} = 4.1
\end{aligned} \tag{10}$$

And finally, Google:

$$\begin{aligned}
Google_{CorporateAggregation} &= \frac{x_{z1}W_{z1} + x_{zs}W_{zs} + \dots + x_{zN}W_{zN}}{W_{z1} + W_{zs} + \dots + W_{zN}} = \dots \\
\dots &= \frac{4 * 3 + 3 * 1 + 2 * 2 + 2 * 2 + 3 * 1}{3 + 1 + 2 + 2 + 1} = 2.9
\end{aligned} \tag{11}$$

7.4. Interview with Massimiliano Mannelli transcript

[Questions by the interviewers will be in bold and the answers in regular]

it's maybe a little bit obvious, but do you think that having the right portfolio does make a difference for a company regarding how much order entry you make?

Yeah I mean obviously it's a very important the only aspect of course but it's a very important aspect because it defines what is you know I mean a he affects many things he affects how efficiently you so let's start from the outcome so it effects of course the appeal that you have to the market overall because of course it depends it depends on how you define the structure of portfolio but I would say structure before should be what allows you to meet the wider possible demand in the chosen markets of course the portfolio is not an absolute thing it depends on the chosen segment that you want to serve so of course in different segments you would structure portfolio differently but once you have defined a segment and once you define a segment in turn in terms of customer segments and within that customer segment you have identified what are the needs that you want to serve so the use cases they want to address then of course the portfolio structure determines how effectively you can address those needs when I mean if you have a good portfolio structure you should be able to address those needs with minimal effort and here we go I mean at the end the ultimate goal is profit and profit is a factor of revenues and cost so of course cause revenues are affected by how appealing your products are and you can have a million products of course you make more money than having two products probably but then doing a million products versus to make effects quite a lot the cost side so the a good portfolio structure I think should aim to find the right balance between the two to maximize the two I think use

Interesting thing there because if I if I put like a block diagram like first answer is like of course there is a there is an affection but I like that you mentioned that the defection is not like direct there are a lot of things in the middle you know like portfolio affects a lot of things that ultimately affect the order entry

It affects the order entry effect so also the cost so I think in the end yes if yes a an impact to the profit because again a good structure it depends on the definition my definition that portfolio is well structured if it allows you to serve the customers use cases so the need so two Pro to really generate value that is appreciated so people are ready to pay for it and on the other side it achieves the result with a reasonable cost a course is not only a cost of development but it's also cost of marketing cause of sales so it should be something that you know I make some practical examples if you have many products they are well designed for specific customer needs and again here I'm thinking corporate let's say business so B to C not B to B not B to C because of cost there is a difference there so but let's take B to B if you have you know a product design for every customer really customize your customer of cost there the perceived value will be very high I mean all your customers will be very happy but it will impact the cost I mean the cost will be will not be possible and you will have a lot of cost to develop the product to also promote the product because it will be different for every customer so you will have to also have a lot of effort from marketing point of view and also sales point of view so again you have definitely the best revenue but you will have incredible cost of profitability would be a very hard target to achieve okay I believe I mean he has a large impact and on both aspects on both revenues and cost

I was taking some notes because you mentioned now but also before that one of these important parts of the of the portfolio is the market in which you're in and I was thinking like for myself that if we if we think about this the an example of the of this kind of like portfolio management strategies that one of the most known is this Boston Consulting Group we're inside the portfolio management you consider kind of like the link not even blink like a part of the portfolio is a market to which the portfolio applies

Well, if we think of it the portfolio depends on the market because let's take I don't know a consumer product I mean a consumer product will depends a lot on you know the location and the needs I mean

they are of course some international standards but it depends a lot also on the locale let's say there is a lot of regionalization because the you know the culture of different countries will impact a lot on how you need to present how you need to shape your products there is a lot of variance there I mean if you take like the market we are in which is highly technological I mean specifications and let's say international best practice are more established so there is a bit more uniform of cost is not totally uniform definitely no but there is a more uniform I'd say expectation in the market so you can have a bit more generalistic products in that sense so in that's why I'm saying that depending on the market you are in and the type of business you are in the structure of the portfolio has to be different in some cases hi-hi customizability will be a paradigm in other cases is not the key element so I don't think that there will be a description that fits all at eye level probably you can find some global variables but how you characterize the weights you give to them will depend on the market I believe when the market segment

Okay yeah interesting that connects with the with the next question but just now I know that it sounds a little stupid but if we go back to the original person like how the product portfolio affects the profitability let's assume that somebody says like well I really don't believe that if I can you give me some examples about that like this is an example where a bad manager portfolio brought the profit of the company down

Yeah I mean there are some classical examples is like you know when in a way it's also it's not so much the structure of a portfolio but you know like how adaptable to the very needs you have that can impact it in this axis so before I mean they are the classical example when a technology becomes obsolete and you're not you don't have a portfolio that can adapt I mean to use maybe you know to seal address a need but with a very different yeah technology ways I mean you go to Kodak or other classical examples but you know when you don't have enough flexibility in the portfolio to again to serve the same market but to adjust to the varieties or Nokia NOC is a classic example day they miss the smart phone change and they disappear from the market in at incredible speed because they were you know the they didn't diversify the portfolio they didn't capture a technology change and they and they failed to address it on the other side the portfolio structure I think is of course it's more a different angle to the example of made I mean portfolio structure is more like it's a way to find the right in my opinion is a way to find the right balance between the revenues and the cost I mean lately this is what it impacts it doesn't imply so much revenues itself or cost themselves but it's the balance that is impacted by that so I think a badly designed portfolio may still be successful if you do a lot of marketing if you have a recognized brand and at least in the medium term in the long term I think it will affect the brand itself but it's a badly designed poor fool you can still generate revenues but it will have very high costs therefore the profitability will be affected yeah on the other side a very well-structured portfolio but in a in a you know in a declining market or where you know where there is really poor economics I mean yeah it will maximize the possible but will not be highly successful so in that sense the structure a portfolio is not an absolute variable it's one element in the chain so it's the one I would say that still considering as a non-exec sternal dimension so you need 2 s 2 so dimension let's assume you have a given market you have already chosen when it's given and you have a given technology means and so on and you have a cost structure so you are producing in a car in a country and not able to go to other countries so then the portfolio structure is the one that will allow you with the given external conditions to find the best balance possible I think this is where the portfolio structure plays an important role

Very good this actually like links very well with the next question because we said like I like you said like the product portfolio is not like a unique point and it cooperates with other kind of like let's take characteristics and we're speak up on the market like if the market is extremely good we can assume that even about portfolio can make some money or you've mentioned also marketing or very powerful name or branding behind can make about portfolio so to wait and this close with the next point which is what would you consider that they're the parameters of the product portfolio in our example here we consider like a part which is only based for

product another part for market and the last part for corporate do you think like that's a good summary of the let's say integrating factors of a portfolio seeing it in a wider scope

Yeah let's say that I would say that structure of the portfolio is an important element here this is why we are mentioning it a lot because again the number of products you know this highly depends I mean in some markets three products are too many in other markets is just nothing so it depends you know if you take Rohde Schwarz overall of course we have I don't know ten thousand products I mean these probably are too many I don't know wait III really don't know but they are we are talking about hundreds if not thousands of products and again because the scope is very large in other areas you need to again in in some businesses so rohde schwarz in a very high technology market so let's say that you know there are some niche products and portfolio which have very high that's a potentially you can have high cost because the revenues can be very high as well because they are very specialized if you are more in a consumer business which is commoditize I mean it's is you know the numbers the number of deliverables for the scalability the efficiency in production all these things are much more important even in our portfolio D in the oscilloscopes space and it to be very efficient in productions very efficient into distribution because again the unique cost is very low and it's a very competitive market there are some other areas where we have some special you know rather applications or you know in very high frequencies where there are very few players that are able to do that and it's not this the mass production that is there is the key differentiator so in this sense the number of products depends what you're trying to address so it's more like in relation to today to induce you're in into the segment you want to serve and the diversity of the customer so a market where there is a high variety of customers of course you can have many products but when you have like you know a market where you know there is some standardizations there are regulations and so on I think you should aim today minimum number of products and make them same what we are trying to do and in our case to make them modular so you can try to reuse functionalities and to do to embed a bit of adaptation within the products but try to reduce the number of variables because again cost not only of production and development but also of promotion would become very high with more products so this case less is more but I have my might my market segment in mind if you are in consumer well different countries have different taste ease so if you don't adjust you won't be successful so you will need to have more products in the case

So that's interesting because now we analyze like specific parameter and one of the conclusions is that there is not a right answer for the product portfolio itself you have to consider the market

I would say so I mean at least at least the weights you're put in here would be would be very important for example number of products you know in a in a regulated market probably less is more in a in a in a very variety more is better so it's difficult to have the same answer

But what I was meaning the product portfolio cannot be analyzed only from the product perspective but you have to consider this wider scope of the portfolio right if we consider them these pillars so they're like okay we in this case we said like let's annoy the portfolio and we analyze three different pillars one is like only for the products which of course you have to think about the other like as you for example this number of products it depends on market theory but you evaluate how well this is adapted but this is the product the other one is you evaluate the market and the last one you evaluate the corporate

Yes and I would say in the in the product maybe one thing that would add here is of course the number of clocks is important because I mean the more products you have the more cost you have so it's an important element of course it will be more important especially in high in in a market like ours it would be less important into a consumer market where you know just to make a new product one or in the financial market where maybe the cost to create a different version of it would not be high yeah it also depends again how are we used to create a new products yeah you know in the finance market great millions of products just changing a few parameters then you get into the question what is a product I mean is it the same product with just different parameters or is a solution Prada tourists sorry here you would have also today to define very well there what a product is but I think the important

element is what value can you create out of the product so how unique can you make your product I think that's you know that's a critical element because if you so maybe you reflect this in the technical quality but technical quality by itself is not the you know it's an element of value so what I mean is like uniqueness or this is more like you know perceived value you can create something as unique and here you could innovation is a clear element here if you can you know as usual if you are early in a market because you create something new that address a need that is there and you have a unique proposition you can you can put higher prices if you arrive to the same mark with the same offering but it's not perceived unique then you will have much less margin so in that sense uniqueness is a key element of course uniqueness also has an impact to what you say investment in the product so maybe you can link it to that so to make it unique you need to invest of course if you are a follower you need to invest less because you just copycat or just follow the others

Exactly like I think this uniqueness is a let's say if we take like a knowledge analytic perspective we have to make some groups and uniqueness is like some of a lot of things because unique to be unique it has to be like something which is technically adapted to achieve a goal but also this goal has to be relevant for some use case I mean like I can create like a perfect product to measure the amount of flies that entered my house and it's absolutely perfect the best product ever to measure the flies that enter the house but who cares right?

