

MASTER

Business model portfolio management the integration of business models in portfolio management

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Award date:
2015

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Eindhoven, February 2015

Business model portfolio management

*The integration of business models
in portfolio management*

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In partial fulfilment of the requirements for the degree of

**Master of Science
Innovation Management**

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TU/e School of Industrial Engineering
Series Master Theses Innovation Management

Subject headings: Portfolio Management, Business Model.

Acknowledgements

This report serves as my Master thesis resulting from my graduation project at BICORE in the research field of portfolio management and business models. The thesis is the final part of fulfilling the Master Innovation Management at the faculty of Industrial Engineering, University of Technology Eindhoven. I would like to express my appreciation to the people who helped with the conduction of the project.

First of all I would like to thank my university supervisor, Jimme Keizer. With his knowledge in the field of research he was always able to show different possibilities to me and made me question my vision. This way I was able to set up a research in a grounded, scientifically justified manner. This was crucial to get the right track, especially in the beginning. Additionally, I would like to thank my second assessor, Bob Walrave. The extra feedback he provided was always straight to the point and this helped me in many different ways. The knowledge he added in the methodology field en the composition of the report was really valuable and helped to focus the research to the direction aimed for in the research question.

I really appreciate the way the team at BICORE accepted me directly from the start and gave me support whenever I needed this. My company supervisor, Jac Goorden, was always ready to provide feedback to me and the newest scientific knowledge within the field of BICORE. I am truly grateful for the opportunity he gave me by allowing me to conduct the thesis at the company. Maarten Kluitman helped me with prototyping and developing my model in the software of BICORE. Therefore, I want to thank him as well. All other individuals that helped complete the research which I do not mention by name are appreciated for their help, such as the people that wanted to participate in the interviews. This was essential for the research. Thank you!

Management summary

Introduction

This research was conducted within the company BICORE in the field of portfolio management. BICORE is the developer of a strategic portfolio management software tool: Flightmap; a screen capture is included in figure A. The problem BICORE encounters is that customers want to innovate their business model one way or another. Multiple different business models cannot be displayed in Flightmap and neither be compared: how to input multiple different business models and compare these with each other?

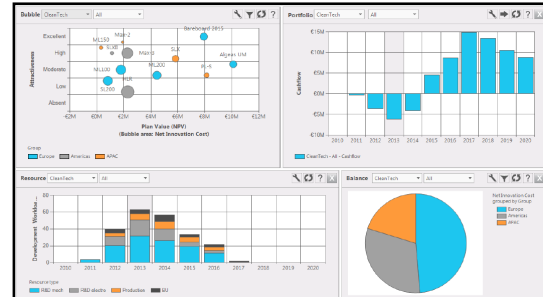


Figure A. Screen capture Flightmap

Literature

The concept business model derived from the literature review (Morris et al., 2005; Osterwalder & Pigneur, 2009; Amit & Zott, 2010) is defined as: *the process in which value is created, delivered to the market, and captured by gaining revenue out of this. The revenue opposed to the costs made should result in a profit.* Portfolio management for product innovation (picking the right set of development projects) is critical to a company's success; it is the business' list of active new product and R&D projects that is constantly up-dated and revised (Cooper et al., 2001). In addition, rather than putting all efforts on one means of access to an attractive opportunity, smart companies have found that it makes more sense to fund a number of small projects intended to capture market opportunity in different ways (Macmillan & McGrath, 2002). Correspondingly, Sabatier et al. (2010) argue that firms can combine different business models contemporary to deliver value to different markets. With the knowledge of Behrens and Ernst (2014) that visual aids are very useful in the decision-making process in the portfolio, the knowledge reveals a gap: it is not elaborated how different proposed projects can be visually presented as a set of different business models. This also is the problem BICORE encounters, which leads to the following research question with corresponding sub-questions:

How to present a proposed project within the portfolio as an amount of possible business models to include the impact of one business model or another in the decision making process, taken the possible portfolio constraints into account?

- *Which characterisations for business models can be derived from the literature?*
- *Which characterisations do practitioners want to use to compare business models?*
- *How to present projects this way when dealing with financially unattractive, but strategically interesting projects?*

The most important characterisations of business models based on the literature were captured in a framework consisting of: value, customer, costs, revenue, profit, and partners. The framework is schematically depicted in figure B. The goal was to implement the framework in Flightmap and eventually design a prototype that could serve as update for the program.

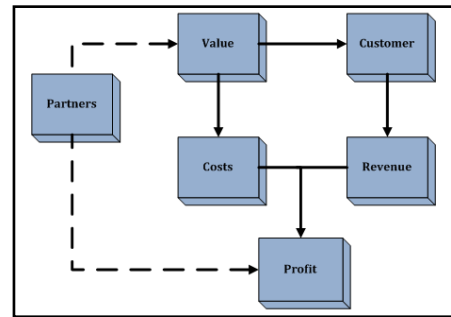


Figure B. Business model framework

Methodology

The design science methodology (Romme, 2003) was used in this research to serve the goal of the research to design a prototype. Phases of this type of research are empirical findings, grounding, and testing. Semi-structured interviews were used to gather information from practitioners. In the testing phase screen captures of the prototype were discussed with a sample in a second round of interviews to validate the goal of the prototype: input different business models and compare these visually with each other.

Results

The results revealed that practitioners would like to add ‘channels’ to the framework and partners were not considered in this aspect. Comparing business models would add value to the decision making process. Business model innovation is a serious issue in practice and the main driver seems to be ‘servitization’: the switch from selling products to selling solutions (Baines et al., 2009). Service based business models should, therefore, be included as well. This resulted in figure C that was the basis for the prototype.

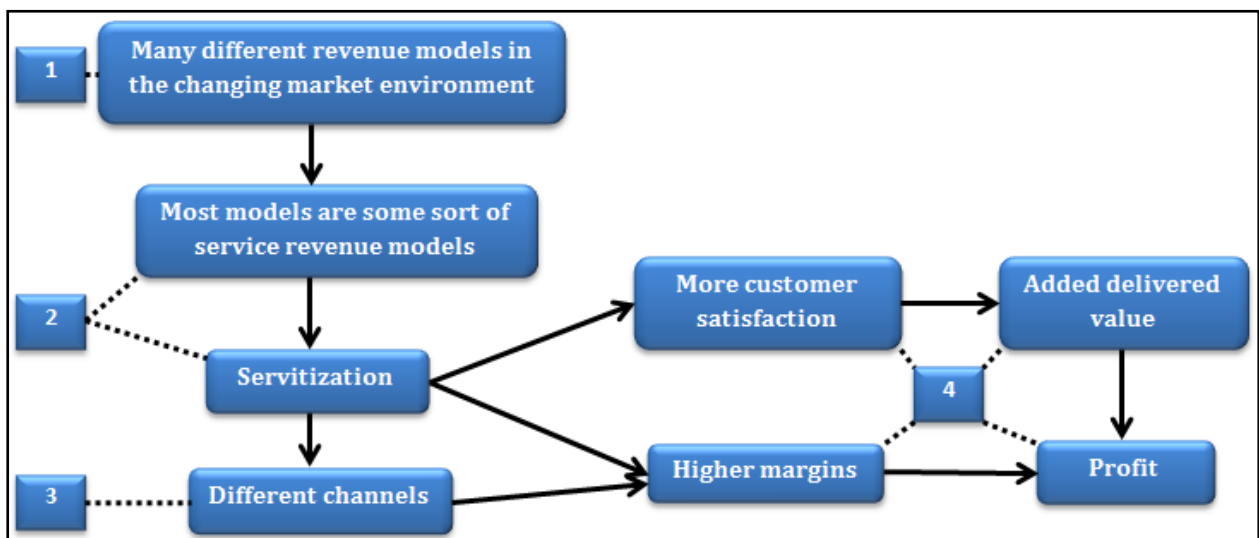


Figure C. Underlying problem structure of business model innovation

Figure C is a conceptual scheme with every part of the scheme serving as a requirement for the design of the prototype: create different revenue models, include service based revenue models, add channels, compare among others on profit.

Design

The results of the interviews were combined with the body of scientific knowledge regarding business models and portfolio management into design specifications as described by Van Aken *et al.* (2007): functional requirements, user requirements, boundary conditions, design restrictions. The resulting major requirements for the design are discussed qualitatively in this section. The project can be duplicated by selecting 'new variant'. An external market can be selected or a project specific market. The difference is that the external market makes use of total market estimation (with installed base and new sales) and a market share. In a project specific market only the volume of the sales has to be entered as data input. The costs are split in innovation costs and costs of sales, i.e. before and after introduction. To create different revenue models, product based as well as service based, it was designed to start with a basic revenue model and expand it by checking boxes for different add-ons. Table A displays the included options. Channels were included as a qualitative label attached to the project; one channel per project.

Table A. *The basic revenue models with the different add-ons*

Description			
1	Product	Subscription	Transaction
	# * price	# * price * time	# * (price + # * price)
2	Initial fee		
3	Service subscription		
4	Consumables		
5	Spare parts		
6	Fine (negative impact)		

Conclusions

Strategic projects are important for the long-term sustainability of the company, however, not considered as a possible business model upfront. Out of the interviews can be concluded that companies genuinely use different business models simultaneously. These different business models are mainly product based; for these models the visualisation of the development over time in one graph helps to improve the decision-making process. In the struggle with the shift to service based business models the visualisation of this process compared with the product based in a graph helps the decision makers. This research shows it is beneficial for the decision

making process to oppose different business models in a graph. The business model that yields most for the company can be selected.

BICORE recommendations

The research showed that companies are appreciating the addition to compare different alternatives of business models with each other. Additionally, companies struggle with the servitization of the industry. To help companies in this switch, the service based revenue model needs to be extended to create an accurate visualisation. The current set of variables is a good start; however, the terms used are strongly aimed at hardware. The principle of the present design with different add-ons by checking boxes was appreciated; however, information overload should be prevented.

The costs split, in innovation costs and costs of sales, is appropriate; it should, however also be possible to see the total costs. The market is designed well. The channels are interesting as a feature in Flightmap as well; however, the link from channels to the financial aspect is missing in the prototype. Summarised, expanding Flightmap with more options to let the companies customise their own model really adds value to the program according to the sample. Companies like recognition in the program, perhaps further customisation of the user-interface is a possible Flightmap expansion for the future: the possibility to change labels and customise even more than in the current design, without loading the programmers with amounts of work and complexity.

Theoretical contributions

This research contributes to the existing body of scientific knowledge by gaining initial knowledge regarding the implementation of business models in portfolio management. Companies seem to consider business models also on project level, not only on company level. During this research a business model was considered as different even if only one characterisation was different. This research contributes to this knowledge by defining the characterisations based on business model knowledge that practitioners, in the high-tech sector, would like to include in the business model concept: value, channels, customer, costs, and revenue. Corresponding to these characterisations the profit, risk and initial investment are considered important to compare the business models. Practitioners use quantitative characterisations to compare different business models with each other. Comparing these business models with each other can be done by opposing the developments over time. A line-chart is a manner to display this process clearly, according to the sample. The development can be based on different variables, such as profit, revenue, costs, or cash flow. This helps to visualise the forecasted implications for the company.

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1. Introduction

This research was conducted within the company BICORE in the field of portfolio management. BICORE (abbreviation of Business, Innovation, Cooperation, Results) is an innovative business service provider specialised in innovation management, including R&D portfolio management. BICORE wants to improve the 'Return on Open Innovation' in the high-tech sectors ICT, Electronic & Electrical Equipment, Automotive, and Life Sciences, as well as the process industry in the Benelux. The consultants of BICORE provide a picture of the current new product development portfolio status of their customers. The knowledge of these consultants and existing literature about project and portfolio management has been used by BICORE to develop a software tool: 'Flightmap'.

Flightmap is BICORE's strategic portfolio management solution. Flightmap enables better decision making regarding the innovation portfolio, and leads to more value creation. The unique powerful analysis capabilities support comprehensive strategic scenario planning, road mapping, project selection, and resource and budget allocation. With Flightmap, the progress of the project funnel can be monitored and managed, and it supports transparent, traceable, and efficient decision making.

Furthermore, the business model of BICORE is quite extensive. Next to Flightmap BICORE offers value by decision support and portfolio management and analysis for their customers. The support and development team is constantly improving Flightmap and maintains the customer relations. Further development may also be the result of conducted researches; this knowledge and the portfolio analysis algorithms give BICORE competitive advantages. Revenue is gained by subscription and consultancy fees plus additional revenue for portfolio analysis.

The practical importance of this subject in the field is still rising. Many researches are conducted trying to find drivers for business model innovation. According to the Economist Intelligence Unit (2010) a company should continually review the business model for a long-term competitive advantage. Pure product advantage is short-term. The rising importance of business models is a logical reaction to too many choices in the market. Companies in many sectors will distinguish themselves by innovative business models; these may be new pricing models, a shift to selling products as services or another model that will differentiate their offering from those of global competitors. In the survey to find challenges and opportunities for the years after 2010 a figure was also presented showing the result of a particular question out of their 2005 survey. Many respondents think that new business models are more important as a source of competitive advantage than new products and services. This is depicted in figure 1.

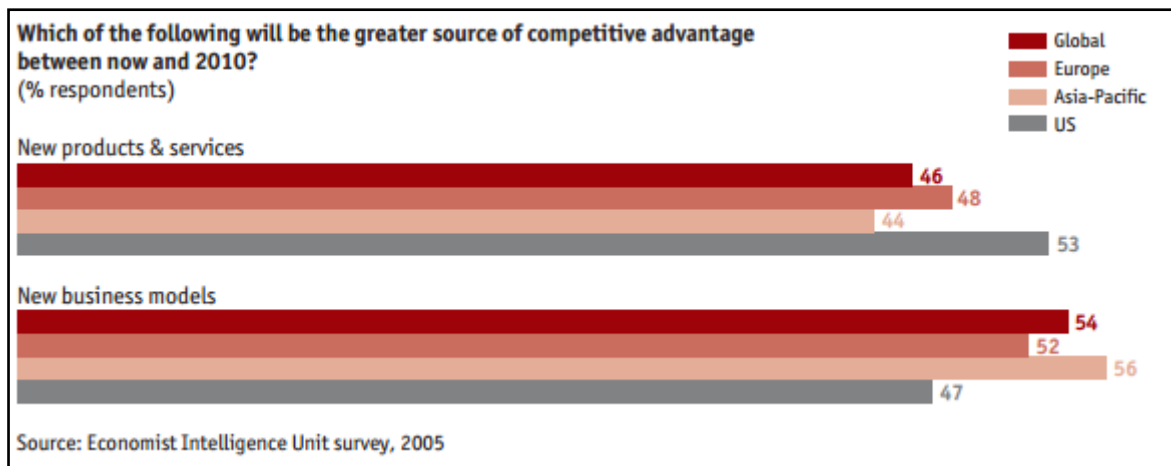


Figure 1. Importance of business model innovation

According to Rosenblum, Tomlinson, and Scott (2003) a cycle of business model myopia occurs very often in modern companies. The cycle works as follows: “a company’s business model emerges out of management decisions about who its best customers are, what offers they need, and how those offers can be delivered in a way that is attractive to the customers yet economically beneficial to the company. Success in the marketplace validates the model—industry leaders get constant validation in the form of strong financial results and an influx of imitators—and that reinforces management’s assumptions about which customer segments are viable. The greater a company’s success, the more myopic it becomes; assumptions about unprofitable customer segments become ever more entrenched, and the cycle continues.” Therefore companies should revise their business model regularly and rethink traditional offers to reach the customers. In addition, to serve a number of customer segments, a company should organise its businesses as a portfolio of business models. This will force managers to resist watering down the product offers or business processes.

The problem BICORE encounters is that customers want to innovate their business model one way or another. Multiple different business models cannot be displayed in Flightmap and neither be compared: how to input multiple different business models and compare these with each other?