Yeah exactly of course unique is assuming that you address in a need I perceived need in the market so again he has to generate value I mean if no one is interested of course it will not be and unique is many things actually so it's not only technical quality because just think of the iPod when Apple launched it I mean the world life products I think from Sony and others that you know from a quality pure quality point of view they were much better so I mean they were but they had more they had more disk space they had more flexibility but there were other elements of also based on marketing and design they make that product unique so even if technically was not the best one the way other characteristic they made it unique so in that sense it was considered better to address a specific need and it was not just technical

Indeed a very good example because as you said like the uniqueness or the differentiator why iPod was uh was that the differentiator was a design that the perceived value the marketing the brand yes so we said like it's an it's a combination and there we go to this to this idea that the portfolio is a combination of different factors and we have to wait different times

Absolutely just take again Apple is a good example I mean it's like you have the iPad that that typically you had a fixed version so you had like 16 gigabytes I mean 32 64 I think now they are much higher but I mean get the principal and they were compared and they didn't allow an external hard drive they didn't allow a micro or card nothing I mean they were basically one or two USB and that's it probably not even the USB actually and other products competitive products they allowed all of that you could expand memory so in terms of values should be much more but you know a customer just to have the iPad was willing to sacrifice something that was a tangible value I get something with less space so we will affect how much I can do with it and I'm still preferring these to the other product so it's indeed is it's not just technical appeal it's not just price is a combination of many more elements

I think this Apple is a very good example where the differentiator comes from this corporate maybe like the product portfolio is very well organized also to do cross selling just like internal of the product but in our in our theory what we came here with this these three pillars that that assigned the portfolio which are the product related marketing market related and then the third one the corporate internal do you think like this as a summary could give you some glitch I lost you for 10 seconds can you can you say it again sir yeah sure it's like a Paul was the worst example with a with a very good marketing yeah and here we have this theory or we put we summarize the portfolio in three big pillars one is that product related so there's the market related and the last one is the corporate internal factor related work by the way we consider marketing like in this case

Yes and I also agree with you with this structure because you need I mean it's like you have many and again I gave the example of the Sony you know I don't even know what the name was I mean I know I put for sure I don't remember this holy name and me must be you know it's already an indicator right so but that I mean from a technical point of view that product was better was better features and it was really very powerful very effective but it didn't succeed so you know the product quality I mean it's important I mean something that really work is sloppy product I mean which is not the case of the iPod I mean yes it will I mean it may come from the perfect brand but in the end it will lose traction but indeed this is just one element and again I mean also you know also in this space I think competitor have many versions of the things but that doesn't like also in the mobile phones I mean there is just the iPhone that's it others have tons of other models and it doesn't mean that they are they would be more successful again they just diversity why they don't address the same market so they have a different strategy so again this is just to prove the idea that the number of products and the structure of the portfolio depends of what you want to address of course within a given market you need to find the right the right balance so it is it is important but it's not an absolute value and absolutely I mean the combination of these three different elements I mean also I mean let's assume you are you have two products one which is from very good from a product measure from parameters related to a product so it's like you have invested where also the quality is quite high you have created a good portfolio mix you have good synergies and so on it's well integrated with other thing so you can cross sell and generate you know things like that and another product which is not well structured is just you know not no not perfect at all but the first product in a is in a commoditized market there is no growing this stagnant and the second product is in in a in a in a market which is moving very fast and is innovative I think the second one although much worse Oh as a possibility to better financial success again because you are in the right place if you are in a non-profitable industry you will have a lower success possibilities I mean there is our new division had they were saying if you are in an industry where the average profitability is below 10% you should and invest and again if we haven't talked about if the product is good or bad it's just you know it's the element of the market segment you are in a pool market segment so you shouldn't put your money there so indeed it has an important element to the industry success

So indeed like one of the conclusions is that the product or for the management has to be and this is sort of obvious that has to be like correlated with the market and with the capabilities of the company and based on those then you have to adopt what you what you produce

Absolutely I mean at some point you should have also an exit strategy I mean there are some products over time lose appeal because their market you know I mean it could be for many reasons it could be that you know there are technology shift so you know the fundamentally we're using let's assume one day you know you can do drive test based on I don't know we were talking about this today that's where I make the example based on in-car modules they are in every car so you don't you don't need to pay anyone to go around with the system and I mean every normal car would give you the results out of the chipset or the mobile phones themselves we collect more interesting data so you're actually way to address the market it becomes obsolete again Kodak disappearing from the market not the people didn't want picture anymore it's just a picture on a on a Polaroid was of course not needed anymore you can do it digitally so the need is still there but your way to do it is obsolete so that could be a reason why a is so the market doesn't disappear but the change fundamentally you can't adapt again no case the same example is not that Nokia failed because people didn't want mobile phones anymore but they want a smart phones not the feature phones and so that is the reason why market change another reason is simply they need these appears I mean people don't need to do certain things anymore so I mean you're selling some today's of no use so in that case I mean I can't think of an example but I don't know CD-ROMs again the need to but they are more similar it's not that the need to watch movies as disappear or to listen to music but you know people do it in a very different way they don't want to buy the thing forever very often they you know change a lot so you know the need or the type of need changes and you need to adopt you have to go to the market yeah or something becomes like a commodity so again the need is still there but you know the kind of the differentiation between supplier or the perceived value goes down in that case I mean you need to structure your portfolio

differently I mean you shouldn't invest into innovation but you should invest into a very lean process to produce the minimum cost so then you need to adjust your portfolio in the sense or you know they've before that stays the same but the way you build products needs to change you need to focus a lot on efficiency and profitability so there remember there are three different dimensions here is like you know scalability how as you are in producing or innovation level so in that case I mean you may have a high cost of production but you know you thing is you know innovation so if you are innovative people are ready to pay in compensate or high cost of production

This implies something that sounds a little bit obvious I would say but we can imply that dang there is a good portfolio management and there is a bad portfolio management absolutely and then the next question is maybe a little bit tricky but you have a lot of experience managing portfolios in your market but let's imagine now that you are consultant and you're in a absolutely an absolutely new market for you and market that you don't know like for example like purifying water like distributors yeah do you think that you could that there could be like an analytic way to quantify how good the portfolio is

I think so I think you can again this you may argue in the single items but I think what you know also what you're describing here is on one side you take the different dimensions of the product in itself the indices of the let's say the market dynamics and also let's say how good you are as a company not only to produce a product but also to distribute the product so I think this is the this part here so again this part here you may argue maybe you could put lifecycle management within the product or not that I think that the points is still valid so again how can you promote what you have which is not necessarily is a different thing and so how good you are to produce a product I mean we see a lot I mean just to make any an example of why I'm saying that is we have a lot of smaller companies they are you know knocking on our doors because you know they you know they want to cooperate with us what do they want to cooperate with us because fundamentally they were good into developing an idea to ever in an idea in a certain market and to develop something that is of need but they fell into the distribution so let's say they are quite good in point number one there may be okay in point number two because they may be in the right you know in the right market and they may also have some unique points so in this comparison to competitors but they fail here they don't have I mean they don't have a sales force they don't have a name they don't have a marketing they don't have a support organization they are not financially stable so they are not like someone that would be chosen I mean we saw also when Swiss code was acquired I mean the first two three years were booming the products were the same as before the only difference was so I would say that the point number one and two didn't really change the market was the same the products were the same but is the financial stability the brand appeal this support organization where you have 70 countries you don't have any more like you know what one you know one headquarter name and lose people around the world that made a big difference of course I mean this doesn't last forever but yeah it was you know was the result for a large success in that in that period of time so again it's not you know also a portfolio is not something that this good or bad in absolute the same portfolio in different times yep can be great or bad it has to adapt to the changing conditions because the market can change conditions constantly so this kind of adaptability where you say like at some point product other yeah this thing I mean this changes a lot and one thing maybe I don't know I need to think more but we need to maybe the classification could change over time I don't know maybe the profitability that the pry the cost part maybe part of the proof of the product elements so profitability no but cost I would separate maybe these two the profitability is an absolute thing so it can be in the industry because I mean the examples I made before if you're in an industry where the average profitability so you can assume that in different is not that you know in a certain industry they're all bad products and another interesting are all good products or the bad guys are only one interested you can assume the in average there are good and bad companies in every market but there are some industries where the profitability is super good and other industry where the profitability is terrible yeah if you are in pharmaceutical you have very good profitability if you are in I don't know and to service delivery for her in in many services in the telco industry the profitability is horrible and you I wouldn't say that Ericsson managed services are idiots as compared to rush they are just in a different type of industry it's always relative I would say

right yes but I would say the cost I would keep it separate because again this is you can have even if you have a high cost you can have very good profitability and we are one example also again pharmaceutical there have incredible costs but you know the profitability is a part of the product yeah I will put it as part of the product yes

But one thing that we are doing here is that we take something like portfolio minutes like if I put like we take the portfolio and then we try to evaluate individual parts and then to group like the power of the whole portfolio this doesn't work in all the cases meaning like well a car you can say like it's a best tuning is the best tires you the best commodity then you add everything up and then probably the best car but there's a typical sex is the example is with a woman you take the best knows the best eyes the best mouth you put them together and you have a Frankenstein

Yeah exactly I mean is it has to be blended well together so again I would say they did the items I don't see anything wrong again I need to say reflect but you know but I would say maybe product that tension I would say that you know here is more driven by how good you are in the product because if you counted r2d2 the market is not you know a type of market so again if you define this like I mean I would say two aspects maybe I think they are in both areas but in a different way so this could be actually the thing that is from a market perspective as I said before there are some industry segments that require a lot of customization of that ability again if you are selling I don't know a food in different countries you have to have a bloody great adaptability I think Nestor day as a million or done own as a million brands and flavors and so on because the variety is high so in that sense this category you could represent it rather than how good more the product adopts the mark is like what is the market demand you need a lot of variety or is it quite you know market way I don't know if you are making hard drives you don't have a lot of valuables righteous how big in our fast I mean you don't have a million variants you can sell the same hard drive in any country of the war no one would say no I need to wonder is or Spanish than Chinese I mean so in that sense I would say that there needs to be a category here about you know the variety require variety and but there is this thing how good the products are to adapt to the variety I think is a product characteristic at the product parameter how adaptable how customizable is the product I would just split in 2

Now I'm going to make like small twist and we thought like portfolio influences some ways the profitability of the company we said also that the product portfolio is something that can be split into different parameters that so we can characterize the product portfolio by measuring its single elements we can we can argue if one element is here there or we can put more elements but then then the next question is like is this real down right but then if we can tell them by affecting single elements of the portfolio we could link that to the final let's say profitability of the company so for example here in this case by affecting the comparison with the competitors how could we compare or how do we different where with the customer we can affect the profitability of the company we can measure that

Yeah I think again I think this is the right approach and also the importance the weights are very important because again if you put take this one because we just talked about it if variety is a very important element so in the food industry of course is a very important lemon I mean I made the example the hard drive is a hard drive no matter if you sell it in China or Patagonia but rise again rice is rice you may say no rice is not right there is a type of rice which is very good for the Indian cuisine and if you make an Italian risotto with the same rice is just rubbish so in that sense variety is very important so you would say in that specific segment you would say this is a very high importance in the hard drive industry the variety is not so important it's only yeah I mean of course the size but it is not you know there are not many other flavors so in that sense I think the weight will have to adjust the specific market you are in and again market / use case come again automotive industry I mean automotive industry you could sell you know just you know parts for a car or you could sell what we sell like testing system so they are very different thing so you can't just have one mark just customer segment alone also an operator buys from many services for networks - you know testing tools - I don't know building systems I mean the three things have very different dynamics

So to put it a little bit blunt like if we were to make our own consulting company for portfolio management we can start with this model and then we can go to one market then validate it and then we move to another market and then we have to do some tuning in the model

Yes I mean it's like I don't know this is kind of your bidding and MPs and NPS for food industry will have different weights from an NPS for a I don't know a consulting firm for or finance business or maybe they have white categories I mean the broadness of the portfolio I mean this is important for all of them and but in a different way so I won't have the same impact maybe the relevant I mean all these elements I think will be present but the relative impact would be very different for example price is more important if you are selling nails price would be a super important element in if you're selling body scanners it will be not as important debate would be different but it but the item will still be there I mean in some case the weight could be null so I mean the model could adapt in that sense

So, the model can adapt to or we can say we can apply the model to all the markets however each particularities would require some adaptations here and there and potentially revert back to the original model to make it more robust

Yeah in a way yes so you have to apply different ways because the characteristic of the market and the need it will be different so you will have to adjust so they the relative so the importance is still there but the relatively important between the factors will change I mean I again you will have to try it on a different industry and maybe you find pattern maybe at some point it's like you know machine learning would be good there because you may find some parameters actually they influenced very minimally there the outcome also across different industry it could be in that case you would say well this is low in general so but without an analysis like that I would you know you could you could assume that you know you need to change the weights depending on the industry within the same industry I wouldn't say that you know if you're in South America need to change the relative weight I don't think I mean there's more like by industry type but by general needs

But I don't know exactly your perspective there but it's again like I'm thinking like an a consultant for a company and they're like okay let's go to a new market where I know nothing and I have some knowledge of a portfolio and they're like okay then I have to understand everything and so I would say great this maybe I'm okay I'm an engineer maybe is too analytical but I think this advantage of having a model where you can qualify the portfolio as Boston Consulting Group did with the famous matrix have like standard is going to weight or not to way to benchmark or to assess the portfolios I think it's something very interesting

I think I mean what you're trying to do here is actually very interesting because I mean what Boston Consulting Group II you know they have a metric so you know it gives you good advices to you know how you should evolve your portfolio and how you should rate your portfolio and take some decision but they don't link that to the actual financial success so it's like you know I would do it this way and then you see how it goes here you're trying to go one step further you just want to see the end result which is you know at the end to try to say what are the things that you know how can you measure the success and to again it's like an NPS you say well you can score very high and if you don't score very high you can also find out in which areas you score low so you have also a way to you know you invest in the right place I mean if there is let's assume that you know price in that market is importance is high and you have incredible production costs and your price are off the roof that you know where to act right you need to streamline your production you need to reduce costs if instead prices you know it's low then the problem may be is innovation or you know the broadness of the portfolio which is more important than you invest there so in that sense I see a really good value here and of course like MPs you need to find the right the right mix and identify the ones that you know and this would be I think over time I think I imagine like what you have to do with machine learning I mean first of all you need to find the features they are relevant because you may analyze I don't know 30 features and in the end you say well 15 are actually I'm not influencing much the outcome they you know there is a big variety and the outcome is now driven by that they are these are the 15 and then I think you

need to work on the weights I don't think again staying within the machine learning I don't think you can use in an unsupervised model I think you need to have a trained model

Interesting because a lot of kind of like economic models they have like it's a formula but then at the end you have like a beta or an alpha that quantify the market for example to calculate I remember from there some theories that you have a built a better that is between minus one and plus one of how dynamic is the market like how elastic is the market and this would actually modify their weight

So it will put a different weight depending on that so indeed I agree and this is I think for example profitability in certain industry could be higher or low so did the actual importance I mean again it depends what outcome do you want to have I mean also what I think what you're trying to do here is to say what are the important you want to predict the financial success of a company based on some parameter and also way to say well how do you want to matter to keep it a guideline how to maximize that I guess right yeah that's you need to take the characteristic of a certain industry and trying to apply that to here to the weights and this will be there you know that kind of course ideally will I have an ETSI agreed weights so then it's easy but it could also be that you have to have the mp3 score and the p3 score and the other scores and then I say public context the one that has the best the best weights will be the consultant that will be chosen and of course I mean again if you do is systematic maybe you can find absolute parameters

Interesting the this as you said like their adaptations I don't know just to finish this with this question if you if you could measure or just review the example for this cloud computing which is like a market which is not completely unknown to you but I guess not like a super knowledgeable would you say like if I come to you and then I present you these evaluation of course we can argue fine-tuning here and there and these are like this would provide like an added value

Yeah I would say so of course you need to again I think the disc or in general would with reasonable tuning would I think would work the value of I mean let's say the value of having very well-tuned items in the list I mean having the right elements here and having the right weights will be important of course in the evaluation but even more important that after the evaluation I think I mean your mother although I don't think you had the time to go in absolute detail of all the elements and to fine-tune them to try them out to really you know spend a little time to do to adjust them steel the result is make sense makes a lot of sense so you say why should I spend too much time in fine-tuning well the fine-tuning of the items and the weights I think would be very important if you want to take action we want to say okay I'm google I suck what do I do then if you have a very clean list here and a very you know very well so true least then you can give very good advices because a way to make the model maybe there is a way to make the model very universal you just reduce the number of category you make it a bit more generic maybe you find a way to make universal but the problem will be then yes you know if you are good or bad but yeah you can just look at the balance sheet for that but you don't know what to do about it because it's too generic yeah you should improve marketing okay fair enough it's already something I mean it's better to know do I need to invest more in the products or do I need to invest more in marketing actually already this helps really a lot but if you can go one level down of course is even more value well actually I need to it's not so much in general into the into let's say let me say you need to improve your go to market if you can also say within the go to market what the problem is if the livery part is the marketing part so it's a pre-sales for sales I mean what is the part that I can effect well the value increases a lot but that part we require a lot of fine-tuning I'm just talking loud so I'm just you know brainstorming with you maybe if we talk more we come to different conclusions

But no but that sounds absolutely logical and it's also like a way of we did something that is a first step that of course in order to be more let's say like a pastor or more add value needs further like evaluations or further iterations with different...

Yeah but actually would be nice I mean to find a model anywhere we can also try to you know to use it for our own portfolio to see again this is more than portfolio actually this is you know how successful a company is in relation to what is doing in different aspects I mean if we find that at the end of the day we are very weak here in marketing then which is where we need to work is not so much in the portfolio oh so it's like a ten point or vice-versa mean yeah you can invest in marketing million things but if you don't do what the customer really need I mean they won't work it's not an it's not an interesting we're perception is the key thing is you know it has to work so then you need to employ best executive quality already having this indications I think it's they are crucial it's like for example I mean one thing goes in our industry I mean rohde schwarz the Swiss cool as well so they shared the values there I mean they also I think customer expected we are a bit more expensive because we are perceived as high-quality I mean right or wrong you may argue but this is how it is so this is I think we need to invest in technical quality because if then people start to be very disappointed you in the long term you lose this brand recognition

But yeah you make kind of like summary like of course like they would be like modifications to be there to be done here and there but you see like can really have a value of the whole project

No, absolutely. I think it's a very cool idea it's a very nice exercise because again it just as usual I mean as everything in life I think the innovation is not so much that yeah should you analyze how good a well structure and interconnected is the portfolio I mean no one will get a Nobel for saying that but just putting the things together and also organize them in a measurable way it's actually adding a lot of value because all the other things are quite qualitative they are not quantitative if you can find a way to it's like I don't know again to create an NPS because everyone knows that if you have better drops if you have better throughput if you have better call setup time at the end you have a better network yeah thank you very much you very innovative but if you put together these in a measurable way and you say how good you need to be in the single items to be the best actually this is a massive value so if the single elements are kind of obvious the combination is the part that is not obvious

When the sense like um like the number of dimensions that were speaking where we can identify like action points based on single dimensions this adds a lot of value

And also today identify because I mean just they're thinking and talking about it you can come with a hundred dimensions but I think that the critical element would say what are the most influential ones is not an obvious question to answer I think it's a critical one what are the thing what are the features of the model really impact the result should I continue to monitor a hundred features or do I restrict my model to 32

No, it's something I think that of course it goes out of scope of out the of the work because as

But again it the goose I mean if when you do something there is nothing else to be done after you may argue out value what there was and of course you have a great point question then it's fine but if you have a topic if you don't have any follow-up well it's not a reheater scenario if you do have a follow-up it's a good sign

But yeah I agree with you in the sense like or it sounds reasonable but in order to validate the model I think it looks ok promising out of one market but you will need to place it with more markets in project as more different markets as possible...