To gain more knowledge in the research field an extensive literature study is conducted and discussed in chapter 2; this will result in a more specific research question. Chapter 3 discusses the methodology that was used during his research, with subsequently the results split in chapter 4 and chapter 5. The conclusions that can be drawn out of this research together with the implications and discussion are treated in chapter 6. Finally, the references used in the research are presented. Appendices are referred to in the text.

2. Literature review

BICORE is a company aiding their customers in portfolio management. Scientific knowledge regarding this topic was required. The problem statement also needed more scientific knowledge regarding business models. Therefore, business models are discussed first to elaborate portfolio management more thoroughly in the second phase of the review.

2.1. Business models

To obtain a clear idea what exactly is a business model, first the business model construct will be discussed. Subsequently, definitions of three leading authors will be discussed in more detail.

2.1.1. The business model construct

The business model is not a strategy but includes a number of strategy elements. While the term 'business model' is widely used by practitioners, its appearance in the academic literature is less common (Schweizer, 2005). According to Teece (2010) it is similar to other interdisciplinary topics: business models are frequently mentioned but rarely analysed. Therefore, they are often poorly understood. Not surprisingly, it is common to see great technological achievements fail commercially because little, if any, attention has been given to designing a business model to take them to market properly. Highly emphasised in entrepreneurial practice, business models have received limited attention from researchers. No consensus exists regarding the definition, nature, structure, and evolution of business models. Still, the business model holds promise as a unifying unit of analysis that can facilitate theory development in entrepreneurship (Morris, Schindehutte & Allen, 2005). It seems that the executives, reporters, and analysts who used the term "business model" never really had a single and clear idea or definition of what it meant. They inserted it into their texts to describe everything from how a company earns revenue to how it structures its organisation (Linder & Cantrell, 2000).

The business model construct builds upon many theories like the value chain concept (Porter, 1985), the resource-based theory (Barney, Wright & Ketchen, 2001), the strategic network theory (Jarillo, 1995) and cooperative strategies (Dyer & Singh, 1998). Further, the model involves choices (e.g. vertical integration, competitive strategy) about firm boundaries (Barney, 1999) and relates to transaction cost economics (Williamson, 1981). Porter (2001) essentially classified businesses among cost leaders and differentiators; Timmers (1998) classifies business models among degree of innovation and degree of integration. Additionally, Amit and Zott (2010) view a business model as a system of activities that depicts the way a company "does business" with its customers, partners and vendors. More precisely, as the bundle of specific activities that are conducted to satisfy the perceived needs of the customers, including the

specification of the parties that conduct these activities (i.e., the focal firm and/or its partners), and how these activities are linked to each other.

2.1.2. Business model decisions

Morris *et al.* (2005) created six decision areas underlying a business model: (1.) How do we create value? (2.) Who do we create value for? (3.) What is our internal source of advantage/competence? (4.) How do we competitively position ourselves in the marketplace? (5.) How do we make money? (6.) What are our time, scope and size ambitions? These questions are called components. Thereafter, a framework is proposed that consists of three increasingly specific levels of decision making: 'foundation', 'proprietary,' and 'rules' level. The foundation level consists of basic decisions that every entrepreneur must make (general), the proprietary level consists of decisions that result in marketplace advantage (more specific) and the rules level delineates guiding principles governing execution of decisions made at levels one and two. While the foundation level is adequate to capture the essence of a model for many firms, sustainable advantage ultimately depends on the ability of the entrepreneur to apply unique approaches to one or more of the foundation components. Where the foundation level is generic, the proprietary level becomes strategy specific. Once implemented, a model's success can be tied to a basic set of operating rules. These guidelines ensure that the model's foundation and proprietary elements are reflected in ongoing strategic actions. Sustainability requires that the model's components are consistent, this can be described in terms of internal and external 'fit'. Internal fit includes consistency and reinforcement within and between the six components of the model where each component affects and is affected by the other components. External fit is concerned with consistency between choices in the six areas of the model and conditions in the external environment. As environmental conditions change, the model may require adaptation or wholesale change. This business model is consistent with Porter's (1996) definition of strategy: performing different activities than competitors or about performing similar activities in different ways. Each of the six decision areas and the interactions between areas are supported by a variety of activity sets. The business model encourages the entrepreneur to (1.) conceptualise the venture as an interrelated set of strategic choices; (2.) seek complementary relationships among elements through unique combinations; (3.) develop activity sets around a logical framework; and (4.) ensure consistency between elements of strategy, architecture, economics, growth, and exit intentions. Strategic choices are made both intentionally and by default; the business model makes them explicit. At the foundation level, the model provides a framework for deciding what not to do and recognising trade-offs. At the proprietary level, unique configurations are produced that can result in sustainable advantage.

2.1.3. The Osterwalder business model

In his research Osterwalder (Osterwalder, 2004; Osterwalder & Pigneur, 2009) believes that modern business models are increasingly complex and different variables influence its success, it could be interesting to apply a more fine-grained characterisation or classification. According to Osterwalder (2004) a business model can be defined as:

'A conceptual tool that contains a set of elements and their relationships and allows expressing a company's logic of earning money. It is a description of the value a company offers to one or several segments of the customers and the architecture of the firm and its network of partners for creating, marketing, and delivering this value and relationship capital, in order to generate profitable and sustainable revenue streams.'

He proposed a standard business model on nine axes which are the nine basic building blocks of a business model. Every block is a characterisation of a specific part of a particular company's business model. Next are the nine blocks explained, the word in parentheses points out which part of figure 2 is described.

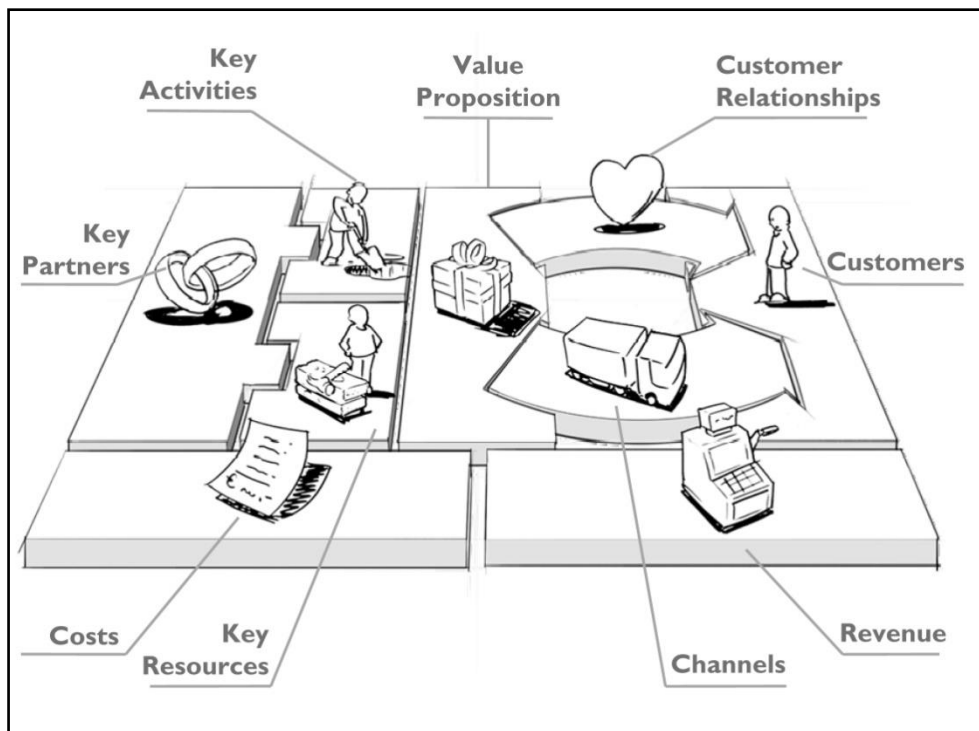


Figure 2. The Osterwalder business model (Osterwalder & Pigneur, 2009)

Value Proposition/Product/Value Leadership (Value Proposition): To characterise the value proposition of a company one could imagine a scale showing how strong it performs concerning the price/value ratio of its value proposition(s).

Target Customer/Market Share (Customer): A second scale could show the company's market share to show its actual dominance in a specific market.

Distribution Channel/Channel Complexity (Channels): Channels could be characterised by their complexity having companies with a single distribution channel at the low end of the scale, companies with several stand-alone channels in the middle and companies with a range of complex and interrelated channels at the high end.

Relationships/Customer Integration (Customer Relationships): The relationship scale could show how integrated a company's customers are. In other words, how deeply they are involved in the value creation process and how far the value proposition is tailored to their specific needs.

Value Configuration/Degree of Business Model Integration (Key Resources): The value configuration could be characterised by the degree of integration of the business model. The computer manufacturer Dell, for example, has a very integrated business model where everything from the supply chain to customer service is highly integrated.

Capabilities/Spread (Key Activities): The capabilities of a company could be characterised by the range or spread of the different capabilities necessary to execute the business model. A business model that builds on few and similar capabilities would be found at the low end of the scale, whereas a business models that demand many and diverse capabilities would be found at the other end.

Partnerships/Networkedness (Key Partners): This element could be characterised by the degree of “networkedness” of a company; in other words with how many partners the company works to execute its business model.

Cost Structure/Low-Cost Leadership (Costs): Characterising the cost structure is rather straight forward. At the top end of the scale we have the low cost leaders.

Revenue Model/Revenue Diversity (Revenue): The revenue model could be characterised by the diversity of its revenue streams. A company with a single revenue stream would be found at the low end of the scale and a company with diverse revenue streams at the other end.

2.1.4. Business model adaptation

The focus of Amit and Zott (2010) in their research is to foster innovation with business models, to innovate by making small adaptations to the business model of the company. Prior research on business model innovation measured the extent of being new to the state-of-the-art, and not just new to the firm (Birkinshaw, Hamel & Mol, 2008). This is explained with process innovation: “In the operations area, much of the innovations and cost savings that could be

achieved have already been achieved. Our greatest focus is on business model innovation, which is where the greatest benefits lie. It is not enough to make a difference on product quality or delivery readiness or production scale. It is important to innovate in areas where our competition does not act – by developing new competencies, alliances, etc.” Business model innovation is not costless. Barriers to change can seem costly in times of economic crisis when capital resources to fund substantial R&D are scarce. However, business model innovators do not need to commit R&D investments to technologies. Rather, they deploy technologies in innovative ways. The overall objective of a firm’s business model is to satisfy a perceived need in order to create value for all stakeholders; this is reflected in the customer value proposition (Amit & Zott, 2001; Magretta, 2002). Important design elements of a business model that characterise an activity system are its content, structure, and governance. The content of an activity system refers to the selection of activities to be performed. The structure of an activity system describes how the activities are linked, e.g., the sequencing of activities and the exchange mechanisms among the linked activities. The governance of an activity system refers to who performs the activities. Franchising, for example, represents one possible approach to innovative activity system governance. These three elements can be highly interdependent; managers can innovate on all three elements as well as jointly. One of the interdependencies is the one between the business model and its revenue model. To achieve business model innovation managers need to ask themselves the following six questions: (1.) What is the new objective/which new value is offered? (2.) What novel activities are needed therefore (business model content)? (3.) How could these activities be linked to each other in novel ways (business model structure)? (4.) Who should perform the activities, and what novel governance arrangements could enable this structure (business model governance)? (5.) How is value created for each partner? (6.) Which revenue model is appropriate?

Concluding, based on the literature review regarding business models organisations need to create value and deliver this to meet customers’ needs. The organisation should then gain some sort of profit or value out of this as a result from the strategic choices involved (Morris *et al.*, 2005; Osterwalder & Pigneur, 2009; Amit & Zott, 2010). To link this knowledge to the field of portfolio management, this subject will be elaborated in the following paragraph.

2.2. Portfolio management

Portfolio management for product innovation (picking the right set of development projects) is critical to a company’s success; it is the business’ list of active new product and R&D projects that is constantly up-dated and revised; a project is the possible development of a product or service. This process includes multiple phases; from ideation to introduction (Cooper, Edgett & Kleinschmidt, 2001). According to Cooper *et al.* (1998, p. 3) “*portfolio management is a dynamic*

decision process whereby a business's list of active new product projects is constantly updated and revised. In this process, new projects are evaluated, selected and prioritised; existing projects may be accelerated, killed or deprioritised; and resources are allocated and reallocated to the active projects. The portfolio decision process is characterised by uncertain and changing information, dynamic opportunities, multiple goals and strategic considerations, interdependence among projects, and multiple decision-makers and locations". "The set of projects carried out during the portfolio management process will enable the firm to grow profitably over the long term" (Kester, 2011, p. 641). Additionally, in highly unpredictable situations, smart companies have learned that the best way to make sure they are able to respond effectively to future challenges is to deploy patterns of projects; rather than putting all efforts on one means of access to an attractive opportunity, they have found that it makes more sense to fund a number of small projects intended to capture market opportunity in different ways (Macmillan & McGrath, 2002).

However, the portfolio management challenges should not be underestimated as they may have severe consequences for the firm (Kester, Hultink & Lauche, 2009). In contrary, a successful new product portfolio has commonly been framed in literature in three dimensions: value maximisation, balance and strategic alignment (Cooper et al., 1998; Kester et al., 2009). Cooper et al. (1998) also define a fourth dimension: right number of projects.

Value maximisation sets out the goal to find the most profitable ratio between resource input and return; 'you select projects so as to maximise sum of the values or commercial worth of all active projects in your pipeline in terms of some business objective (such as long term profitability)'.

Balance has the goal to achieve a desired harmonious balance in terms of different types of parameters, such as high/low risk or long-term/short-term projects. Within many firms the focus has shifted from radical to incremental innovations within the new product development (NPD), thus the portfolios became unbalanced and not in line with the strategy of the organisation (Barczak, Griffin & Kahn, 2009), due to the focus on short-term benefits achieved by incremental innovations and exploitation. Chao and Kavadias (2008) argue for the use of 'strategic buckets'. Strategic buckets encourage the division of the overall new product development resource budget into smaller, more focused budgets that are defined by the type of innovative project (incremental or radical). In addition, according to Archer and Ghasemzadeh (1999) portfolio selection is a strategic decision about the balance among the selected projects such as risk, size of projects, and short term versus long term. This is important because having too many high risk or large projects could be dangerous due to the fact that failure of several of

these projects may have severe consequences for the organisation, however, too many low risk projects may not lead to the financial return or strategic growth that is more typical for high risk projects; too many long term projects may cause financing or cash flow problems.

Strategic alignment wants the final portfolio to truly reflect the business' strategic aspirations. A company in a fast developing environment with the strategic aim to be sustainable competitive by making many innovations should, therefore, have a more risky portfolio.

The right number of projects states that most companies execute too many projects contemporarily, therefore many projects end in the queue in the pipeline. This results in delayed projects and an increased time-to-the-market (Cooper et al., 1998), which implies that the resource allocation was not carried into effect appropriately. Success requires a fundamental trade-off: short-term benefits accrued through incremental projects versus long-term benefits achieved through radical or new-to-the-world products and services (Tushman & O'Reilly, 1996). Moreover, according to Repenning (2001) the new product development portfolios have become overloaded, whereby managers are fully occupied with urgent problems, thereby losing the 'big picture'. This process, therefore, needs to be managed appropriately.