And then you would find relations or some general traits which are universal versus ad-hoc that could be yeah it could also be that in general you say well different ways but there are these three features that always score high all the time well that would be great because then you know that there's a general rule just make these right it's important I don't think to be honest there is such a thing but who knows it's probably worth on find a way to make this like you know some if you find a way to characterize these four different industry with an affordable effort of course if you analyze you know if you have been an industry with their you know a hundred thousand companies you analyze all of them one by one you put it together in the end I'm sure you will have a very good model but you know what do you have for to do it is it it's just crazy no one would do that so if you instead you find a way

and also unfortunately these market segments will change over time so what you have after you finish your investigation is already obsolete probably so if you find a way to industrialize a bit the machines so you don't have to have so much you know you find that mushy learning way of doing things then yeah then it could be something really valuable.

I think that was that was helpful I think we covered this in this hour a lot of a lot of things

Yeah the problem is to structure this somehow but you know we are more in brainstorm I hope to this point yeah I'm keen to see the results and already reading your thesis is interesting that you're also mentioning some interesting articles yeah I hope to find the time one day to really go a bit more deeper because it's very interesting there are a lot of things actually like even this Boston Consulting Group do you have like nine different dimensions and then you can combine them even these Boston Consulting Group matrix is something more complex yeah I remember when I did the portfolio strategy was actually was I was in marketing then but I mean they are there are many models anyway every of them will give you an advantage it depends what you want to achieve indeed but they can be very complex okay so

7.5. Interview with Mr. Peter Raser Head of Products and service process solutions BTG

To what extent the product portfolio connects with a company financial success?

Automatically a portfolio is linked to financial success. Only a portfolio covering customer's demand creating business success and differentiate from others allow sustainable pricing and margins.

How does the portfolio affect the sales of a company?

A portfolio needs to full fill demand in a better (or at least equal) way compare to other options as competition or other technologies or products on the market.

A single product is typically (or at least in most companies) not the full picture of success. It is one of the main mistakes in practical portfolio management to take out products and analyses on their sales numbers and contribution. It is often missed what is the impact on the full portfolio. Sometimes just to have (or have not) a product in the portfolio can decide on sales of many of them.

Can you support your answer with real life examples?

BTG is very active in Fiber line / pulp mill measurement and control. The Portfolio is containing several devices to control and optimize the pulp process. (Kappa, Bleach Load, Brightness, Residual, Consistency, etc.) In a fiber line the complete process is around lignin elimination. (also known as Kappa). "The one who owns the kappa is owning the process"

In history, BTG for a while skipped Kappa-measurement in its Portfolio. This was followed by a drop in overall fiber line business close to zero. Also related products as Consistency meters, by the way the biggest contributor in BTG's portfolio was running down in number of units and sales revenue.

Coming back with new technology and new strategy to optimize delignification by having a Kappa measurement, Bleach load and Dissolved lignin measurement, inline and single point and a corresponding control strategy BTG gained back market share and is today again market leader in this area.

What are in your view the most important parameters of a product portfolio?

Can you enumerate them?

- All industry related KPI (Market)
- Number of products (breadth)
- Number of variants (depth)
- Balance between high and low runners
- Relation to customer demand
- Balance between high and low CM
- Cross selling / cross connections
- Market position (competitors, etc.)
- Growth on products
- Development and maintenance costs
- Quality (also Quality costs)

Are those parameters related in a hierarchical structure?

Not necessarily, but some of them are related to each other.

Also depends on strategic setup of a company and strategic positioning

Do you think it makes sense to structure those individual parameters and weight them?

yes

Do that portfolio parameters and structure affect the company performance?

In what ways?

It supports decision making, priorities, it enables looking forward and enables strategic planning

Do you have examples about it?

Each new development idea is analyzed in several figures. A business case doesn't only rely on a single product calculation, it also investigates impact on the portfolio. As an example, a new measurement and control of X will impact also existing products related to the same process area very much. (Kappa to brightness and consistency and service, in an easy way)

Product maintenance and improvements follow a priority. Portfolio parameters help to identify this priority.

What do you think about our model?

Are we covering the right parameters?

The model fits well your example even if the evaluation is difficult. I think any model can be used as the base to start with, but each portfolio requires a certain adaption to market models, customer demands, etc.

Is the structure well oriented?

Looks like yes

Do the weights make sense?

Absolutely, even more without weighing the model would be useable.

Do you think the conclusions of our use case evaluation can be extrapolated?

Under certain pre-conditions yes, with changes in market/industries and products and customers (B2C versus B2B) not.

Do you think that the thesis is well oriented?

I think it is well oriented, again defining a model and showing some general impacts and linkages.

What would you change?

Even scientific approach requires broadness I would be a bit less generic in defining the frame conditions as Industry, Market B2B, B2C, as I would assume a better limitation of parameters chosen.

7.6. Interview with Filippo Meloni transcript

[Questions by the interviewers will be in bold and the answers in regular]

Do you think that the company product portfolio has an impact on the financial performance of the company with something obvious for you?

Yeah it is it is obvious and yes it has huge financial impact on the company revenue profit in my experience is really one of the really like the main core factors for the determine the financial success or failure at least pretty much in in every company because whether you call it product would you call it services is actually something the you do you work on so yes definitely high impact and yes also my understanding is also quite obvious

Okay I thought that is that like according to your experience don't want to I don't want to discuss any information, but would you have like some examples where you would say like well this is obvious like from real life of matter for a

Yeah well if you if you work in a in a company that is like manufacturing or product reason so it's really like the main thing that they do are products that then they sell then the variety of this product is it's like your portfolio is basically the most important factor then of course there are other factors that we actually also I like during the during the in your introduction which I also recognize but it's like without this product portfolio you will not be able to for instance it's like the foundation yeah so far I've been working almost every yeah in every in every component that I'd be working for it was very strongly product related though there has been a couple of cases where I'd been also in a company that was more on the service so now here is disputable if you can say well actually the service it could be seen as product you know there's not something that you manufacture or you develop a dislike your product is actually the service that you offer if you see that in that way then of course it is also part of the product portfolio

Also something like related to that is about we speak about manufacturing services this may be a little bit sidetracked but you think like the product portfolio would be different for very different area like for example if we are in b2c b2b online offering you'd say like this is completely different or you could see some common let's say pattern

I think it depends for many factors like the industry geographical location or the market for instance what I saw is that if you are in our case in in Switzerland so you are a very country where the cost of labor is very high in order to be competitive so to sell you have to have product portfolio which is very innovative very innovative means you need to offer a lot of added value to your customers whether in service or in product features if you are in so let's say if you want to succeed in a high developed market or with cost of labor very high like Switzerland you need to go there if you start from the bottom of the market and you develop out like a me-too solution you're probably not going to last that long but there are certain markets or certain geographical region certain industry where you can also start actually from the bottom of the market and go the way the way up you can do a me to solution not particularly innovative but maybe cheaper you might say well doctor the innovation is that and you have reached other ways of doing things in a more in a cheaper way so I think I think is now really the b2c or b2b is this more industry related what kind of recent technological level has the industry and also I will say market related like geographical related for instance all these kind of things but I will make a distinction between b2b and b2c I don't see it at least

Very interesting because you mentioned like for example cheese run where like in your example like that the problem is the cost of labor right so here is like if you have like a manufacturing company and you put it into is run of course you have like but there's something that you can measure something that maybe you cannot measure with the with the current system as you said is the industry meaning right there may be some markets which are much more dynamic than modern market but this is the example like if you are creating screws nobody cares for innovation or if you created mobile phones it's very important innovation

Yeah but you might have also you don't have to innovate in the product but you might be innovative in the way you produce it Britten's my company car company has the production in Switzerland and what they do they keep they are able to sustain this by innovating in the production themselves so they tried they don't succeed always but they try let's say to be cost-effective and high quality at the same time and then if you reach that you might not always but you might be able to have higher costs of production but still be able to be successful so in the screws for instance sure a screw is ok it doesn't really matter for like certain application but if you have application that they have like you sell your screws to NASA to space six then they have to be certain they have to meet certain standards they have to meet certain specification regulation then you are highly specialized is not just screws and then it is also matter the way you produce them so it's like you're adding value to that it's not just a screw but this component that maybe will last so many years under certain conditions temperature whatever so it depends it depends a bit on the conditions

But I'll take what you said and I bring it one step into one direction which is every industry is different it may have different particularities but at the end you can still find common points across different industries like first of all you can also be innovative in creating screws by reducing cost for example or using new material which are lighter or especially Indonesia therefore from that perspective it's not a crazy idea to develop a method that will be like Universal for all the portfolios and all the industries you think

I think a common methodology it makes sense is more this common methodology should be adaptable to the degree of technology evolution for instance of the industry it's like how much that the other technology has evolved so for instance let's take the smartphone's right something that we're both familiar with so at the beginning when they were starting producing smartphones the smartphone were pretty I would say basics but you know they were pretty simple they have yeah at that time was very complicated but if we look at them now they were very simple I'll speak central unit processing more than blah blah blah and a very basic display no so at that point probably you need to be companies who need to integrate everything so they were doing everything by the self-producing or collecting things and doing the old integration and being innovative was I wouldn't say easier but was like was more common let's say because whenever you the market is not really so developed technologically if you want to focus on doing a product properly then you might have a high chance to succeed but when then the market the technology has evolved like this these times if you want to like now today if you want to go out with a new innovative smartphone you really have to you know you really have to be either like something completely different or you need to do the things that other people they're all the competitors do much better plus of course now there are a lot more competitors in the market like if you look at smartphones manufacturers before they were like only few started as far as because I'm remember you know you had like Motorola Nokia then Eric song they were got three yeah three four that's it now you have like so many you know like Apple of course Sam Soon all those Chinese producer manufacture Thai from was the name of the HTC the mouse this kind of disappeared so you have a lot of competition and you have a lot of high level of technology so I believe this is really more it's not so trivial to go there and do an innovative product you really have to nail things down back to your question to answer your question I think methodology can be can be applied definitely is more like I believe you should be able to tune it depending on different variables one okay one I can think of is definitely the degree of evolution more technology advancement of that of the industry for instance