2.2.1. Project choices

Portfolio management decisions involve three main types of project choices, i.e. project selection, project termination and project deletion (Kester et al., 2009). It is a common mistake to see portfolio management just as a project selection process (Cooper et al., 1998). Project selection represents the major decision that is normally made in portfolio management. This decision has normally been treated in literature as a decision process that uses financial and operations research theories in order to rationally decide the best new product development project to undertake, so the firm ultimately obtains a profitable and balanced portfolio (Kester et al., 2009). The information at hand is not always entirely reliable and many uncertainties plague this decision process (Kester et al., 2009). In addition, dependencies between products in the market and development make evaluation, selection, and allocation of resources among them difficult (Blau, Pekny, Varma, & Bunch, 2004). For example, it might be beneficial to invest in a financially unattractive, high-risk product, as it might lead to significant strategic benefits from sequentially developed products. The difficulty of decisions about new product portfolio management occurs as there is limited amount of reliable information regarding customer demand, specific design requirements, and required investments (Chao & Kavadias, 2008).

Additionally, Van Bommel, Mahieu and Nijssen (2014) modelled the decision to maximise the value of a set of R&D projects drawing on the same underlying technology. Both engineers and

managers face difficulties in estimating technological challenges and market opportunities. In the process, they tend to gravitate towards difficult and high-return projects rather than low-risk, low-return ones. Moreover, potential learning effects between different projects are often not factored in or even omitted. However, having considered the earlier R&D projects as part of a technology trajectory with possible learning spillover could have resulted in better return on R&D investments made. More importantly, 'the value benefited from selecting less challenging projects with a lower project value first and performing more difficult projects with higher project values later. The reason is that learning is more likely to spillover from easier than difficult projects' (Van Bommel et al., 2014). This shows it is more beneficial to select and perform a less risky project before taking on a more technologically challenging and high-return project, when making the decision between projects with the same technology underlying. Also affordable loss limits the downside potential of pursuing an opportunity by not investing more resources than the firm can afford to lose without jeopardising the chance of developing the new technological avenue (Van Bommel et al., 2014).

2.2.1.1. Project termination

According to Kester et al. (2009) project termination decisions (ending new product development projects) free up resources that create room for better project opportunities. This decision may, however, be a hard one. A project showing signs of low probability of success, and therefore should be abandoned, could be continued in some situations: managers already have an emotional bond to the project and will see the termination as personal failure; this phenomenon is called 'escalation of commitment' (Kester et al., 2009). Moreover, the research of Behrens and Ernst (2014) shows it is beneficial to make use of a combination of the advice of a consultant and visual decision aids reducing escalation of commitment. Consultants do not have prior beliefs about a project as they temporarily work for several firms in different industries and are typically not involved in the development process for an innovation project. Visual decision aids are useful information sources for decision-making, as they help clarify complex relationships, visualise trends, make forecasts, and provide an overview of business activities. They also help enrich the information environment by structuring underlining uncertainties. As a result, management is generally more receptive to visual decision aids than to large tables or detailed statistical analyses because they provide clearer data representations. The research shows using both approaches simultaneously provides the strongest de-escalation effect.

Concluding, visualisation of the portfolio projects and the planned gains are beneficial for the quality of the decision-making process; especially in combination with the advice of a

consultant. The planned strategy can be compared with the current portfolio and visualised; projects that are not in line with the strategy can be terminated more easily.

2.2.2. Strategic portfolio management

Portfolio management decisions are of great importance to a company's short- and long-term future as they help to operationalise a business' strategy (Chao & Kavadias, 2008). Rumelt, Schendel, and Teece (1994) define the content of strategic management qua discipline as "the purposeful direction and natural evolution of enterprises"; another definition says 'strategy is the long-term direction of an organization' (Johnson, Whittington & Scholes, 2011). This second definition is used in this research to define strategy.

The strategy of a firm is materialised in the moment the firm's managers decide how and where to allocate its resources (Cooper et al., 1998). Important inputs to the portfolio management process are the goals and strategy of the organisation, some organisations do not insist on knowing the value a project would add to the strategy before granting approval (Meredith & Mantel, 2009). Saying, organisations start projects without checking the added value they offer the company based on some sort of analytics, such as a strengths, weaknesses, opportunities, and threats analysis. This may lead to a misaligned portfolio. On occasion this will mean shutting down projects prior to their completion because their risks have become excessive, their costs have escalated out of line with their expected benefits, another (or a new) project does a better job of supporting the goals, or any variety of similar reasons (Meredith & Mantel, 2009).

According to MacMillan and McGrath (2002) much of the value of projects lays in the future, it is hard to know when, or whether, they are going to pay off. This creates enormous stresses in the resource allocation process for most companies. Particularly when resources are stretched thin, it is common for companies to focus too much on extending their existing technological bases, thus under-investing in the future. The balance between extending technological bases, exploiting, and investing in the future, exploring, is company context specific (Jansen, Van den Bosch, & Volberda, 2006), therefore it is possible that some companies need to invest more in exploitative projects to sustain.

According to Cooper et al. (2001) poor portfolio management leads to a scattergun R&D and new product effort that does not support the organisation's strategy, low value projects due to deficient decisions, a lack of focus which increases times to market and decreases success rates, and selecting the wrong projects. This all will thus lead to a decreased value of the firm, less profit and a decrease in market share. Cooper et al. (2000) therefore argue for a structured and formalised new product development portfolio management. However, these methods really fail

to provide criteria for a forced ranking of projects against each other. Projects are rated against objective criteria, but are rarely force-ranked against each other. So there is little discrimination between projects: they are all accepted (Cooper et al., 2000). This asks for evaluation criteria to compare different projects to each other.

2.2.3. Real options portfolio management

According to Kester et al. (2009) project selection literature primarily focused on financial models. These models have been subject to extensive criticism regarding the uncertain and speculative nature of project data until introduction. In response to this criticism more sophisticated methods have been developed, which are commonly classified as probabilistic financial methods, such as real options (McGrath, 1997). Real option methods follow the principles of buying options in the stock market and aim to compensate for the associated risks of innovation (McGrath, 1997). Although real option methods can help to obtain realistic risk and reward calculations, they are not user friendly. Real options decompose project in different stages all attached with certain value; therefore, it may be beneficial to a company to start a project and never (plan to) finish it. This approach was not applicable to the problem of BICORE that asked for a more top-down view and compare total projects with each other for strategic purposes.

Additionally, although financial methods are the most-researched portfolio decision-making methods, research shows that using strategic buckets (Barczak et al., 2009) is the best way to achieve success. The strategic buckets method for evaluating a portfolio is a top-down approach that operates from the simple principle that implementing strategy equates to spending money on specific projects where the money that is spent mirrors the business's strategy (Chao & Kavadias, 2008). Therefore, the strategic approach with the use of buckets and strategic choices was more applicable to the research problem of BICORE. This point that the approach of strategic choices is more applicable than real options for BICORE was also shown by the former internship-student: Andrés Caballero; real options are not elaborated any further.

2.3. Matching portfolio with business model

MacMillan and McGrath (2002) conducted a research about the allocation of resources and portfolio management within companies as strategic choices. Within projects the company needs to deal with uncertainty. Macmillan and McGrath (2002) make a difference between market uncertainty and technical uncertainty. The market uncertainty reflects the doubts about whether or not the customers will buy it and for what price; technical uncertainty addresses questions such as will it be ready in time or will it work in the field. These two concepts are used as the axis for the matrix, which will serve as the basis for their portfolio management division

of resources. Macmillan and McGrath (2002) suggest division of projects in categories corresponding to the fields resulting from opposing technical and market uncertainty depicted in figure 3. In addition, the authors argue that employees should be allocated for a maximum of 90% of their time.

TECHNICAL UNCERTAINTY	HIGH	POSITIONING PROJECTS		STEPPING-STONE PROJECTS
	MEDIUM	PLATFORM PROJECTS		SCOUTING PROJECTS
	LOW			
		LOW	MEDIUM	HIGH
	MARKET UNCERTAINTY			

Figure 3. Portfolio division (MacMillan & McGrath, 2002)

MacMillan and McGrath suggest that a company should pre-divide their resource allocation in the different categories of figure 3 based on a company specific context. The division differs for companies in a relatively stable environment or a highly uncertain industry. In stable industries companies should invest more in low uncertainty projects, and contrary, in uncertain industries one should weigh the proportion of resources in the portfolio more heavily towards more uncertainty projects. A company should determine the mix of projects it needs to support its strategy and the amount of resources available. New projects can only compete against other projects in their own category. This way a company will get the best portfolio and the division stays the optimal way for the company's portfolio. The strategic choice is the amount of resources available for each category (Macmillan & McGrath, 2002). This view shows similarities with the research of Chao and Kavadias (2008) regarding the strategic buckets mentioned before and using strategic buckets described by Barczak et al. (2009). In these researches the authors argue for a pre-defined resource allocation strategy for a new product portfolio that is aligned with the strategy of the company.

In addition, a company should have a clear idea of what its business model is to have the company's strategy clear (McGrath, 2010). According to McGrath (2010) the business model is a

way to analyse the 'core competences' of a company that create value for customers and gain revenue out of this. The competition is analysed as well as the potential sustainable competitive advantages. Most important are process or operational advantages, which yield performance benefits. The building block of the strategy is the 'unit of business': the value the customer pays for. The business model concept is a powerful idea for strategic thinking according to McGrath (2010). Then the company can make an appropriate resource allocation in the portfolio planning, as discussed by MacMillan and McGrath (2002).

2.3.1. Business model portfolio

Sabatier, Mangematin and Rousselle (2010) argue that firms can combine different business models simultaneously to deliver value to different markets. They define a portfolio of business models as 'the range of different ways a firm delivers value to its customers to ensure both its medium term viability and future development'. Many firms have a portfolio of business models to 'develop the market value of their core competencies and to generate revenue streams to balance time-to-market pressure, risks, interdependency and expected returns'.

According to Sabatier *et al.* (2010) business model and business model portfolio are particularly useful to address customers' needs and organisational capabilities of the firm. All firms implement business models, and many implement several business models simultaneously to deliver value for different categories of consumers and to balance revenue stream, risks and interdependencies with other actors. The concept of business model is an intermediary concept between core competencies and business strategy, linking internal appraisal of organisational capabilities and the strategic positioning on evolving markets. Core competencies refer to a firm's fundamental ability for undertaking specific activity, to create a value proposition for the ultimate customer or to deliver that value more efficiently. A business model connects core competencies with market and customers; it is deeply interrelated with business strategy. As business strategy, business model does not cover the entire company, therefore firms may be involved exploiting several business models (Sabatier *et al.*, 2010). This description of the concept of a business model includes more detail than the definition used by McGrath (2010). The concept of business model articulates the creation and delivering value for the customer, with the organisational capabilities of the firm to differentiate strategies (Margretta, 2002). Firms need to find a balance between their business models to create synergy for their core competencies. This is pointed out in table 1.

Table 1. *Balancing business models portfolio (Sabatier et al., 2010)*

		Risk and time to market		
		Low and short	Medium	High and long
Interrelatedness between business models	Highly interrelated	Low expected returns for firms mainly involved in service activities. They may serve different interrelated customers.	The firm addresses the same market balancing high risk business models based on the product development and low risk business models like those based on knowledge architecture.	High expected returns. The firm is highly dependent on external funding. Highly risky for the firm.
	Disconnected	Pure diversification, based on different activities.	Similar core competences which may be turned into different businesses to address different customers OR different core competences may address similar markets.	The firm is investing simultaneously in highly risky business. Based on diversification, such a strategy is too risky for independent firms. Only subsidiary companies may invest in such a strategy.

A business model portfolio refers to a range of different projects allowing a firm to meet different consumers' needs and build the idiosyncrasy of the firm's bundle of activities. The concept of business model portfolio is to balance risk, revenue stream and interdependencies (Sabatier et al., 2010). Firms can have one or more core competences enacted within different business models, revealing the coherence of their activities (Teece, Rumelt, Dosi & Winter, 1994). Different business models can be driven by similar business logics, when they extend the market niche addressed or the services or products offered to similar audiences. Companies may run parallel, vertical integrated business models to cover more sectors of their value chain, and their consecutive articulation can allow the firm to benefit from synergistic effects, adding more value for customers and (hopefully) more profit for the firm. A business model portfolio encapsulates the firm's strategy to balance multiple projects. It conceptualises firm diversification within the same industry to generate and capture rents and to balance the times-to-market of different products or services. Finally, it illustrates two generic strategies: core competence extension to enlarge the market and to address additional customers and core competence redeployment to serve similar market with the same core competence (Sabatier et al., 2010).

2.4. Research question

In the field of portfolio management it became clear that a project can be executed in different ways. In addition, in highly unpredictable situations, smart companies have learned that the best way to make sure they are able to respond effectively to future challenges is to deploy patterns of projects; rather than putting all effort on one means of access to an attractive opportunity, they have found that it makes more sense to fund a number of small projects intended to capture market opportunity in different ways (Macmillan & McGrath, 2002). Correspondingly, Sabatier et al. (2010) argue that firms can combine different business models contemporary to deliver value to different markets. With the knowledge of Behrens and Ernst (2014) that visual aids are very useful in the decision-making process in the portfolio, the knowledge revealed a gap: it was not elaborated how different proposed projects could be visually presented as a set of different business models. This also was the problem BICORE encounters. The scientific body of knowledge regarding business models provided insights for the depth of the research problem. More precise, the main research question is stated as:

How to present a proposed project within the portfolio as an amount of possible business models to include the impact of one business model or another in the decision making process, taken the possible portfolio constraints into account?

To find an answer to this question, three sub-questions were derived to respond the main research question. The three sub-questions are stated as:

- *Which characterisations for business models can be derived from the literature?*
- *Which characterisations do practitioners want to use to compare business models?*
- *How to present projects this way when dealing with financially unattractive, but strategically interesting projects?*

First the body of knowledge gathered in the field of business models was used to derive a framework of characterisations. This answered the first sub-question. The framework was subsequently modelled in a representation in Flightmap. These together served as input for interviews with practitioners to answer the other two sub-questions, which are discussed in the methodology.

2.5. The business model framework

Deriving from the literature review organisations need to create value and deliver this to meet customers' needs. The organisation should then gain some sort of profit or value out of this as a result from the strategic choices involved (Morris et al., 2005; Osterwalder & Pigneur, 2009; Amit & Zott, 2010). This definition needed to be visualised into a framework. The business

model representation of Osterwalder & Pigneur (2009) (see figure 2) was considered most useful for creating a visual framework. The aspects that could be implemented quantitatively were selected as characterisations of the framework to make it compatible with the data fields in Flightmap. The most important characterisations for the business model framework are the value that is captured (product of service), the customer to which this value is delivered, and the profit gained by capturing the value (revenue model opposed to the costs made). In addition, possible partnerships may be interesting as extra characterisation; this will have influence on the value, but also on the revenue and/or costs and, therefore, on the profit. The influence of the partner could be considered quantitatively, and therefore it was included in this framework. The framework is schematically depicted figure 4. The dotted line implies the partnership is an option (e.g. with or without a partner) that will, therefore, not always have influence on the business model.

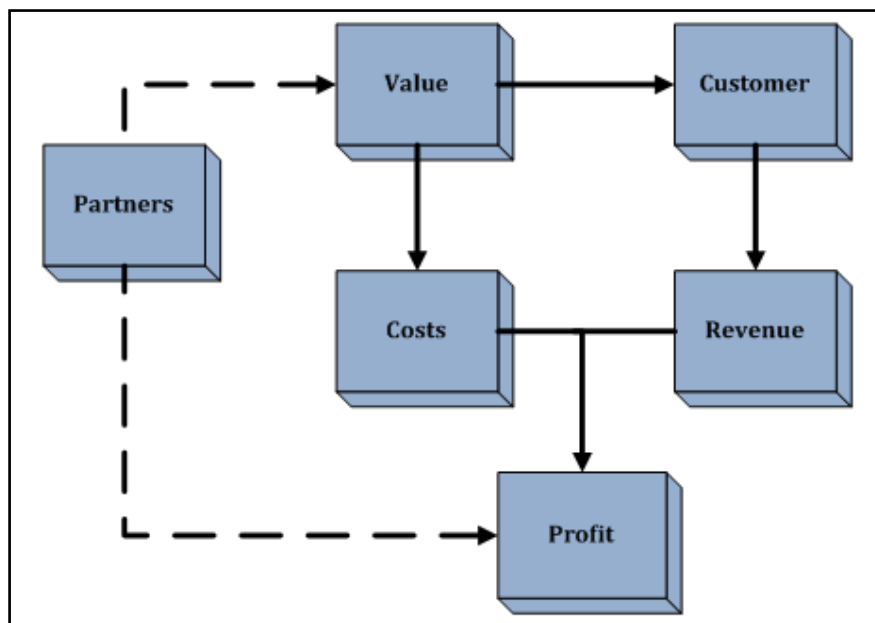


Figure 4. Business model framework

The value in this framework represents the value that is created, such as a product, service or knowledge. The creation of this value brings costs, explaining the direct link between these characterisations. The created value must be delivered to meet the customers' needs. The customer in the framework represents the total group that will be addressed. The arrow between value and customer means the delivering of the value. The subsequent arrow represents capturing the value by the delivering this value for an amount of (in general monetary) value, thus making revenue. The revenue made by delivering and capturing value opposed to the costs made by creating value results in the profit gained by the company. As discussed above, partnership is an option in this framework. This is, however, a complicated

characterisation. Co-creating value does certainly have influence on the created value in the framework. In addition, this partner may take a part of the costs made for his account and/or the revenue as well. Due to the assumption the costs opposed to the revenue result in the profit, the influence of the partner is on the profit in this framework. However, a partnership may also imply access to a new market through the network of the partner for example. This would imply an arrow is missing from partners to market. However, then partners would be very emphasised in the framework, while the purpose of the research is to clarify the role of business models in portfolio management and not the role of partnerships in business models: it is therefore chosen not to include this aspect to the framework. The characterisation 'partners' is included for more depth to the framework. In this research it is assumed that a difference on one of these characterisations already implies that a different business model is used. For example, a company may both sell a device to consumers and sell the use of the device to businesses. These are considered as two separate business models within one company. These different business models differ, therefore, from highly interconnected to disconnected as discussed by Sabatier *et al.* (2010).

2.5.1. Model development

The schematic representation of a business model in figure 4 served as the framework of the model designed; the visual representation of the framework. According to the research question the purpose of the model should be to present a proposed project as alternatives of business models. A project represents the value created, delivered, and captured in this case.

The possible partnership in this model is a yes/no decision. If yes, the possibility exists to provide the part of the revenue and/or costs the partner takes for his account.

To create a clear overview of the market to which the value is delivered, it is assumed it is better to make an estimation of the total market in combination with the market share of the company than an estimation of the amount of customers or products sold. This way the total market size can be seen in combination with the relative market share and, therefore, the possibilities for growth as well.

The costs can be split. There are costs that the company has to make independent of the exact number of products sold, such as personnel. Other costs may, however, be dependent on the number of products sold, the magnitude of the product or the times of usage, such as costs of raw material. This separation is in fixed and variable costs (Seal, Garrison & Noreen, 2009).

The tab technology was added according to the research of Van Bommel *et al.* (2014) suggesting that a low risk project should be executed prior to a high risk project if the underlying

technology is the same. This would enlarge the knowledge spillover. In the technology tab the underlying technology could be described and a corresponding advice regarding the sequence of execution possibly could appear as a pop-up.

2.5.1.1. Revenue models

For revenue streams several different models can be used. Based on scientific research a number of different revenue models were selected to include in the software prototype, namely: *product based, subscription based, licensing, usage fee, lending/leasing, intermediation fee, freemium, advertising, performance based, and the cost-price revenue model* (Osterwalder & Pigneur, 2009; Niculescu & Wu, 2010; Farr, 2001; Bonnemeier, Burianek, & Reichwald, 2010). Subsequently, these are discussed shortly:

- ❖ *Product based*: selling the ownership rights of a physical product.
- ❖ *Subscription*: revenue is generated by selling continuous access to a service.
- ❖ *Licensing*: revenue is generated by giving customers permission to use protected intellectual property in exchange for licensing fees. Licensing allows rights-holders to generate revenues from their property without having to manufacture a product or commercialize a service.
- ❖ *Usage fee*: revenue is generated by the use of a particular service, the more a service is used, the more the customer pays.
- ❖ *Lending/leasing*: revenue is created by temporarily granting someone the exclusive right to use a particular asset for a fixed period in return for a fee.
- ❖ *Intermediation fee*: revenue derived from intermediation services performed on behalf of two or more parties; usually a percentage of the intermediated price or a fee.
- ❖ *Freemium*: refers to the revenue model where a certain product for customers is offered free of charge while profiting from charging a premium for a more advanced version of the product.
- ❖ *Advertising*: revenue as a result from fees for advertising a particular product, service, or brand.
- ❖ *Performance based*: based on the performance of the solution in the customer's business environment. The solution provider guarantees a certain performance level to the customer and the customer pays per milestone.
- ❖ *Cost-price (Consulting)*: the supplier charges his amount of work and adds a certain mark-up to ensure profitability. Because of this fact, in the service context this pricing approach is sometimes called the 'time-and-materials model.' If no cost limit is assigned, the supplier usually charges his complete effort to the client.

2.5.1.1.1. Subscription

The subscription model discussed above needs some special attention. According to Baines, Lightfoot, Benedettini and Kay (2009) modern companies seem to struggle with the switch from selling products to offering services. This process is called servitization, and may be interesting in this research when practitioners also point out this problem in business model innovation. Servitization is the innovation of an organization's capabilities and processes to better create mutual value through a shift from selling product to selling a product-service system, i.e. servitization is the process of creating value by adding services to products. A product-service system is an integrated combination of products and services that deliver value in use (Baines et al., 2009). Servitization frequently occurs because of financial drivers (e.g. revenue stream and profit margin), strategic drivers (e.g. competitive opportunities and advantage) and by marketing drivers (e.g. delivered value and customer desires) (Baines et al., 2009). This process would mean a significant change in the usual business model of the companies. 'A change process wherein manufacturing companies embrace service orientation and/or develop more and better services, with the aim to satisfy customer's needs, achieve competitive advantages and enhance firm performance' (Ren & Gregory, 2007). There are some hurdles to overcome making a transition. Firms might not believe in the economic potential of the service component for their product. Second, although a firm might realise the service market potential, it may decide that providing services is beyond the scope of their competencies (Oliva & Kallenberg, 2003).

There are various forms of servitization. They can be positioned on a product-service continuum ranging from products with services as an "add-on", to services with tangible goods as an "add-on" and provided through a customer as co-producer strategy to deliver desired outcomes for the customer (Baines et al., 2009). Services often have higher margins than products and can generate substantial revenue from an installed base of long lifecycle products. In addition, service offerings are a sustainable source of competitive advantage, since they are more difficult to imitate than goods, are less visible and more dependent on close relationships with customers (Oliva & Kallenberg, 2003). The revenue aims at the 'installed base' of the market and the evaluation of the installed base service potential, and the extent to which a firm should enter the service market could be quantified by a decision support model (Oliva & Kallenberg, 2003), suggesting that a model in Flightmap could be very helpful in this situation.

In addition, according to Neely (2009) five options for servitization exist:

- ❖ *Integration oriented*: ownership of the product is sold with extra services as doing retail, distribution, financial services, consulting services, property, and real estate services.
- ❖ *Product oriented*: ownership of the product is sold with extra services as doing design and development services, installation and implementation services, maintenance and support services, outsourcing and operating services, procurement services.
- ❖ *Service oriented*: ownership of the product is sold and additional services are offered as integral part of offering (health monitoring services or intelligent vehicle health management).
- ❖ *Use oriented*: focus on service through the product when the ownership often stays with provider and selling the function occurs via sharing, pooling, leasing.
- ❖ *Result oriented*: focus on pure service and sell the performance.

Concluding, the characterisations included in the model derived from the literature are value, customer, costs, revenue, profit, and partners. Different revenue models were planned to be included in the prototype, and possibly servitization may be an interesting aspect within the developments of revenue models. Offering an alternative business model may be based on one of these characterisations, e.g. only a different customer segment implies a different business model. The alternatives should be visually presented to make the best decision. This knowledge was compared to characterisations of business models practitioners use to compare those business models with each other. The second and third sub-questions were answered with the responds given by the participants in the interviews described in the methodology.

3. Methodology

This section discusses the methodology that was used during the subsequent part of this research. The design of the research for the interviews will be treated. The sample is described and the way data was gathered together with the interview used. The way the data was analysed is subsequently discussed. The previous section already discussed the first sub-question. This part, therefore, mainly discusses the manner information was gathered for the second and third question.

3.1. Research design

In this case qualitative research was most appropriate since a new field has been explored. New investigation often starts with qualitative studies exploring the new phenomenon (Blumberg, Cooper & Schindler, 2008). In addition, Bhattacharjee (2012) argues that exploratory research is often conducted in new areas of inquiry, where the goals of the research are: (1) to scope out the magnitude or extent of a particular phenomenon, problem, or behaviour, (2) to generate some initial ideas about that phenomenon, or (3) to test the feasibility of undertaking a more extensive study regarding that phenomenon. For this research the aim was to generate initial knowledge; the extensive literature review revealed the field of business models implemented in portfolio management is quite new and no such thing as a framework existed yet that could be tested in a quantitative research.

3.1.1. Design science methodology

Due to the fact this research derived a framework from literature and made this applicable to organisations, the design science methodology seemed very appropriate. This grounded methodology is among others described by Romme (2003) who argues for a design approach to organisation studies. This design approach may contribute bridging the so-called relevance gap between scientific knowledge and practice. This was very applicable to this research, due to the research aim to create a model to visualise a project as an amount of possible business model options. For BICORE this meant the gathered knowledge from the literature and the practitioners could serve as new input for Flightmap; an upgrade for the program that helps serving the customers better.

The approach describes a circular design methodology, which ‘essentially implies that the organisation’s ability for effective learning and decision making at all levels is increased by adding a so-called circular structure to the existing, usually, hierarchical structure’ (Romme, 1999). The circular methodology acknowledges the organisational problems, and uses broader purposes, ideal-target-solutions, and systems thinking, to guide long-term organisational development (Romme, 2003). Key elements of the design approach are the design propositions.

'Design propositions, as the core of design knowledge, are similar to knowledge claims in science-based research, irrespective of differences in epistemology and notions of causality. These design propositions can provide a shared focus for dialogue and collaboration between design and science' (Romme, 2003). The empirical findings should, thereafter, be grounded and tested.

First, the body of knowledge and research methods of organisation science can serve to ground preliminary design propositions in empirical findings, suggest ill-defined areas to which the design mode can effectively contribute, and build a cumulative body of knowledge about organisation theory and practice. In turn, the design mode serves to translate empirical findings into design propositions for further pragmatic development and testing; it can suggest research areas (e.g., with emerging design propositions that need empirical grounding in organisation science) to which science can effectively contribute; and, finally, design research can reduce the relevance gap between science and the world of practice (Romme, 2003).

Van Aken (2001) describes the testing in more detail and argues that testing should involve both alpha and beta testing, notions adopted from software development. Alpha testing involves the initial development of a design proposition, and is done by the researchers themselves through a series of cases; this testing is done by the researcher throughout the developing of the design and through literature. This will not be treated specifically in the further report. Subsequently, beta testing is a kind of replication research done by third parties to get more objective evidence as well as to counteract any blind spots or flaws in the design propositions not acknowledged by the researchers (Van Aken, 2001). The testing interviews will serve as beta testing and be named as according in the further report. The process of the research is schematically depicted in figure 5.

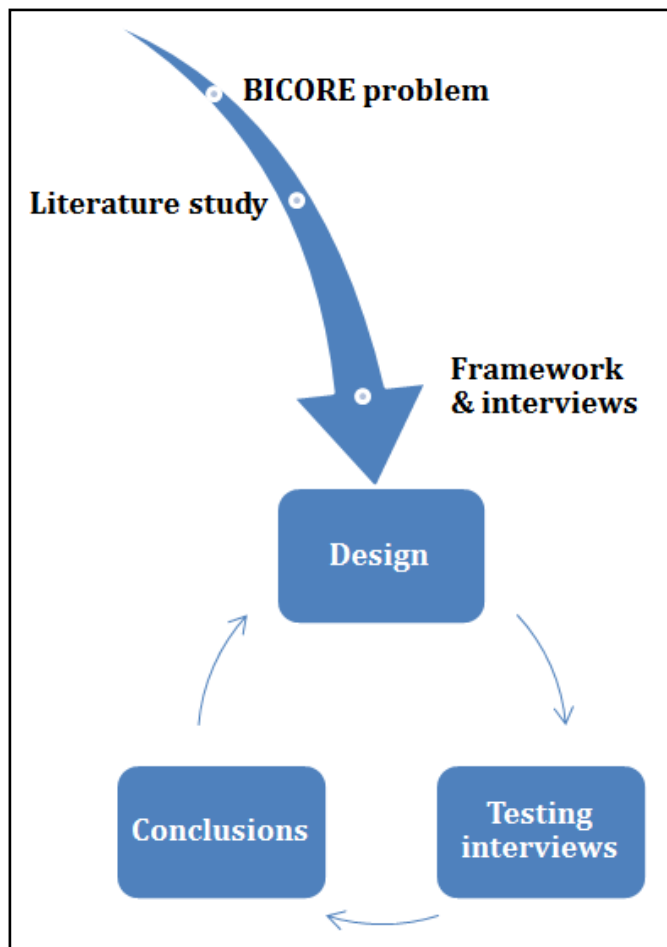


Figure 5. Schematic methodology of the research

Following the design science methodology this research first needed to investigate the empirical findings. That is, the framework derived from the literature needed to be discussed with the practitioners. These discussions resulted in design specifications for the model. The model, thereafter, needed to be tested to ensure the empirical grounding. In the testing phase, screen captures of the prototype were discussed with the sample to validate the goal: input different business models and compare these visually with each other. In figure 5 the parts design, testing interviews, and conclusions form a circle. This research was stopped after the conclusions; these conclusions, however, do consist of certain recommendations for future research. These may serve as input for an improved design that can be tested again. The conclusions also cover the theoretical contribution and implications for research in the academic field.

Denyer, Tranfield and Van Aken (2008) extend the design propositions (Romme 2003), through the so-called 'CIMO-logic'. This logic involves a combination of a problematic Context, for which the design proposition suggests a certain Intervention type, to produce, through specified generative Mechanisms, the intended Outcome(s). Design propositions can result from empirical work in individual, original research projects, but these often offer only a single perspective on the typically fuzzy, ambiguous and complex issues in organization and management and often produce conflicting findings. This was, however, not the case during this research. Additionally, the design was aimed at the variance of the sample, and therefore the 'CIMO-logic' would not add significant value to the design science methodology in this research.

3.1.2. Semi-structured interviews

The set of basic characterisations of business models was composed that served as the basis of the interviews. As in most qualitative studies, these interviews were semi-structured. Semi-structured interviews are helpful in learning the respondent's viewpoint regarding situations relevant to the broader research problem; these interviews are flexible depending on the course of the conversation (Blumberg *et al.*, 2008). Structured interviews would be less suitable in this situation, since structured interviews will not allow exploring a topic.

In addition, questions can be unstructured or structured. Unstructured questions ask respondents to provide a response in their own words; structured questions, in contrary, ask respondents to select an answer from a given set of choices. Subjects' responses to individual questions on a structured questionnaire may be aggregated into a composite scale or index, such as the Likert scale, for statistical analysis (Bhattacharjee, 2012). In this research, the underlying reasons were important to explore the field. These cannot be captured by structured questions, unstructured questions, therefore, were more appropriate (Blumberg *et al.*, 2008).