This is exactly the I'm taking notes and that the note that I took here in this that the methodology you said like it should be adaptable like it's okay to develop like something but it has to adapt to the condition this adaptation now this is a question back to you like could it be adapted somehow like for example like let's say like you measure like degree of maturity of the of the industry so even if you did not be the model the methodology has to be adoptable agree this can be inside the methodology and this can be quantified that it is somehow right yeah

Absolutely for instance one way to measure that is the degree of modularization industry usually according to the theory of you know innovation and evolution of the markets for instance you start as I

said like at the beginning when you come to a new market which is not evaluated then you have to integrate everything if you want to do a new smartphone you have to do a bit everything yourself when the technology evolves the accompany the specialize in different parts of the smartphone there might be some that they are specialized the display there might be some that they are specializing in there in the memory system maybe somewhere specialized in in the radio parts wherever and then at this point you could so basically if you are as a smartphone manufacturer you don't have to do everything by yourself you don't have to redo invent a new display you don't have to invent a new battery power pack you just have to go to wherever who's like corner they do the displays the Samsung that I do the probably the chipset they actually produce the chipset for Apple for instance right so these kind of things so you might measure the degree of modularization for instance and then you can say okay now this is an advanced market mature market absolutely

Yes actually I was thinking now that you said like modularization you need to measure like that the detection of the to the product I think here in this this use case that we that we did we took like a very big cheat with it like cheating because if you check on the one market then everybody is in the same condition you benchmark companies which operate in the same market all these things should be like comparable well for example if you compare product portfolio of Apple for example and our company that is doing food or for cows and of course that's super different but if you do a benchmarking within a the same market this should be much easier you think

Yeah of course because we have different parameters and the different markets

So the model cannot be so well compared between different industries and you're like but I get a for and I'm doing food for cows it's not comparable and for in a product tour however if you compare yourself if you if you benchmark with a direct competitor this number has much more meaning the vert the Mogul can I still be universal the numbers may not be like how do you say they may be biased for different markets

You might be introducing a weight or the different technology maturity level maturity degree so like a company that produces as a food for cattle would be maybe the apple of the food for cattle so like that the most involved in an inner market but maybe because the market is not that evolved it will look like pretty dull I don't know you know these kind of things

That sounds very interesting I've heard that was a point that was coming later in the interview regarding waiting there is a very important work missing

If you want to compare different markets, they have different parameter you might have to apply a few weights know it's like to normalize everything

Before going into that direction which is the important thing is like what do you have in the market now is a lot of are not in the market in in the research literature regarding product portfolios a lot of qualitative evaluation here we're doing more analytic quantitative evaluation where you put where you split the product portfolio which is something abstract and you put it into specific boxes parameters like which are measurable you think this is something like you could do with something so abstract like a product of folio and distribute it in different categories and say like well let's put in this box we said for example product market and corporate enduring factor think this is something you can do

I believe you can yes I mean I also I mean one thing that you told me about is you mentioned that the corporate factor in particular because now we've been talking about the product and then the industry so the market position and then the corporate structure actually from my point of view I'm actually one of those believes that this corporate factor are as well important as the product itself because you might have companies that for instance produce things products that which features whose features are ready let me call it standard which means a high level of modularization everyone is more or less at the same level right and then you have very small differences between companies between products made by different companies product a from company a has slightly better performance in certain things product B from Company B that's another one prodigy from Company B as slightly better

features or slightly better performance in another field so you have really like very small differences but then what makes a difference you might have also the company a is much more successful of Company B and then you say like okay why is that the products are basically the same you know very similar we different with more or less the same value even at the same price so why is it that that Company B it's more successful and here what a lot of people a lot of product managers fail to what a lot of problem you said right you said something like when I when I talk about the portfolio and then I put also corporate factors then people say why you need to do that because actually this is a very important part so you might have an organization that has a very good sales structure that has very good corporate communications or like marketing in meaning able to promote the product you might have a company that's extremely good engineering service or services and that is actually what makes the difference not the product the component itself I've seen cases where companies that they do products very similar to any other company but the difference is really the service how you deal with customers understanding the need customizing also the ability of customizing things the ability of giving the right price to the right you know and this is actually very important to me so the corporate factor are definitely important so to answer your question yes definitely you in my opinion is not like you should you might you might take into account but it's like you must take them into account or the other end is it's also like you know the four piece for piece of product management right the two are price and product so it's pretty much what you can define technically but the other two are place and package so it's like how you distribute your product and where so it's basically that's also kind of the service

I wanted to pull like an example because nice body weight had like another example very much in line with your with what you said and I don't know if you're a lot into this cloud computing but Amazon is definitely ahead in the like Amazon product is much better than micro but regarding corporate factors Microsoft is much ahead like to get like corporate accounts I mean when it's dealing with corporate corporations stays for everything Microsoft is a good service they and there and there they have like a super strong cross selling in the problem now industry did it Office 365 you already have an account with Microsoft so their Amazon is behind so that's a good example of what you mentioned before

Yeah I mean like I also myself for instance as a user I am a fan of Google right I like Google stuff and so on but at the end I purchased a Microsoft 365 office 365 account because it just has everything included and then you don't have to bother about wait a minute if I edit this file in Google Docs will screw up the whole formatting we're here it's really cool and as everything really everything that I need in one place

What we did also here to go a little bit into the details there but we said like corporate factors products factors but we split them into smaller boxes and like for example Massey put the sample like forestry squirrel like after being purchased by Roger Schwartz although you may say like this doesn't sound so important one of these factors that we're evaluating here is the financial stability in right if you have like a product from two companies and one company is much more financially stable than the other that makes a difference also in the success that you have so what we're doing is splitting big categories into smaller pieces that we come measure in an easier way does it make sense to you to try to be in a hierarchical way because we start product portfolio okay it's big we split it and then we keep on splitting it into smaller category

Yeah I mean it depends on how you define the categories but definitely another layer I would be adding like for instance if I believe if I think of a product portfolio you might have different categorization you can use for instance that one way is like the ants of matrix you know like the degree of evolution of a product or if it's like sorry if it's like if it's in a new market a new is a new product for a new market with a new product for an existing market the degree of differentiation and market development how you know another one is the Boston Consulting Group map is also another one another way is like buy price and value so saying like the low the bottom of the market like low end middle and premium so that there might be different way to categorize the products depending on what these you want to want is that you want to see so for itself okay so the boss beating each other

the Boston Consulting Group they're nervous they're hungry the Boston Consulting Group would be more alike to understand that they face life the product life face yeah the life face of a product if it's like in its maturity is declining or that the answer will be understanding which Square you would put your products on understand like strategically if I look at my portfolio do I cover everything or can I expand things you know even though you have product that they are like quite crappy in in revenues you might see that actually they are like new product the new market so actually you're taking a risk you know usually taking a risk means also a chance to be negative you know so it makes sense again there depends on what you want to see or what you want to achieve

Yeah one but one of the notes recovering to what you what dimension or one of the premises of the of our study is that you have like several methods like Boston Consulting Group where you take portfolios or products and you put it into baskets however what we say with this approach it's not incorrect and this this may be like practical but this doesn't make a full analysis of your portfolio well this is a little bit like the core here like this one gives you like okay this product I'll put in this box this product I'll put it in this box but what we say here is like wait a minute we want to evaluate structure your whole portfolio we don't want to put it into boxes

Yeah okay but you want to give like an absolute measure at the end I kind of

Like to put some structure into your portfolio and in matching company a Company B again like let's imagine that they are in the same market to reduce this this better but then you say like in company a you have a problem with your costs didn't Company B you have a problem with your sales force and in Company C you have a problem with the structure of your portfolio's too complex is not structure and in company D you may not be promoting cross sorry so you actually do a whole evaluation of your portfolio and then you can spot areas in your portfolio that are weaker stronger compared to your competition yeah it's a little bit the goal

Okay but then you might have different variables in different way I'll see the same thing I mean at the end you might you might have you might be adding or trying to do a kind of global measure of success or completeness of your portfolio math units if you can call it like that of your portfolio like how effective you are in building a portfolio and including also corporate factors on and I think you could reach the level you can say like which understand that the goal of your work it's I think I mean what it would be useful if you know if I'm like the CEO of the company or the product director or whatever would be to understand and the different dimensions like if my company has a more mature more evaluated better let's say product portfolio of Company B then what does it mean a bit like in other parts right like how they call it out this number the network performance correlate score their network performance score so at the end you put a number you say like okay that's the net of performance cool you have you know is it measured is it a number one to ten or whatever and you have eight and my mini I have seven okay cool unless than you but what does it mean you know so at the end you should have like different levels should be summarizing maybe a could be a global score interesting but then you need to have those edge to be actionable right you need to understand also what does it mean

That's a very good point because like it's connecting with what you said but we started with portfolio does it have an impact on the financial yes we believe so then we split the portfolio into different categories and so on then okay if portfolio has an impact and it has different categories you should optimize your portfolio appears right because it has an impact and you have different components or different part therefore you should optimize those and also optimize or identify at least those that are suboptimal and therefore they have a negative financial impact into your yeah

Just came with something out when you say optimize also if you look at this whole like we mentioned all these tools and so forever I mean like they are if I might think of optimize you can measure also against your strategy like let's say that my company strategy I enter certain market let's say I'm now say China let's say I don't know like a country that emerging I don't know Brazil whatever you say okay I'm entering this the market of whatever product and my goal is to do I don't know toothbrushes

yeah toothbrushes and my goal is to do cheap and convenient toothbrushes I don't care about the technology evolution I don't care about whatever I just don't care I just want to have a lot of cheap and affordable toothbrushes for everyone so in that case if you if you if you measure your product portfolio depending on the technology evolution you would have a crappy product portfolio but if you measure your product portfolio depending on how much you know your market parent penetration will be how many people buy your toothbrushes or how much you save in costs producing them you know like the ratio between cost production cost and price for instance things like that can think of this parameter then you will be very successful that means that different strategies also I mean let's say causes called different criteria of success or and so to say mature nests of your portfolio also the strategy can also change in time you might say at a certain point you know what now I want to be I'm tired of doing this this crappy simple and you know toothbrushes I want to do the best electrical toothbrush with all the services I bought one recently I was completely astonished by the features that they have so Nick massage whatever it is these and that and like oh cases the two but you know that is a completely different strategy is the same market toothbrushes but a completely different strategy and my required completely different way of measuring your portfolio so yeah I think you cannot you cannot measure success in in like in a common way and if you do you really need to give a lot of detail and there are a lot of factors yeah it feels if you're if you sell 300 million you see a number toothbrushes they are crappy but you sell like hot bread then you're very successful yeah that's your strategy you really nail it down