3.1.3. Flightmap

The research was conducted at BICORE. This implied the eventual prototype must be designed in Flightmap, the portfolio management software solution of BICORE mentioned in the introduction. To get a better understanding of the design of Flightmap, a number of screenshots are included in Appendix A. The system was tested to get a better understanding of the graphs presented and the calculations needed for these visual aids. Additionally, explorative interviews were conducted with programmers of BICORE to investigate what the possibilities and boundaries of the system are. This was very important to obtain accurate and the desired information in the interviews. This led to a first visualisation of the framework found in the literature in Flightmap. The screen capture of the visual representation of the framework (see figure 4) that was used during the interviews of the first round is included in Appendix B.

3.2. Sample

Within this type of exploratory research the focus should be at depth rather than breadth. The selection of people in the sample is crucial. The quality of the sample is more important than the quantity (Blumberg et al., 2008). BICORE has built a network with their customers, who all make use of business models and actively manage their portfolio. These people will, therefore, have a clear state of mind of suiting characterisations and the way they would like to see this in practice. The findings phase needed a different sample than the testing phase. The sample of the testing phase is discussed later in the report, when the first results are presented and the model is derived.

Due to the research question how to present a business model portfolio, we needed the people in the sample for the first round to be decision makers on basis of these portfolios, not the input providers. The decision makers should know what the drivers are in the process of changing a business model. In addition, it was a requirement that the participants already had knowledge about Flightmap. This way, the participants did not need extra explanations about the presented graphs and other visual aids and possibilities. This was an advantage for the focus of the interview; it could be more in-depth this way. Additionally, these companies are going to use Flightmap after the update.

To create a sample, the variables that should be covered needed to be determined. In the Flightmap prototype several revenue models were planned to be included; these should be verified in the interviews. Additionally, company size may be important regarding to the insights on the characterisations of business models. In discussion with Jac Goorden the sample is divided in table 2. Experience in table 2 is regarding to the business model experience or maturity. A company may have other requirements for a new business model than to a mature

business model. The companies are coded to ensure that their data and responses could be handled strictly and presented anonymously. Different participants were interviewed until saturation was reached in the information obtained in the discussions as stated by Van Aken (2001) for prescription-oriented research. In this first round of interviews 8 individuals from 6 companies participated. At one company the two participating individuals were interviewed together. The second round of interviews consisted of 4 individuals from 4 different companies; this is discussed in more detail in chapter 5. The two samples contained different people from different companies.

Table 2. Sample findings phase

Revenue model										
		Product based	Subscription	Licensing	Usage fee	Lending/ Leasing	Intermediation fee	Freemium	Performance based	Cost-price
Size	Big	X	X	X	X	X	X	X	X	X
	Average									
	Small									
Experience	Arrived	B; C; D; E; F		A	B	E	F		E; H	A; F
	New		C	B	D		D	D	D	

A noticeable aspect in table 2 is the absence of the advertising revenue model, while this was discussed in the literature review. This is due to its similar nature with the intermediation fee. One could argue that a company advertising for another is in fact the intermediating party. Two of the companies in the sample were considered using this kind of revenue model. The discussions in the interviews needed to turn out whether these two revenue models could be considered as one or separately.

The sample is restricted to technology aimed or high-tech companies, due to the possibility to cover the revenue models within this sector, and additionally due to the possibility of approaching these companies via BICORE. That is, these companies already have experience and know-how about Flightmap, which was a requirement conforming the modelling restrictions for the first round. Additionally, these companies actively use Flightmap and the findings resulted

in an update will be most important for them compared to other companies. All the companies within the requirements, however, were big companies¹.

3.3. Interview design

The goal of the interviews in the first round was to validate the framework (see figure 4) and gain first insights for the prototype in Flightmap. The second round of interviews was used to validate the prototype and is discussed in more detail in chapter 5. In the beginning of the interview a short introduction of the research and the purpose of the interview were given. The role of portfolio management in the company and more specific of the participant were discussed to ensure his role. Subsequently, the framework was discussed to validate the chosen characterisations; the revenue models of the company were validated to confirm the division made in table 2.

To ensure the discussion in the interviews was about the same subject, the definition used in the research was told to the participant prior to the question. Portfolio management in this sense is considered as *the continuous decision making process whereby projects are updated, evaluated, and prioritised. New projects may be selected to start; ongoing projects may be accelerated, stopped, or kept on hold. In this process the resources must be allocated as well according to the information available.* For a business model the following definition was used in the interviews: *the process in which value is created, delivered to the customer, and captured by gaining revenue out of this. The revenue opposed to the costs made should result in a profit.*

In addition to the framework derived from the literature, the screen capture of the Flightmap visualisation of the framework was offered to discuss the ideas of the participant on this aspect. The possibility to create a combination of revenue models was discussed thereafter; this could give extra insights for the prototype.

The last part of the interview covered the discussion about the strategic projects as discussed in the literature review. The total design of the interview can be found in Appendix C. The total list of revenue models included both intermediation fee as well as advertising to validate the made assumption before. Visual aids that were used during the interview are the business model framework presented in figure 4 and the division proposed by McMillan and McGrath (2002) in figure 3. The model in Appendix B was used to show a first impression of the possible translation of the framework in Flightmap. The underlying purpose of the interviews was to find drivers for a change in business model. The purpose of the interviews in the first and the second

¹ According to the regulations of the European Commission a big sized company has more than 250 employees and at least 50 million as turnover or 43 million on the balance sheet total.

round together with the total sample size per round is noted in table 3 to create a total overview.

Table 3. Overview purpose and sample size of both rounds of interviews

	Purpose	Sample size
Round 1	The findings phase. Find the characterisations used by practitioners to create design propositions for the prototype in Flightmap.	<ul style="list-style-type: none"> ❖ 6 companies ❖ 8 participants ❖ 7 interviews
Round 2	The testing phase. Validating the prototype and find aspects for improvement to make proper conclusions and find directions for further research	<ul style="list-style-type: none"> ❖ 4 companies ❖ 4 participants ❖ 4 interviews

3.4. Data analysis

Within the interview certain subjects are included by headers according to the design above. This organised the discussion in different sub-parts; some went more in-depth than others, due to different specialties of the participants and the semi-structured set-up of the interview. The interviews were recorded to validate the discussion afterwards. The interviewer took notes while conducting the interview to create guidelines for a summary of each of the interviews. Relevant citations could be included due to the recording. The notes were drawn according to the division in the interviews made upfront. When a participant made an interesting statement, the time of the statement and tags forming a summary were noted to ensure these useful captures of information were easily to find back. At the end of each topic the discussion was summarised conforming to the notes for internal validation.

All interviews together resulted in the first part of the results described in the next chapter. Due to the design science methodology (Romme, 2003) the results were the start of a cycle. The first interviews resulted in the design requirements according to Van Aken, Berends and Van der Bij (2007): functional requirements, user requirements, boundary conditions, and design restrictions. These concepts are discussed in further detail when applied, to enlarge the comprehensibility. These conditions led to the first design, the prototype. The testing of the prototype will be discussed in chapter 5, together with the design.

4. Results

As described in the methodology, the results consist of the empirical findings. First the validation of the sample is discussed. Subsequently, the interesting parts of the interviews are treated; that resulted in the problem structure that served as the basis for the prototype in Flightmap.

4.1. Empirical findings

The empirical findings resulted in design specifications, which needed to be grounded in the validation phase with a second round of interviews.

4.1.1. Sample validation

First the sample needed to be confirmed. The participants told which size the company is and which revenue models they make use of. This led to the actual sample table in table 4 below.

Table 4. Actual sample findings phase

		Revenue model								
		Product based	Subscription	Licensing	Usage fee	Lending/ Leasing	Intermediation fee	Freemium	Performance based	Cost-price
Size	Big	X	X	X	X	X	X	X	X	X
	Average									
	Small									
Experience	Arrived	A; B; C; D; E; F	B; D; E; F	A	B	B	F		B; F	A; C; F
	New		A; C	C	D	D	A	D	A; D	D

The actual table is more widespread than expected in the sampling phase. Genuinely, the advertising model that was included in the list of all revenue models was not considered as a revenue model for a different business model: 'I doubt the notion of advertising in this bullet list; I do not think this is a real revenue model'. This revenue model is, therefore, not taken into account in the further analysis as a separate revenue model, which implies that the assumption was confirmed for this sample. After every interview the amount of new usable information, both single sentences and significant pieces of information, was counted and noted down in a table. This saturation process is exposed in Appendix D. New information in the interviews was

marked and noted. Appendix E contains the summaries of all interviews in the first round; the empirical findings. The interview summaries in Appendix E of the first round are randomly shuffled to ensure anonymity of the participants and the according company.

4.1.2. Framework

In the interviews the framework (see figure 4) was discussed. Participants were asked which characterisations they found most important comparing alternatives of different business models. Out of the results it was noted down which characterisations were considered most important according to the discussions. Participants were allowed to sum up multiple characterisations of the framework and possibly mention characterisations they missed in this framework. When a participant just mentioned ‘profit’, they were reminded this is the end of the chain. Obviously, this is very important for companies, however, profit itself is a result. The purpose of this strategy was to let the participants think of less obvious answers than results, and think more of underlying reasons. Therefore, profit is left out of this analysis; profit is included as a resulting characterisation anyway. Table 5 shows which characterisations were mentioned in which interview.

Table 5. Framework characterisations mentioned in interviews

		Mentioned in the interview							
Characterisation		1	2	3	4	5	6	7	Total
	Value	X	X	X		X		X	5
	Customer							X	1
	Costs		X		X		X		3
	Revenue	X	X		X	X	X	X	6
	Partners								0

To visualise the results in the table, a heat map of the framework is depicted in figure 6. The more the colour of the block is towards red; the more this characterisation was mentioned in the interviews. To create more transparency the total cumulative number of the corresponding mentioned characterisation of table 5 also is included.

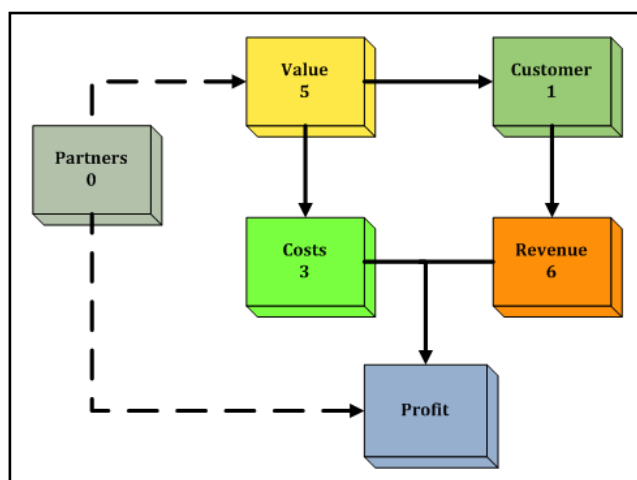


Figure 6. Heat map of the framework

4.1.2.1. Framework discussion

Partners are, however 0 is noted in table 5 and figure 6, mentioned in the interviews. The response was that it is not a characterisation that is used to compare different business models with each other. Partners are considered in a qualitative way. 'When a partner does not achieve the goal or runs bankrupt for example, we need to have an alternative.' Suppliers and OEMs are considered as costs. 'The only time you should include a partner in the financials is when you are in a joint-venture.' 'Partners may increase revenue through new market access for example; someone could higher the volumes, and could then consider the partner qualitatively.'

Customers are essential for gaining revenue. Most participants would not compare business models on this characterisation. One participant, however, suggested they take the impact on their market share into account. This is more in a qualitative way. In the business model the characterisation is essential to deliver the created value to and capture this by gaining revenue. The customer is part of the market and 'the market determines the price of the value you want to deliver'. The market itself is considered in two different ways: total market estimation combined with your market share to oversee the total, or only the volume the company estimates to address based on customer insights.

Value was mostly considered as an important aspect. Regarding new business models participants quoted: 'What additional value do we want to offer?'; 'Offer the customer more value; this makes them willingly to keep paying for the products'; 'the costs do not matter, the added value does'; 'how do we create most value?' The more value the customer perceives, the more he wants to pay for it. Additionally, some of the participants stated that some value is not delivered to gain profit but due to legal aspects; implying another dimension of the framework. However, those projects do not require a business model; those are executed to meet the standards: therefore not compared and not needed to be included in the design of this research.

Revenue gained by different revenue models was mentioned by six of the participants as important comparison characterisation. 'The most important part is revenue'; 'we want to check what yields us the most?'; 'in this company we are looking for results'; 'to compare different possibilities we check several financial rates and revenue'. 'The world is changing; therefore, new business models can be very interesting. It moves towards more service based models.'

The four participants that mentioned both value and revenue stated that these two characterisations are somehow related. One of the participants said: 'The most important characterisations would be the value proposition and the different revenue models, such as the choice between product based or subscription based and the value this would add in the value proposition'. Another participant mentioned that 'one should consider, next to comparison on

margins and revenue, that providing a service means heading towards 24/7 availability, meaning the customer satisfaction, delivered value, is important as well'. And another quote was: 'we check which business case creates most value for the customer, while we compare them on revenue' or: 'the value could be opposed to the costs and revenue.' Applying a certain revenue model may add value according to the sample.

Four participants mentioned 'channels' as missing in the framework; described as the way the customers are addressed (Osterwalder & Pigneur, 2009). 'An addition to your framework would be channels; how do we reach the market?' 'We are considering changing the business to a more service based model. This will mean the third party selling our product will be superfluous, changing our channel. We would have a larger margin.' And 'I am definitely missing channels in the framework'.

Three of the participants posed that the chance of success or risk is important as well. One of the participants stated that considering different 'scenarios' of the same project are related to the same risk level. 'We let different people estimate the risk of different scenarios: in the end all risk levels were estimated at 30%.' It may be doubtful, however, to consider different business models at the same risk level. Selling a product may contain other risk factors than agreeing on a long term subscription for example. Therefore, risk should be implemented in the prototype as well.

4.1.2.2. Framework adaption

These discussions about the framework and the analysis of the responses of the participants resulted in the following improved version of the framework to compare different business models with each other depicted in figure 7.

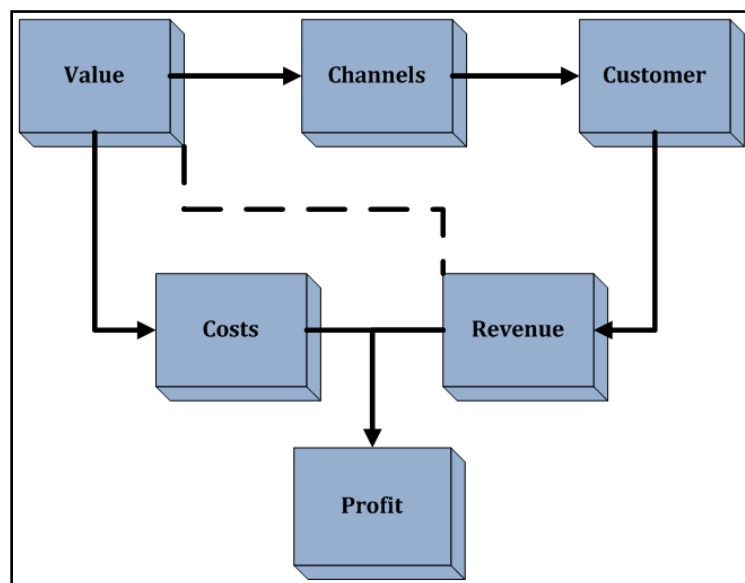


Figure 7. Adapted business model framework

During the different interviews participants responded that strategic projects were considered 'learning projects'. 'The strategic projects are important for every company, and becoming even more important in time.' The division of MacMillan and McGrath (2002), the strategic buckets of Chao and Kavadias (2008) as well as the learning sequence found by Van Bommel *et al.* (2014) were discussed in this part. 'However, regarding these projects we do not use established numbers or borders; these projects happen on trial.' 'This is more pioneering.' A certain clear division or sequence proposed by these authors was not recognised and seemed to be more 'gray areas'. 'The projects are executed and appear to be divided in a certain manner instead of they are divided by a pre-allocation.' 'We look at the possible advantages or learning points we may get from these projects. The best projects that fit within our resources, according to the forecasts, are then selected.' 'I do not think one should compare these projects with each other; these are learning projects. We have a special department for those projects and their job is to come up with different projects and a corresponding budget. The manager, then, determines whether the project will be executed or not.' Before was thought that a pop-up could be useful for managers regarding the division of the projects. The authors describe a certain division or a sequence of execution, but the practitioners do neither recognise clear divisions nor a mandatory sequence of execution. The best fitting project within the possibilities of the resources is chosen to execute. Therefore, no evidence was found that an advice pop-up regarding these aspects would be a good feature to add in this situation.

4.1.3. Problem structure

Several times during the interviews participants proposed some of their wishes for the future: 'we would like to sell power by the hour or uptime for some of our products'; 'Performance based can be very important in the near future: many companies want to offer a sort of subscription model based on uptime for example'. These are more service based models pointing the problem at servitization. This possibility was already taken into account as a possible driver to change the business model in the literature review; some knowledge was already gathered.

Concluding, the underlying structure of the problem is depicted in figure 8. Companies seem to have difficulties with the servitization of the business model; how does this add value for our customers and how can we deal with the new cash flow generating monetary resources with the new revenue model?

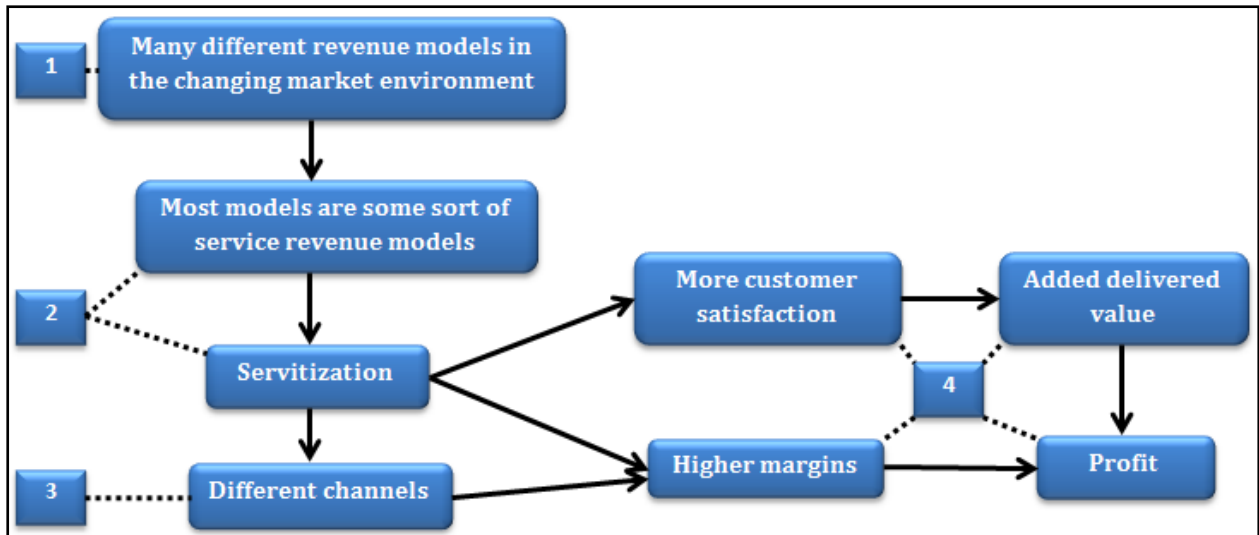


Figure 8. Underlying problem structure of business model innovation

All the four parts in figure 8 represent a part of the first conclusions. The results in table 4 confirm that companies make use of different revenue models. In addition, some of the participants mentioned extra revenue models or described one of the revenue models, but named it in a different way. This led to the first conclusion that indeed many different revenue models are used in the market environment, and companies use multiple revenue models in combination with each other.

The second part of the scheme starts with the observation that most of the models are some sort of a service model. 'Most revenue is gained by offering additional services'. 'We do not want to sell our device, but the usage'. In addition with the mentioned desires for the future, selling uptime or power by the hour, this leads to the conclusion companies are moving towards services.

The third part of the conclusion followed out of the responses that channels were missing in the framework. The following citation explains the link from channels to higher margins: 'we are considering changing the business to a more service based model. This will mean the third party selling our product will be superfluous, changing our channel. We would have a larger margin'.

The fourth and final part of the scheme consists of several blocks resulting in higher profit. As mentioned, servitization frequently occurs due to financial drivers, strategic drivers and marketing drivers (Baines et al., 2009). The same amount of sales with higher margins implies that a company will be able to gain higher profit. Services seem to satisfy customers' needs more than just selling the product. Therefore, this leads to added delivered value. The more value customers perceive, the more they are willing to pay for it. 'Offer the customer more value; this makes them willingly to keep paying for the products'. This will ensure gains for the long-term.

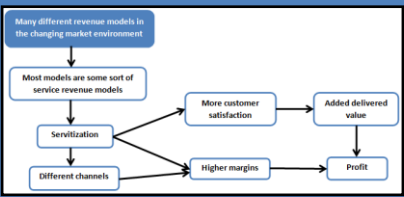
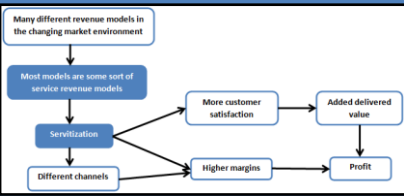
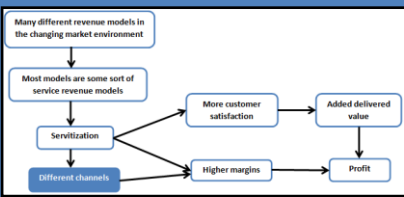
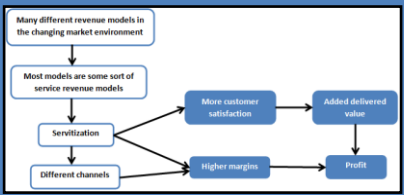
5. Design

The design is discussed in this part together with the testing phase. Based on the improved framework and the problem structure the prototype could be designed.

5.1. Design specifications

Companies may change a business model, for example selling a service instead of a product. The scheme in figure 8, discussed before, consists of different parts. Each part resulted in different requirements for the design. The highlighted parts with the corresponding requirements as result are described in table 6.

Table 6. Corresponding requirements for the prototype derived from the problem structure

Part of the scheme	Requirements
	<ul style="list-style-type: none"> ❖ Include different revenue models ❖ Recognise own revenue model instead of simplified
	<ul style="list-style-type: none"> ❖ Leads to spread revenue: initial investment, risk, and cash flow must be visible ❖ Include service based revenue model
	<ul style="list-style-type: none"> ❖ Add Channels to the design
	<ul style="list-style-type: none"> ❖ Compare alternatives with each other ❖ Compare on revenue and profit

These requirements resulted in the following design specifications as described by Van Aken et al. (2007). These are the requirements, which are the specific parts that definitely should be included to fulfil the demands. Extra additions to the design are later on described in the design description for Flightmap.

Functional requirements: the core of the specification in the form of performance demands on the object to be designed. Realisation of the solution should solve the business problem, which is the key requirement; benefits should exceed the costs.

- It must be possible to present alternatives of 1 project
 - Compare projects on risk, revenue (NPV/ROI), initial investment
 - Not include strategic projects nor an advice pop-up

According to Sabatier *et al.* (2010) companies may use several business models simultaneously; therefore, it may be beneficial for companies to compare alternatives of a proposed project prior to its introduction. The sample revealed that this, genuinely, would be appreciated by practitioners. Practitioners would like to compare the alternatives on chance of success (risk), revenue, and the investment needed to make prior to introduction. Additionally, Chao and Kavadias (2008) suggested that it might be beneficial to invest in a financially unattractive, high-risk product, as it might lead to significant strategic benefits from sequentially developed products. The sample confirmed this statement. However, for these projects no business model is developed, and therefore these projects did not need to be included in the prototype. Moreover, a clear pre-divided resource allocation as suggested by MacMillan and McGrath (2002) nor the sequence of project execution suggested by Van Bommel *et al.* (2014) was supported by the sample, and therefore an advice pop-up regarding this division should not be included in the prototype.

User requirements: specific requirements from the viewpoint of the user. In this case the users are the customers of BICORE: Flightmap users. The new system should be user-friendly.

- Should be easy to switch between the different alternatives
 - Create 'alternative'; this is filled in the same way; only adapt differences. These changes can be displayed in a 'deltas' tab
- Include different revenue models
 - Servitization must be possible to model
- Must be possible to display different Channels
- Make use of an external market with market share and a project specific market
- Costs should be visible in separate ways: initial investment and production costs

Based on the literature review regarding business models, organisations need to create value and deliver this to meet customers' needs. The organisation should then gain some sort of profit or value out of this as a result from the strategic choices involved (Morris *et al.*, 2005; Osterwalder & Pigneur, 2009; Amit & Zott, 2010). The characterisations value, customer, costs,

revenue, profit, and partners were considered most important in this process. According to the sample, channels were missing in this framework. Therefore, channels should be included in the prototype as well. The system should be user-friendly and therefore the switch between alternatives should not cost much effort. Several revenue models were described in the literature, which were confirmed by the sample; different revenue models should be included. Servitization (Baines et al., 2009) is a driver for business model innovation, implying that service based revenue models should be included in the prototype. Costs can consist of different levels of detail (Seal et al., 2009). The interviews revealed that the most important division is between the costs prior to introduction (initial investment) and the production costs. According to the sample the volumes of sales is determined in two different ways: estimate the volume of sales based on the market size combined with the market share of the company or estimate the volume based on customer insights. These different types of market estimation should, therefore, be included.

Boundary conditions: to be met unconditionally. Should also comply with legal requirements, the modern business policies of the company, and fit with the present company culture.

- Total size of Flightmap should not become too large to maintain the speed
- All improvements are appreciated; however, the interface should change as little as possible
- Not too many variables visible to prevent visual clutter or information overload

These conditions were determined by the company. The condition regarding information overload was an advice received in discussion with the programmers of BICORE.

Design restrictions: preferred solution space. The project should be conducted in a certain time-frame; realisation should change as little as possible in the present business system.

- The research must be finished within 5 months
- The design must be drafted in Flightmap

The contract with BICORE had a length of 5 months; this is also the restriction of the Eindhoven University of Technology. Flightmap is the software tool designed by BICORE; therefore, the design had to be drafted in this program.

5.1.1. Design description Flightmap

Baldwin and Clark (1999) describe a way to define parameters out of different requirements. This would make the design more specific. However, in this research the variance of the different discussions in the interviews was considered most interesting. It is, therefore, chosen

to include certain options in the design to address the wishes of different customers, not a standardised model. The design is aimed at customisation rather than parameters. The requirements are qualitatively described and divided in the major requirements and the minor requirements. Major restrictions are logically more important than minor requirements.

5.1.1.1. Major requirements

Value: It should be possible to duplicate a project by the option 'new variant'. This will serve as the possibility to create alternatives. It is important to include the possibility to oppose these projects on: Risk (chance of success); Revenue (NPV and ROI as well); initial investment (innovation costs). Two variants should be compared in one graph.

Market: The type of market must be questioned in the tab. It differs per project whether persons use an external market or a project specific market. The difference is that the external market makes use of total market estimation (with installed base and new sales) and a market share. In a project specific market only the volume of the sales has to be entered as input.

Costs: The costs until the introduction are considered as innovation costs (or initial investment). Costs hereafter are considered as production costs. The costs can be attached to different phases of the project development; this makes it possible to make this separation. It must be possible to see the innovation costs and production costs separate in graphs. FTEs are a separate post, these are namely also important in the resource allocation process. The visualisation is depicted in a screen capture of the model in figure 9.

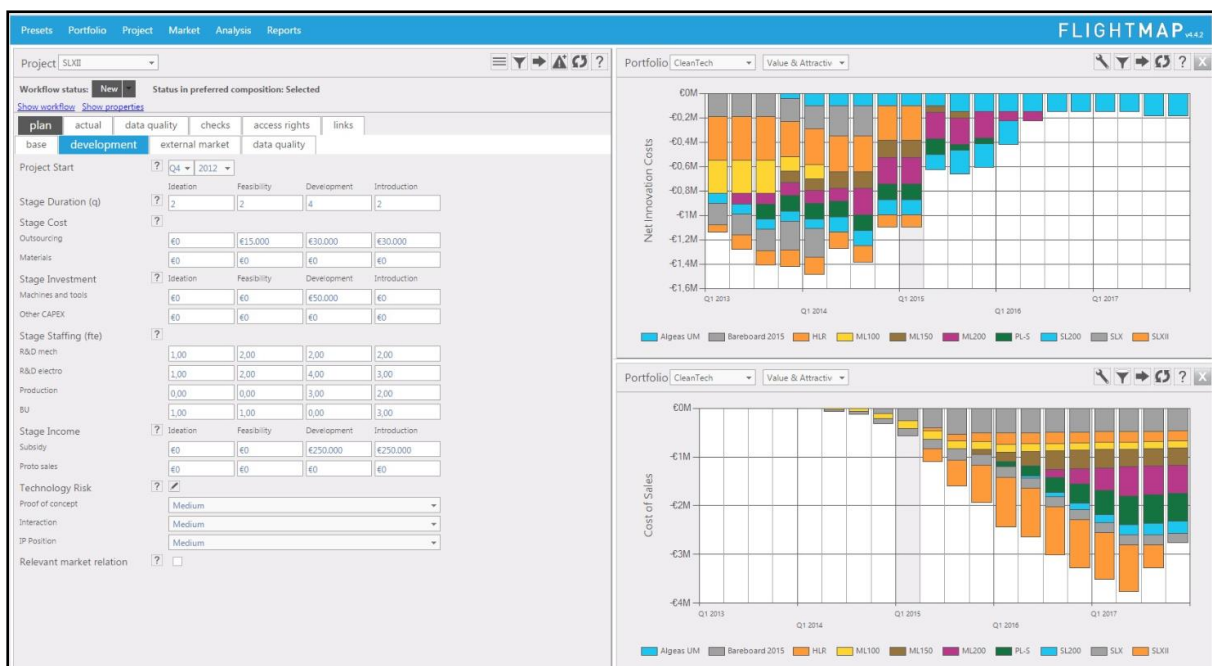


Figure 9. Visualisation of the costs in the prototype

Revenue: In the visual presentation of the framework this aspect is called business model; this should be changed into revenue model. Participants responded like we use that kind of revenue model or a combination. ‘Many companies use multiple revenue models, such as pay an initial fee and later pay for performance’ and ‘most revenue is gained by additional service’. ‘If you explain usage fee that way, we are using that revenue model as well’. In addition, during the interviews the participants pointed out they use several revenue models simultaneously or one party claims the licensing model while the other uses subscription. These models are almost similar in principle. Therefore, these different names and models could be implemented by using a ‘standard’ starting model with certain add-ons. The standard models with the add-ons are listed in table 7. The ‘#’ symbol is used for the number of goods sold or number of customers addressed: the total amount. In the transaction model the first ‘#’ is symbol for the number of customer, but each customer can make a number of times use of the transaction. Therefore, the symbol is used twice in the description of that model.