I'm noting it down here like it is difficult to when you have different strategies but I would say like even those strategies you can measure in the sounds like for example we have here again like even if you have like these two different companies who one is for this super cheap toothbrushes and the other one super advanced these both things you could put in the same Boston Consulting Group matrix right and even both here you can say like what is the product adaptation to the market

You need to see things with like if you put the revenue probably there will be mobile successful yeah actually yeah

To translate that into something that goes into my thing is the mother has to be robust and of course has to be adapt to different industries with that before I can play the bass after now we are saying like has to adopt different strategies it cannot be like Universal so the model has to be flexible yeah but still some modernization or some analytic evaluation could be still possible

I mean could be also kind of how to use an abuse term with these kind of machine learning things you know that the model that you would use the proper tools for a different depending on how what you have you know and then then you kind of learn out of it it's like oh wait a minute this company is doing that it's like a toothbrushes or they are doing like a cheap and convenient stuff like that things that you can buy and maybe after two months you throw them away and you don't you know you don't need to have fancy stuff and therefore you might not or you should evaluate when you put this company against the super cool toothbrushes that you know they're even smart stuff you know toothbrushes that connect one up and they tell you how good you think washing your teeth you know you've been limited which is like but it's like they have their app and then you see like oh this probably you haven't been washing your teeth properly today but if you if you compare this to you cannot compare them on if you want to measure the degree of success technology if you measure the technology of course it will be a huge difference you know that is like the product technology is very low and the other one is like the top but if you measure the revenue as we said well you say well actually they are not so distant from each other so you need to have I don't know maybe an adaptive model maybe a flexible model you need to be able to see things from different perspective so the kind of multi-dimensional should help also to identify where you are

I am flying from what you say that the mother has to be flexible has to learn learning different use cases different strategies so actually the key to evaluate it or to have like a good model is to use it in as many use cases or as many examples as you can and like you create your model but if

you don't use the model it's actually useless and then the model will become better where you evaluate more. Okay good feedback if we go because we have like only like now ten minutes this this use case like if I tell you like as I as I clip in ten minutes oh I did this and I did then I evaluated the cloud computing and at the end I come up to here with a matrix let's imagine that I'm consultant in product portfolio management and you assign me to chemical company selling or evaluate in the market for chemicals for swimming pool this invitation or yeah I come to you with these sort of matrix where I said like okay this company has a better product but is not so much adapted to the market and so you think like this will give you value you think like this approach makes sense like if you're yourself as an experienced product manager to this task right yeah it's imaginary...

Consultant, it is more consultant I would say yes as long as you give as I said this multi-dimensional matrix could be an example you might say degree of technological mature nests or like [Music] costs reduction or degree like how our effect if you are our efficient you are in the production so how much can you reduce costs in comparison to your competitors or service level how good you are in service maybe you can have a like compared to the benchmark doesn't need to be serviced here you know like if I buy a toothbrush that the crappy one provider need a service but if I bided the most fancy one and in my up connected to my toothbrush tells me things that don't make sense probably I will need to have some service so yes definitely would make sense absolutely I would be there would be something meaningful and okay

7.7. Company identification based on the portfolio analysis

In our analysis, three main dimensions in the portfolio were identified, and for simplicity, we represented those three dimensions in a radial chart with three different axes:

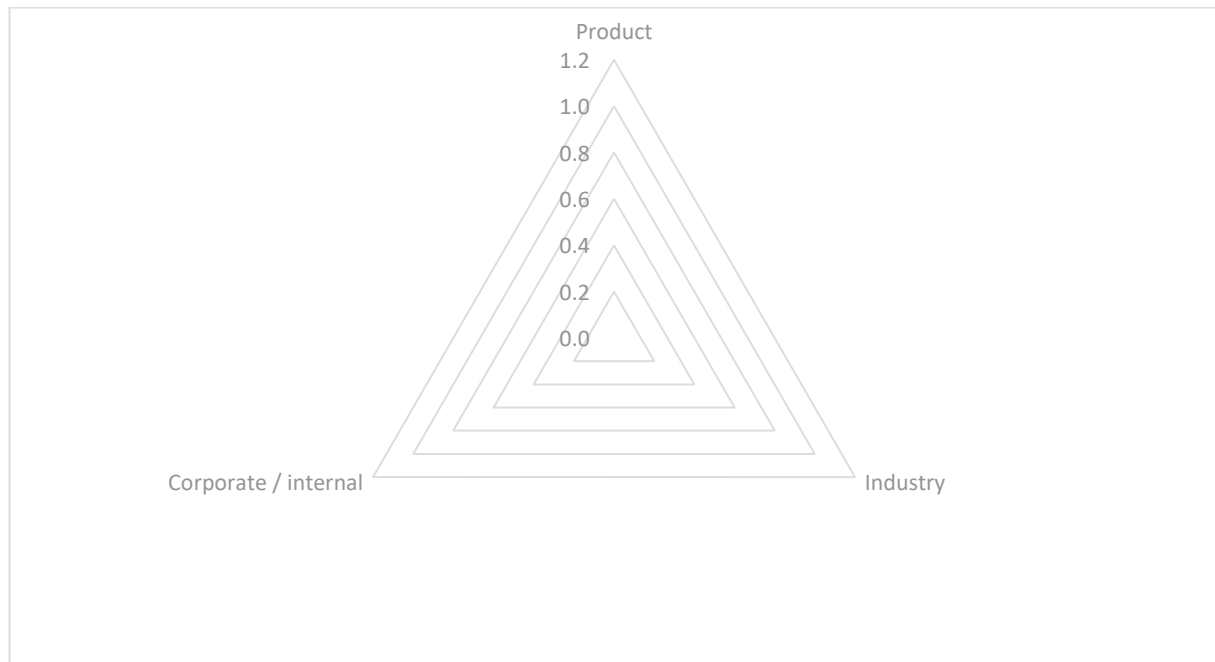


Figure 21 Portfolio dimensions

One of the follow-up evaluations is that just by checking the assessment of those three axes, we could identify the company's type. We can try to see some examples of some extreme cases:

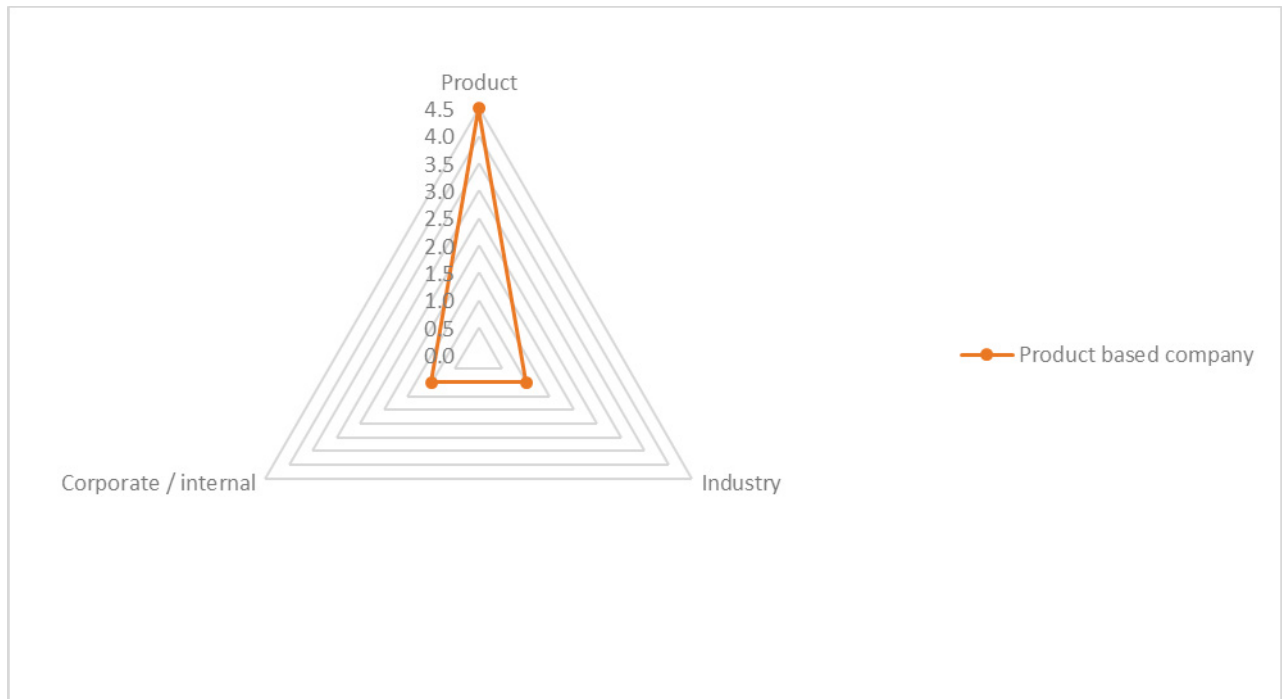


Figure 22 Example of product-based portfolio

In this case, the portfolio has an excellent product, technically very good, but it does not have a big match with the industry. This could be because the industry's need or push is not there yet, and the corporate factors are very poorly weighted. In this case, the hope would be to develop the market need, but without the corporate factors, the possibilities of success are minimal because to push a new need in a market requires funding. In some cases, the product itself can pull the industry demand, but in this case, a partnership to increase the corporate factors would be highly recommended, basically a capitalistic partner at least.

A similar example in real-life would be a startup company with an excellent technical idea in a new area.

To make it a bit more representative, we can call this example the tiger in the North Pole. A strong animal (product), but out of his comfort zone (arctic) and with external conditions not so favorable as it would probably be too cold (corporate).