Table 7. *The basic revenue models with the different add-ons*

Description			
1	Product	Subscription	Transaction
	# * price	# * price * time	# * (price + # * price)
2	Initial fee		
3	Service subscription		
4	Consumables		
5	Spare parts		
6	Fine (negative impact)		

This could be displayed in the market tab; with checking boxes: check the box when the option needs to be included, then the according data field will appear. This way, different companies can compose their own revenue model with different possibilities. It will prevent that too many variables are displayed in the ‘working screen’. In the working screen companies will see the choices they made and the respectively fields belonging. The product model can be designed the same as subscription with time = 1. Some companies let their new customers pay an initial fee for their product, therefore this option is included. Moving towards servitization many companies still do not give their product away for free, but a smaller amount of money is required to ‘purchase’ the product. The initial fee will serve for this. An additional service subscription may be agreed on, for maintenance for example. ‘We sell our systems, and also a service subscription that covers the ongoing costs. Certain specific parts will cost extra money due to their known wear and tear’. Therefore, companies may gain revenue by selling spare parts or additional consumables, such as ink toners for a printer. The fine is included due to

servitization. A company that does not achieve the 95% uptime for example, pays a fine to the customer to compensate the violation of the agreement. Regarding the combination of projects, in Flightmap it is possible to compose different compositions of projects within a portfolio and then check the total value of the portfolio. This part can be stacked by project. The different compositions can serve as the possibility to combine and isolate different projects.

Figure 10 displays the visualisation of two business models opposed to each other. Two types of data are included: the profit and the cumulative cash flow. The black line represents a business model based on product sales. The time-frame of sales is short; the cumulative cash flow represented by the orange line stops to grow quickly. The grey line represents a business model based on service sales. The profit is more stretched over time and the cumulative cash flow represented by the blue line grows more steadily.

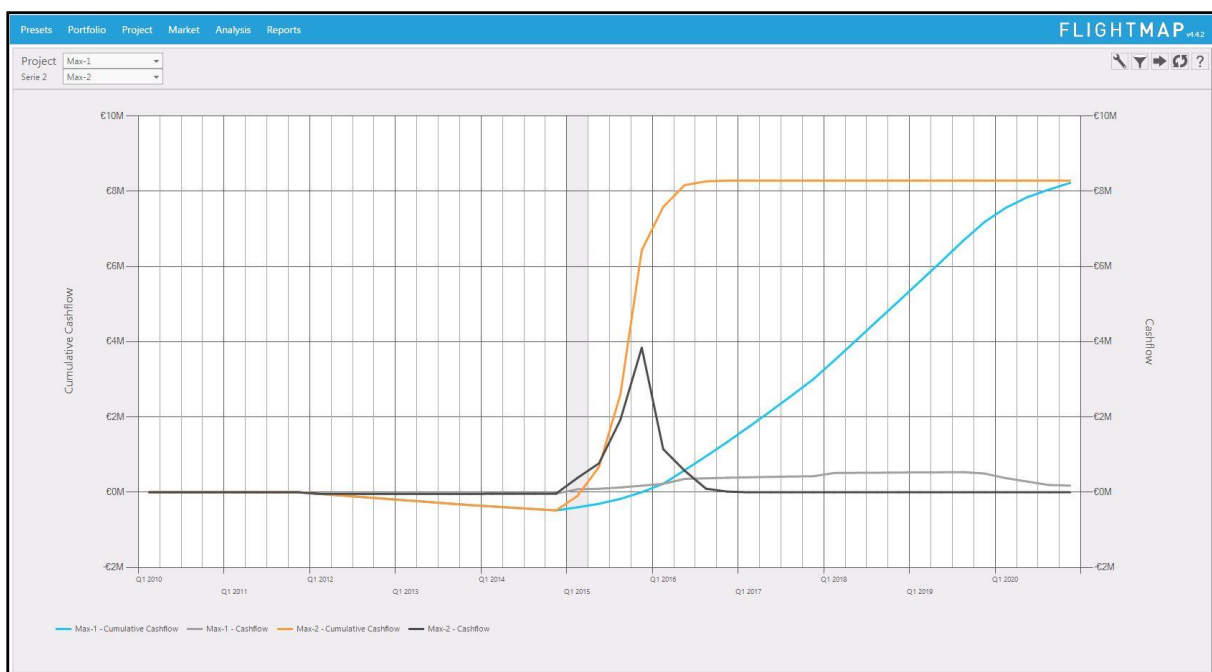


Figure 10. Visualisation of two business models in a graph in the prototype

Channels (the way the customers are addressed): Channels turned out to be an important comparison factor as well; this can be added in a qualitative way: add a label to the project. The 'bubble colour' can be set on channels to make a comparison; this implies that also a pie-chart can be made to see the division over the channels. This way of implementing channels connotes only a single channel can be attached to a project. In practice the customers can be addressed in several ways in the same project; if the possibility would be included to add different channels to one project, this could not be chosen as 'bubble colour' due to design restrictions. The testing

phase needs to find whether it is essential for the companies to include different channels for one project or not. The current design is depicted in figure 11. The different colours represent different channels. Obviously, corresponding colours in the bubble plot and the pie-chart represent the same channel.

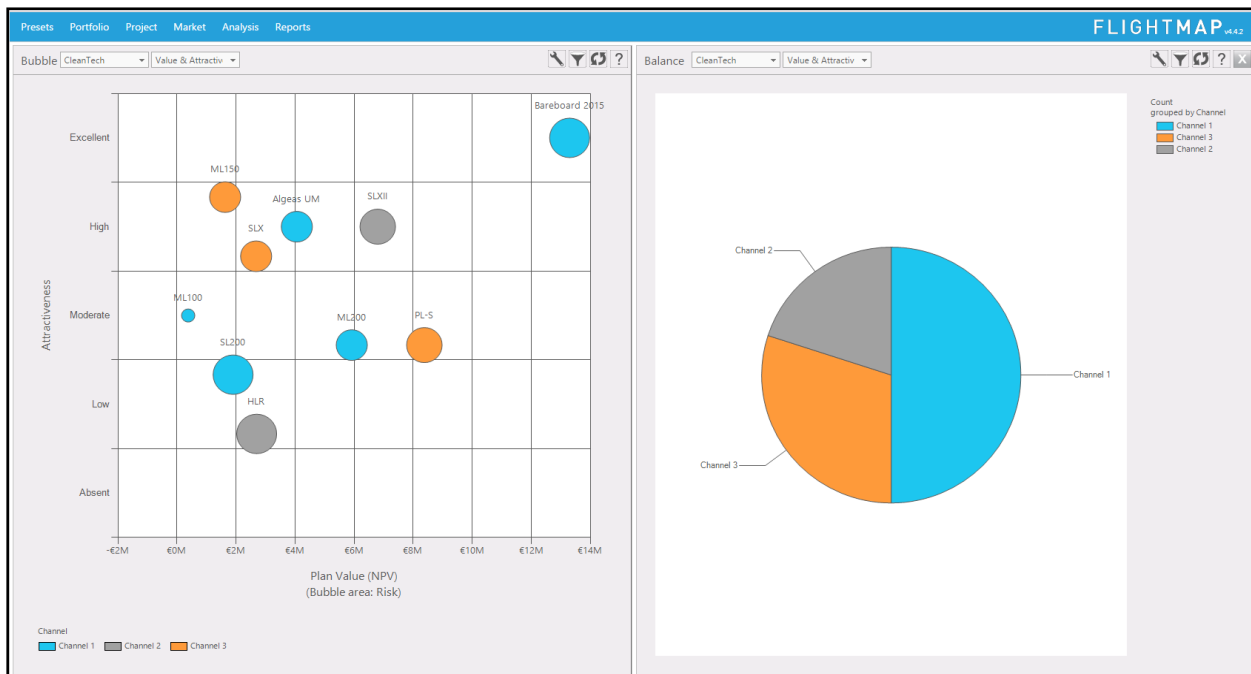


Figure 11. Visualisation of different channels in the prototype

5.1.1.2. Minor requirements

Value is an important characterisation as well. However, this is important to make the customers pay. Therefore, this variable is qualitative and after discussion this will result in more sales or another revenue model for example and it is not necessary to include an extra option for comparison on this characterisation. The possibility to compare different variants in one graph already is a manner to compare the value of those projects. A project can be considered as value.

The price, and thus revenue model, should be placed in the market tab. Every participant emphasised that the market determines the price. By displaying it this way it will look more 'natural'. The total revenue composition should, therefore, be displayed in the market tab. The way revenue is gained from the customers, part of the market.

Include the 'deltas' tab to see what the actual changes are, with another panel next to this companies are able to visualise the changes they made. This can be textual described.

Combine different graphs. For example, the cash flow and market share or market size combined to visualise the company's status quo. Is it losing or gaining market share, can we

explain why this is happening? This can be done with a different scale on the right side of the graph or on the same side between the other scale numbers for variables displaying the same entity.

The partner tab does not need to be included. Partners are considered in a qualitative way; OEMs and other suppliers are considered as costs and not as partners. The tab of technology is not necessary as well; is not mentioned at all in the interviews.

Strategic projects are not needed to be included. These are considered in a different way. The same holds for the advice pop-up regarding pre-allocating the resources or executing less risky projects prior to higher risk projects with the same underlying technology. Most important screen captures of the prototype are included together in Appendix F.

5.2. Empirical grounding

As discussed by Van Aken (2001) the model needs to be beta-tested to achieve the best relevance and applicability for practice. Beta-testing of technological rules can give further insight in the indications and contra-indications of the rules and in the scope of their possible application, their application domain. 'In descriptive academic articles possible "rules" are often formulated as managerial implications in their last pages and these are not tested as such by the authors and even less so by third parties' (Van Aken, 2001). A second round of interviews was used to execute the testing.

5.2.1. Testing sample

The new sample that served as testers had to validate the model. The model is assumed to show product based business models as well as service based business models. The sample should validate this. Therefore, a division in servitization was made. Additionally, to enlarge the generalisability, the model should be applicable and understandable in environments without Flightmap; to check whether new customers are able to understand the principle of the design immediately and whether the design is applicable to their company or not. In other words, the sample should contain participants that do have Flightmap knowledge and participants that do not. As discussed in the methodology section, this sample contained 4 participants from ditto companies to cover all matrix fields as table 8 shows.

5.2.2. Testing interview

The different implemented features in the prototype needed to be tested, according to the methodology. During the interview the different parts of the design were discussed. The way channels are implemented; creating a variant; the division of the costs; the possibility to create a revenue model; validation of possibility to create either a service based business model as well

as a product based business model; the possibility to compare two variants in one graph. The interview was ended with an open question to let the participant think about the visualisation of the use of different business models. The screen captures of the prototype in Appendix F were used as visual aids during the interview; the total interview design can be found in Appendix G. The interview was again semi-structured to learn the viewpoint of the participants regarding these implementations relevant to the total research problem (Blumberg et al., 2008).

5.2.3. Testing results

The participants were first questioned to confirm their role in the sample. The sample covered all the possible fields of the matrix created by opposing the variables 'Flightmap experience' and 'involved in servitization'; table 8 shows the division. The saturation progress can be found in Appendix D. The total summaries of the testing phase can be found in Appendix H. The interesting and relevant information is discussed in this section.

Table 8. Actual sample testing phase

		Involved in servitization	
		No	Yes
Flightmap experience	No	Z	W
	Yes	X	Y

Channels: Regarding the channels different suggestions were made, but there was consensus that it should be possible to attach multiple labels to a project. One participant mentioned a different type of use of channels: 'we care about the product development and produce a new product (or service) for one of our sales areas; they choose the subsequent steps to take. This means that regarding my role as portfolio manager we use only one 'channel' per product; for our case this design would be sufficient.' In another company this design would be sufficient as well due to a different vision regarding channels: 'we have three main target markets or business units. These are divided in different segments. These could be considered as some sort of channels. It would be interesting to see the differences of one of our products in the different segments.' A noticeable aspect in this part is that these participants reflected the usage of the design on their own role within the company. A third participant stated that 'the choice between different business models is not determined on the channel that will be used; this is more interesting for the marketing employees. Then, the division over different channels could be useful; multiple channels, however, can be used in a single project.' Or when the combination of product based and service based revenue model is possible for a project: 'the difference

between a product sale and service sale is the channel conflict. Could it be possible to capture this problem in this design? If you offer one proposition that contains both services and products, you need multiple channels. Therefore, just adding one label to a project may be insufficient.' It should be possible to attach different labels to a project. This implies, however, the visualisation could not be displayed in the bubble-plot. The bubble-plot shows a single colour; attaching multiple channels to one project would therefore not be possible to visualise in a bubble-plot. Other possibilities exist; showing the division in a pie-chart for example.

Value: In the prototype it is possible to create a variant; every data field can be adapted after this. The adaptations made are logged in the deltas tab. This was appreciated by the sample. 'If you create a new variant it is definitely necessary that everything can be adapted.' And, 'if you decide to 'freeze' certain fields, some people will always show up with the complaint they would rather change the inputs of one of the frozen fields. The developers are charged with extra complexity, while it presumably is not very relevant for the user.' Additionally, 'the adaptations someone plans to make may differ per company or even per individual.' The 'deltas' tab seems to be an addition to the program that adds value. 'After a few months a person will probably not remember the exact things they have changed.' Therefore the logging of the changes is useful; 'the differences are interesting'. 'The textual description that describes the adaptation made is sufficient.' One participant mentioned a new option to create a variant to improve the quality: 'It is most user-friendly when all fields are copied from the previous version and just the fields that need to be changed are adapted to the other scenario. However, this will imply that input providers probably skip thinking about certain fields. If you want to make a new variant thoroughly, you should empty all fields when a variant is created. This will provoke irritations, but I think the scenario will be of higher quality. This is a choice that needs to be made: user-friendly or quality improvement.' Regarding the deltas: 'if you start with a blank page, the system should be smart enough to check whether fields are equal or different. The difference should then be displayed.'

Market: The possibility to use the two types of market approaches was considered useful. 'The choice between an external market and a project specific market is appropriate; we use this as well. Additionally, another limitation could be a limitation of the sales: the number of sales employees can handle a certain maximum of volume. However, this can be taken into account using the project specific market.' In another company these two types of markets are used as well, in a different manner however: 'first we check with our market share the assumed 'normal' volume we would sell; then we check the expected volume of sales based on customer insights for example. We compare whether these numbers are in balance. If this is possible creating two

variants with different markets it is useful.' The market seems to be designed useful, and does not need further specification.

Costs: The separation of the innovation costs and costs of sales in general was considered useful. The visualisation, however, may differ per company. 'The separation between the innovation costs and costs of sales is useful; we use this as well.' An opposing opinion regarding the execution of the separation: 'These two types of costs both in 1 graph instead of two different graphs would be more useful. The difference made is useful; perhaps this is possible in some other way.' One participant explained this need in most detail: 'the graphs should be on the same y-axis; therefore in one graph. However, the separation in two different graphs should also be possible due to the use of different individuals, such as R&D and Sales. Furthermore, if you see this total view it would be nice to focus on 1 project: see the division of the different costs within that project. So the total picture and in further tabs more focus would be best.' In conclusion, these opinions would imply it should both be possible to see the separated costs in two different graphs as it is designed in the current prototype as well as in one graph with the separation visible in a different way. A borderline would be possible or the graph stacked by type of costs.