The next case would be an industry-based portfolio:

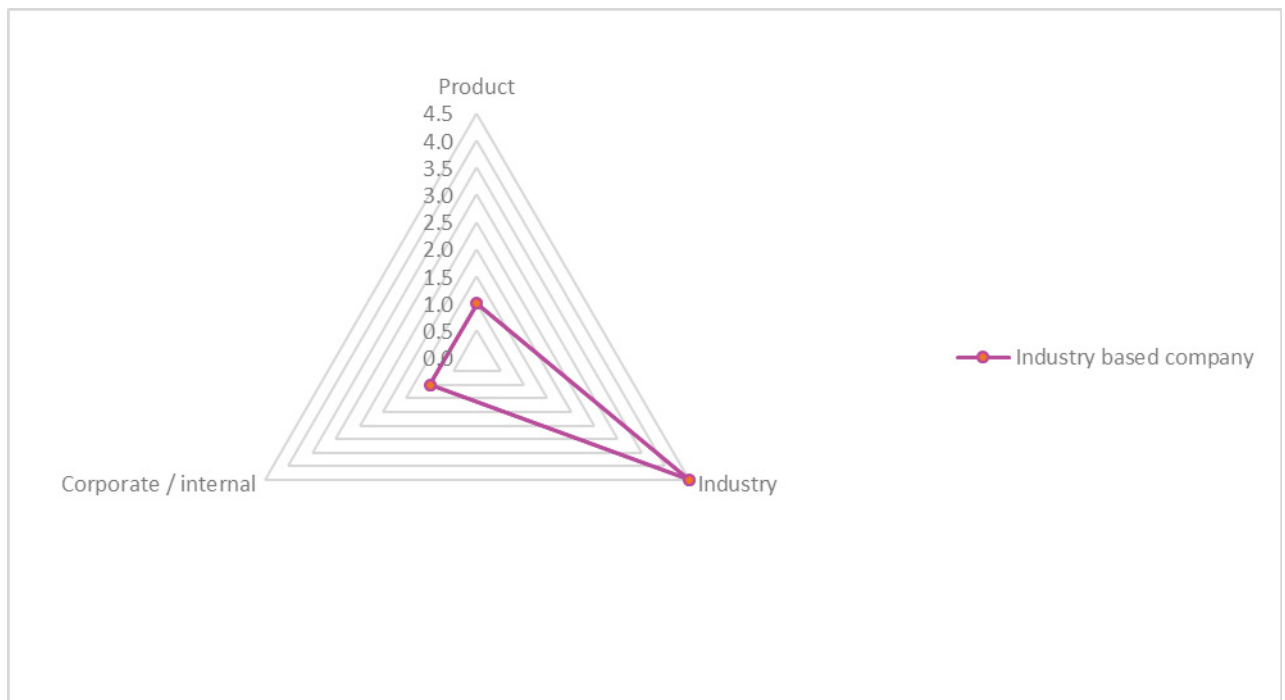


Figure 23 Industry based portfolio

In this next extreme case, we have identified an outstanding industry with good potential, and there is a product that could be well adapted to that existing use case, and ideally, there is also a price advantage. However, our implementation of the product is inferior, and the corporate factors are also weak. If our industry differentiators are so significant and the competition is weak, we can hope that even if our product is not very good, we can still sell some units that would finance the product's improvement.

This example would identify a group of entrepreneurs who found a perfect niche, but they lack the technical competence and money to implement it in the right way. This sounds a bit like Facebook's origins [68]. Of course, the next steps to progress would be to get a technical partner to implement the idea (as Facebook did) or to get a partnership.

Another example in the animal world would be the poison less snake in the rat nest. The perfect match of the animal and environment, but no weapons to reach the target.

And another extreme example:

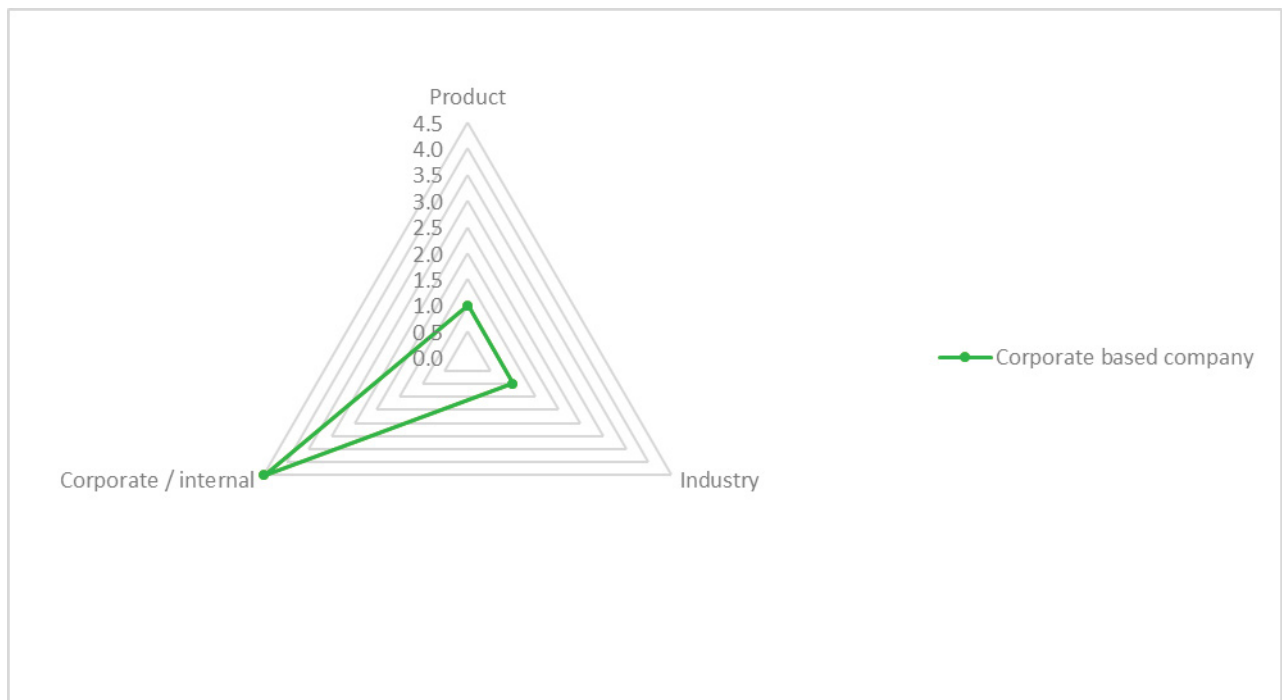


Figure 24 Corporate based portfolio

In this case, we have a very strong corporation that does not have a valuable product, or an industry selected where to focus. With the corporate factors, it would be possible to look for a new industry and build a product, but it requires changes in a wrong setup. The example in a real case for this example would be a big company that has seen its specific industries and products disappear, there is still some financial room to do something, but the company needs a reorganization and look for a new strategy.

In the animal world, this case would be like a drunk lost elephant. It is a powerful animal, but it is not in the best conditions. The best would be to wait till the drunkenness is gone to start looking for the way.

Till now, we examined the extreme cases where only one dimension is strong, but there are other examples with two strong dimensions:

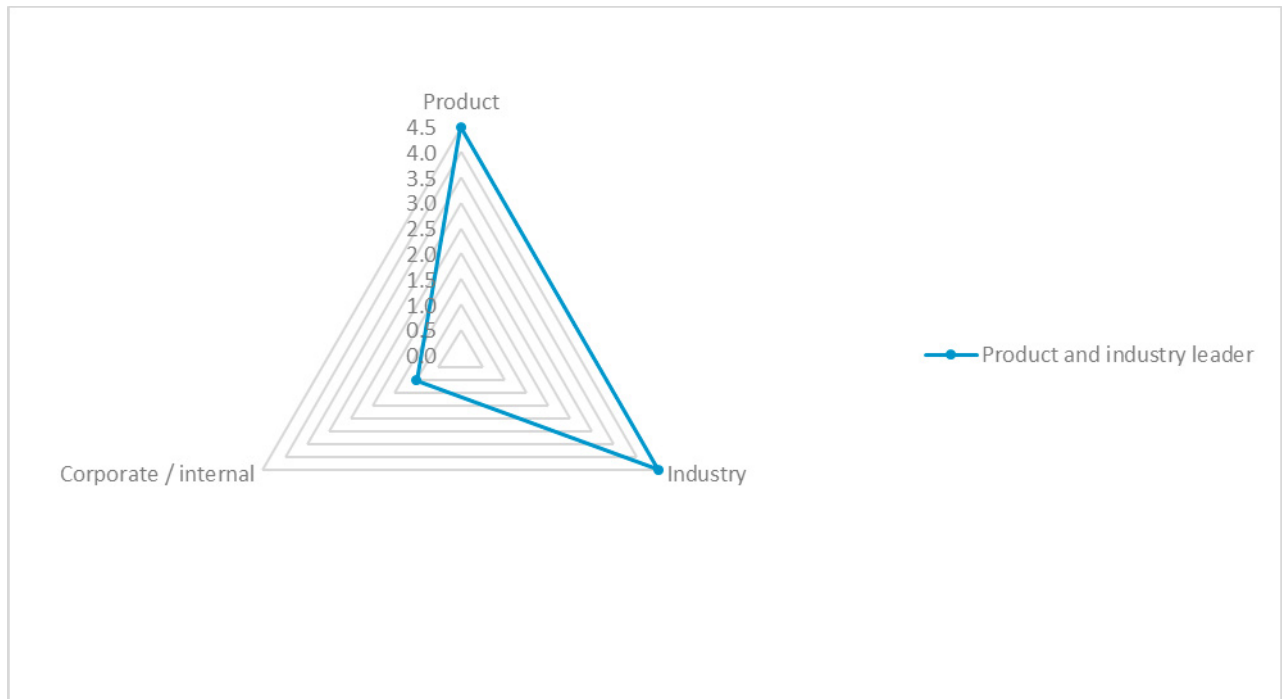


Figure 25 Product and industry strong portfolio

This example shows a portfolio with a very good product and a very good match for the market. However, corporate factors are weak. This would mean that there is little financial support or that the sales or post-sales process will be hard. A strategy here would be to try to shear the market until bigger guys come because there is a weakness in the situation. It would be a real case scenario with a good company that faces some heavy corporate issues, like legal or problems, to get financing.

Again, in the animal world, we can compare this case with a mouse in the cellar. The conditions and the setup are good, but the mouse has many predators, and sooner or later, somebody will notice the mice and start hunting them.

Another example would be if the product and corporate dimensions are very strong:

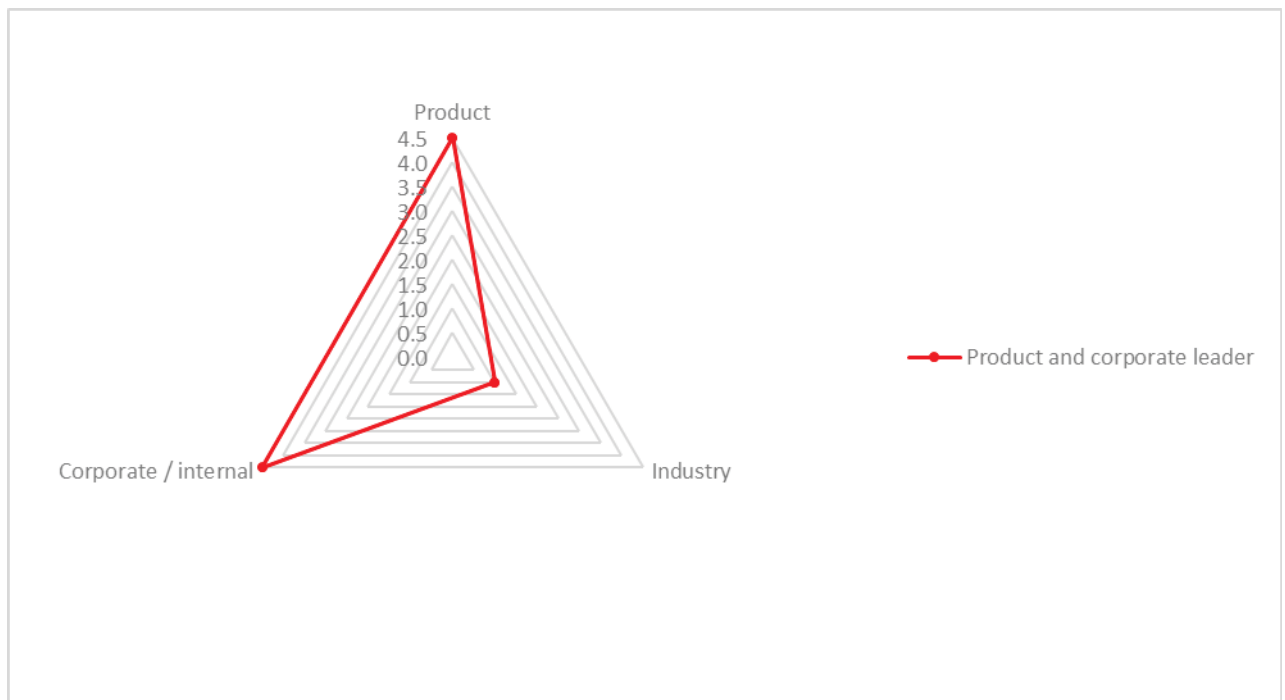


Figure 26 Product and corporate strong portfolio

In this example, the product and the corporate are very strong. However, the industry or market dimension is very poor. In this case, either the market does not exist, or the product is not well adapted to the industry's specific conditions. This would be the case of strong companies in very dynamic conditions, where the market can change very fast (i.e., a phone model that ran outdated). In these conditions, the company has an excellent product (and we assume technical capabilities to create the product) and also a strong corporation to support the portfolio. So, the goal would be to do a switch of the product use case or adaptation to try to match the market or push to create a new market even. Of course, it is not easy, and it could take time until the portfolio gets mature.

Following the animal examples, this would be the polar bear in the South Pole. The polar bear is a strong animal, very capable with very good skills to survive; however, polar bears live only in the North Pole, and the animals and environment are different in the South and North Pole [69], still similar, but the polar bear would need to adapt to these conditions very fast to survive.

Another extreme example would be the good values of the industry and corporate:

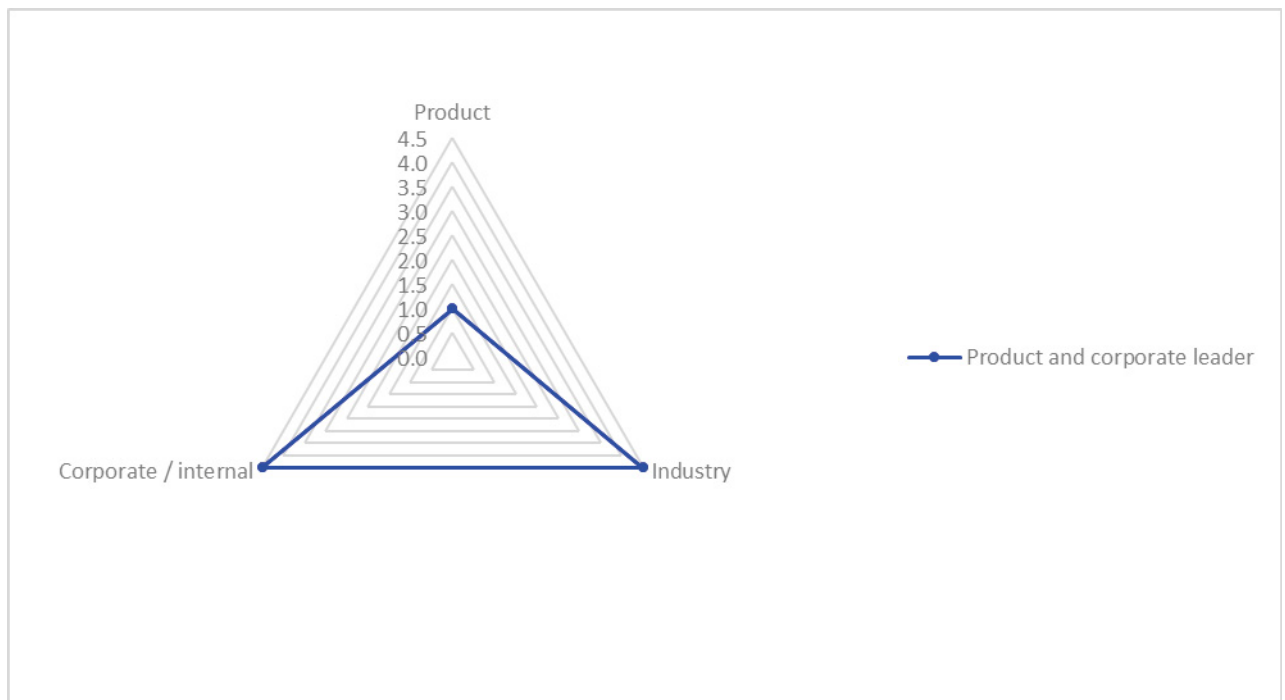


Figure 27 Industry and corporate strong portfolio

We see a case where there are a strong corporation and a strong market, but the product is weak. In this case, the market exists, and the portfolio is correctly matching the market, but either the company misses the technical capabilities to develop a new product or a legacy product that does not address the market well. In this case, the solution would be to redevelop the product and try to improve the portfolio. Given that the company has the resources, this can be doable, but it requires time. An example in the real world would be a big company trying to aim at a new market, as the market research can be done before development [70].

In this case, the example in the animal kingdom can be the eagle with the fear of heights. A powerful animal and good industry or market, but there is something that does not let the animal develop its power. The answer is to overcome the fear and go beyond the limitations, as the capabilities are there.

The last extreme case is where all the dimensions are very strong

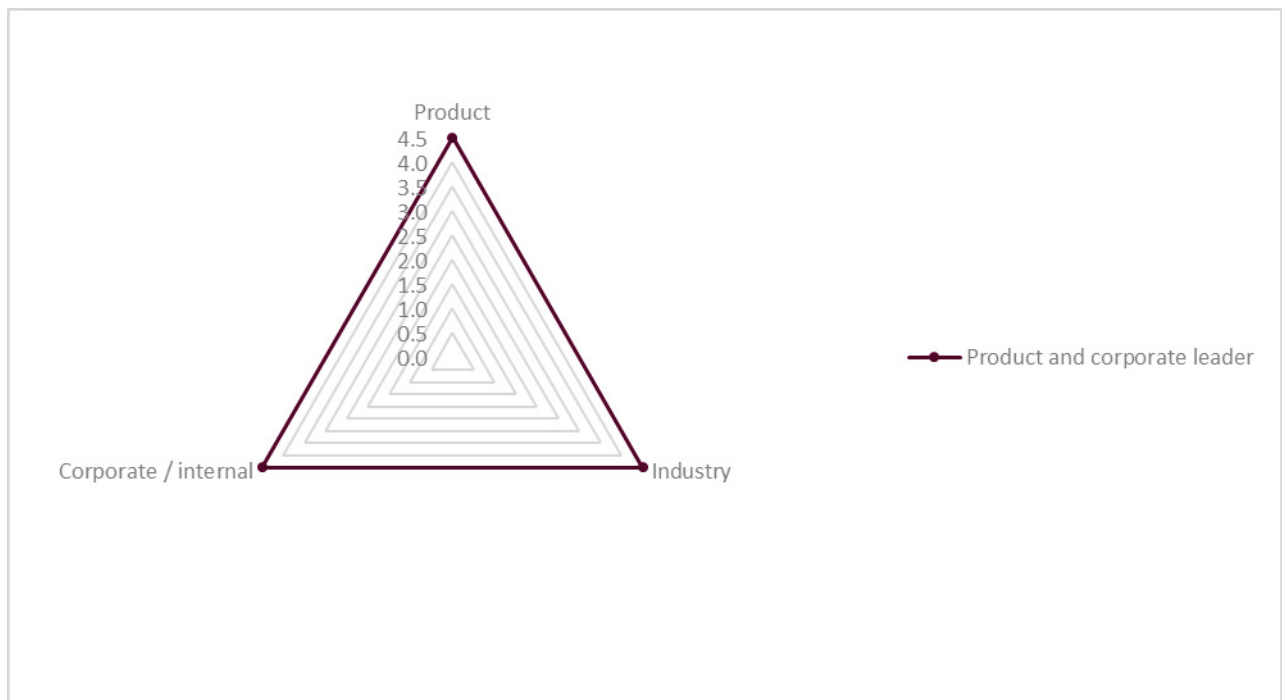


Figure 28 Strong portfolio in all the dimensions

Obviously, this case is very simple, and the portfolio is in perfect conditions. Strong product in a strong industry with strong company support.

An example in the animal world would be the lion, the animals' king, with perfect conditions to succeed.