Revenue: The principle of designing a customised revenue model by checking boxes was considered clear and useful. The possibility to create different types of product based revenue models was confirmed; the basic service based revenue model was considered as sufficient. 'The 'normal' business model can be designed in a proper manner. In the service part some additions should be added.' Another participant confirmed 'in a service model a company has multiple revenue streams: rent/lease, maintenance, consumables, and spare parts. Saying, this is designed well.' For the different types of service based revenue models, which are more complex, variables are missing or different terms could be used. 'In our contracts are also volume dependent components included; this is missing in the prototype.' The prototype, however, does include volume dependent components, such as consumables. The terms used may cause confusion. 'The approach you designed is applicable, but we would need more variables. The use of checking boxes is efficient. Thinking of the switch to service based business models, there are many different options. However, approaching it this way in the beginning is a good start. It is essential to see the big picture.' Another participant stated: 'regarding your revenue model creating options it is possible to create different business models to compare different scenarios. For service based models many different options exist. The research of BICORE in the field of servitization offers many different possible additions to the model.' The research the participant mentioned is a company research regarding different stages of servitization and the different revenue model options belonging to the servitization. 'The

revenue model creation is well designed. The checking boxes with appearing data fields are functional. For modelling services some variables are missing. The fine that you implemented when the company does not achieve its SLAs implies other factors. Therefore, extra procurement costs would be a logical addition. It should be considered to make these inputs consequent.’ The design with different checking boxes was appreciated; the total list with variables needs improvement. The total visible options should not be too extensive, though. This also was mentioned by one of the participants: ‘the view should be clear: if many variables are visible, the different options by checking different boxes must be clear. The things must be consequent and clear.’

The variables in the current list are mainly aimed at tangible services and products; this may need extra consideration as well depending on the type of user. ‘The used terms are strongly aimed at hardware; a company may also provide customer support as extra service. The service calls may also be a separate revenue stream. From the bottom up these different models have the same kind of sub-parts, however the terms differ very much comparing hardware and software; this may be confusing for users of your prototype.’

In the current model one type of consumable can be included in the revenue model; the same applies to spare parts. When a company sells multiple types of these, they should be averaged to create useful input. ‘The possibility to provide input for 1 (perhaps) average consumable is sufficient. If you have to split all these inputs, the model will become too complex and it will not add significant value to the big picture.’ And opposing, ‘the consumables are averaged in your design; better would be that it would be possible to input more different types of consumables due to the allocation to the right business unit. In contrast, spare parts can be averaged.’ Another participant stated that first the main differences are important; in later stages you want more detail. These details are unknown in the ideation for example. ‘Consumables and spare parts should not be split in more detail. You want to see the big picture and not create spurious accuracy.’

Comparison: In the prototype it is possible to plot two variants in a single graph and even use two types of data, as previously discussed. This part of the model is very much appreciated and considered as an essential part of the prototype. ‘To compare two variants in one graph definitely adds value to the decision making process; figures trigger people more than tables and text. With less extreme examples these kinds of graphs will function even better.’ One participant added more detail to this statement: ‘the graph with the two variants displayed really adds value to the decision making process. You want to see the time-frame of the different

cash flows. At which moment in time are we going to gain more money with this new business model, if that moment exists anyway.'

Before ending the interview, the participants were questioned how they would like to visualise the total use of different business models. Some disagreement existed regarding this aspect; one participant suggested: 'the use of different business models would be best visualised the way you visualised channels.' The other participants would rather see it more like the design of the variants in a graph. 'How I would visualise the use of different business models? See the different models in a graph. This way one can compare different totals with each other, this is preferred more than for example the bubble colours you used for the channels. The total cumulated value of different business models compared with each other would give the best impression, the margins for example; rather than the number a certain business model is used.' And, 'comparing different business models would be visualised best cumulative in a line-chart over time: that would add the most value.' Concurrently, another participant said: 'different business models visualised in a line-chart over time would have the preference.' Therefore, a line-chart seems the best solution for visualising the use of different business models.

Summarised, some parts of the prototype were confirmed to be designed appropriate, some were not or partially. Channels were not designed appropriate in the current design; it should be possible to attach multiple channels to a project and the link with the financial aspect is missing. The creation of a new variant was supported; a possibility can be to start with a blank page to increase the quality of the alternative. The market was designed appropriate. The costs are confirmed partially, an addition is that it should both be possible to see the separated costs in two different graphs as it is designed in the current prototype as well as in one graph with the separation visible in a different way. A borderline would be possible or the graph stacked by type of costs. The design of creating a customised revenue model by checking boxes was considered efficient. For service based revenue models some variables are missing and the current terms are strongly aimed at hardware; other industries are possible users as well. The use of an average price for the consumables and spare parts is sufficient for the big picture. The purpose of the prototype was to create a starting interface to compare different business models. Validate the design, further extensions could be added in a later phase. The basic design seems useful. 'This model will function in its purpose to compare different business models with each other.'

6. Conclusions

Based on the results of the research conclusions can be drawn. These will be discussed together with the implications for the scientific knowledge and BICORE. The limitations and possible further research areas are discussed thereafter.

6.1. Research conclusions

This research was aimed to find a solution for the problem of BICORE. Literature was consulted to create a scientific body of knowledge regarding the subject of portfolio management and business models. The goal was to create a design based on the following research question and sub-questions:

How to present a proposed project within the portfolio as an amount of possible business models to include the impact of one business model or another in the decision making process, taken the possible portfolio constraints into account?

- *Which characterisations for business models can be derived from the literature?*
- *Which characterisations do practitioners want to use to compare business models?*
- *How to present projects this way when dealing with financially unattractive, but strategically interesting projects?*

Although the sub-questions are answered throughout the report, in these paragraphs the answers and conclusions found are summarised. The extensive literature study provided the opportunity to define the concept business model as: *the process in which value is created, delivered to the market, and captured by gaining revenue out of this. The revenue opposed to the costs made should result in a profit.* The most important characterisations to compare business models based on the literature were captured in a framework consisting of: value, customer, costs, revenue, profit, and partners.

The first round of interviews has led to qualitative insights of practitioners regarding comparison characterisations of business models. Confirmation was found regarding value, customer, costs, revenue, and profit. Partners are not considered upfront to determine the business model. In addition to the proposed framework 'channels' turned out to be important as well.

Strategic projects are important for the long-term sustainability of the company, concluding from the interviews. These projects are, however, not considered as a possible business model upfront. A company has a separate budget for the business unit regarding strategic projects, and therefore these projects should not be presented as an amount of possible business models.

Conclusions regarding the main research question are based on the prototype that was developed during the research. Companies appreciate the visualisation of different business models and consider this as a useful aid. Out of the interviews it can be concluded that companies genuinely use different business models simultaneously. These different business models are mainly product based; for these models the visualisation of the development over time in one graph helps to improve the decision-making process. Companies seem to consider changing their main business model, the so-called cash cow, from a product based business model to a more service based model. These companies struggle with servitization. The visualisation of this process compared with the product based in a graph helps the decision makers. 'The graph with the two variants displayed really adds value to the decision making process. You want to see the time-frame of the different cash flows. At which moment in time are we going to gain more money with this new business model, if that moment exists anyway.' In addition, the participants in the testing phase responded to the open question that the use of different business models could be best displayed in a line-chart. This was extra confirmation for the conclusion.

6.2. Recommendations BICORE

The conclusions of this research also have implications for the company within the research was conducted. These are mainly about further improvements of the prototype in Flightmap, due to the design aim of the research.

6.2.1. Design implications

The research showed that companies are appreciating the addition to compare different options of business models with each other. In practice, it turned out that companies would like to have more recognition in the input of the revenue model in Flightmap. The design in this research modelled that aspect by creating new data fields by checking boxes. This was considered clear and useful. The visual comparison in a graph turned out to trigger people. Companies struggle with the servitization of the industry. To help companies in this switch, the service based revenue model needs to be extended to create an accurate visualisation. BICORE already did an extensive case-study regarding servitization and the corresponding different revenue models. This may be helpful in implementing the possibility to input service based business models more accurate; some cost variables are included in service contracts as well for example, such as the fine. These aspects are possible additions to the current design. This was, however, beyond the scope of this research. The principle of the present design with different add-ons by checking boxes was appreciated; however, information overload should be prevented. This current set of variables is sufficient to start with as stated by a participant: 'approaching it this way in the beginning is a good start. It is essential to see the big picture.'

The creation of an alternative is well designed. It must be possible to change every single field in the alternative. The deltas tab is considered helpful in logging the changes. The textual description is sufficient as a reminder. An interesting quote from one of the participants for further company research is: 'It is most user-friendly when all fields are copied from the previous version and just the fields that need to be changed are adapted to the other scenario. However, this will imply that input providers probably skip thinking about certain fields. If you want to make a new variant thoroughly, you should empty all fields when a variant is created. This will provoke irritations, but I think the scenario will be of higher quality. This is a choice that needs to be made: user-friendly or quality improvement.' Regarding the deltas: 'if you start with a blank page, the system should be smart enough to check whether fields are equal or different. The difference should then be displayed.'

The costs split, in innovation costs and costs of sales, is appropriate. In this prototype it is not possible to see the total costs in one graph. The total costs could be designed as columns and separated by colouring different blocks, as is designed for different projects in the costs. The costs are currently displayed in two different graphs. Flightmap calculates the needed scale on the y-axis. This may be confusing when individuals compare the different types of costs with each other. The market is designed well; the choice between an external market and a project specific market is appropriate.

The channels are interesting as a feature in Flightmap as well. Further research regarding this aspect is needed to implement this appropriate in the design. The link from channels to the financial aspect is missing in the model. To design this as an appropriate feature in the program the way this can be done needs to be researched.

Summarised, the new design was appreciated by the practitioners. Expanding the model with more options to let the companies customise their own model really adds value to the program according to the sample. This prototype needs further expansions to make it applicable in more situations, e.g. servitization. The current list of variables is a good start, especially to create the big picture. The research also revealed valuable features that can be added, such as channels. Companies like recognition in the program, perhaps more customisation in the user-interface is a possible expansion for Flightmap for the future: the possibility to change labels and customise even more than in the current design, without loading the programmers with amounts of work and complexity. This problem is also revealed by one of the participants: 'the terms used are strongly aimed at hardware; a company may also provide customer support as extra service. The service calls may also be a separate revenue stream. From the bottom up these different

models have the same kind of sub-parts, however the terms differ very much comparing hardware and software; this may be confusing for users of your prototype.'

6.2.2. Recommendations implementation

This research mainly focused on the principle of the design; for the implementation of the prototype in the program the customers use, some hurdles need to be overcome. It became clear that channels do not add much value the way it currently is implemented; qualitative. The link to financials should be included; however, this makes the design way more complex. Additional research is required to find the wishes of the companies. A possibility could be that multiple channels can be attached to a project together with a profit percentage. The program can compare the channels with each other to let the managers of the companies see which channel is most profitable.

For service based business models variables are missing. BICORE already did an extensive research regarding to business models in the different stages of servitization. The revenue model is the main part that needs improvement in this case. There are many different variables that possibly can be included. Certain costs variables as well; this design already included the 'fine'. The level of detail added to the design is up to BICORE; however, information overload should be prevented. The recommendation would be to cluster certain variables in categories; every next category brings more detail to the model. The categories can be displayed in columns; the current design only includes one column. Prior to entering the project screen, users can access the '*conditional inputs*' to set their preferences. This tab could also include a list with checking boxes with all the categories. The user determines the level of detail included in the model this way. The current list of variables is a good start. The further parts of the design were supported by the sample and may, therefore, be included in Flightmap.

6.3. Theoretical contributions

In the literature, subjects were discussed regarding portfolio management and business models. The literature did not cover combination of these concepts thoroughly. Projects are rated against objective criteria, but are rarely force-ranked against each other (Cooper et al., 2000). MacMillan and McGrath (2002) propose a company and context specific pre-allocation of the resources to create a balanced portfolio that strokes with the strategy. The business model concept is a powerful idea for strategic thinking according to McGrath (2010). A business model is the process in which a company needs to create value and deliver this to meet customers' needs. The organisation should then gain some sort of profit or value out of this as a result from the strategic choices involved (Morris et al., 2005; Osterwalder & Pigneur, 2009; Amit & Zott, 2010). These authors, however, consider a business model as the 'blueprint' of a company. That

is, a company can only have one business model. In contrary, Sabatier et al. (2010) argue that a company may use different business models simultaneously to address different markets. Two generic strategies are illustrated: core competence extension to enlarge the market and to address additional customers and core competence redeployment to serve similar market with the same core competence. The concept of business model covers not only the firm's interaction with the customers but also how it benefits from the value delivered.

During this research a business model was considered as different even if only one characterisation was different. That is, a company capturing the same value with different revenue models uses multiple business models. During the interviews some participants already confused the concept revenue model with business model. Implying, practitioners already consider business models as separate models that can be used simultaneously, and therefore this is a useful field of knowledge for scientific research. Thinking in terms of business models offers a way to invent new ways to compete, be they alternative ways to deliver products or services (Sabatier et al. 2010). They define a portfolio of business models as 'the range of different ways a firm delivers value to its customers to ensure both its medium term viability and future development'. This research contributes to this knowledge by defining the characterisations based on business model knowledge that practitioners, in the high-tech sector, would like to include in the business model concept: value, channels, customer, costs, and revenue. Corresponding to these characterisations the profit, risk and initial investment are considered important to compare the business models. According to the sample, companies think about business models on product level. This implies that the integration of business models in portfolio management is a useful addition to the body of scientific knowledge. Further research is needed to bridge this gap between science and practice and to keep the scientific knowledge acquainted of the practical developments.

This research contributes to existing knowledge of business model portfolio management by generating initial knowledge. The portfolio can be based on different business models. Within the body of scientific knowledge no consensus exists regarding the definition of a business model. This research tried to bridge the gap between scientific knowledge and practice by composing a framework out of the literature with variables applicable to companies. These business models on product level were researched in a phase prior to introduction. Different business models were made for proposed projects; therefore in the new product development portfolio. The research shows that practitioners make a distinction between qualitative and quantitative aspects of business models. The first framework included partners as possible important characterisation in a business model. The findings show that practitioners rather check quantitative variables to compare business models with each other. Channels could be

added to this framework as well, however, in a quantitative way. This research shows that companies trying to forecast the outcomes of a proposed business model use quantitative characterisations. Qualitative decisions are made prior to the quantitative roughly. The research revealed that practitioners decide whether to include or exclude a partner for example regarding the business model. If yes, this is quantitatively taken into account in forecasting the business model outcomes. In a later stage is determined which company actually will be the partner.

Comparing these business models with each other can be done best by opposing the developments over time. A line-chart is a manner to display this process clearly according to the sample. The development can be based on different variables, such as profit, revenue, costs, or cash flow. This helps to visualise the forecasted implications for the company. With these visual aids managers can make better decisions regarding creating or maintaining the balance in the company's portfolio and sustainability of the company. With the cumulative cash flow over time it is also possible to maximise the value of the portfolio by comparing which project proposition yields most for the company. The development over time is most important for a company; the sample showed displaying this in a line-chart is appropriate.

6.4. Limitations and further research

This research has certain limitations that should be acknowledged. Options for further academic research will be discussed as well. Research especially interesting for BICORE is already discussed in the corresponding section.

Participants were interviewed until saturation was reached during this research. However, only companies in the high-tech sector were included in the sample. Other sectors, such as the pharmaceutical or financial sector, are not included in this research. To obtain additional knowledge regarding the generalisability of the outcomes in this research, additional research needs to be conducted.

There are only large companies in the sample. One may argue these companies will have a larger affiliation with the research problem due to the fact small companies use more often a single cased business model. However, the influence of these companies should be further investigated and integrated in the research to enlarge the generalisability over all companies.

Another limitation is that some business models are established and determined by the market according to the sample. In this situation you do not have a choice regarding the business model, thus the comparison made would not be useful. This is also a point of attention for further research. Heuristics or rules of thumb for using certain revenue models within certain markets

or for certain products are unknown in scientific literature, indicating a gap in the knowledge. Further research should be conducted to gain knowledge about successful and unsuccessful business or revenue models in the markets. A company starting with a new business model can then use this knowledge in choosing its business or revenue model instead of trying or estimating. This is combined with the problem of the degrees of freedom choosing a business model. The business models may be mutually interdependent (Sabatier et al., 2010) and, therefore, some business models could be unsuitable for some companies.

In addition to this research, it is interesting to investigate possibilities regarding the implementation of consulting advice in a model to compare business models. According to the research of Behrens and Ernst (2014) it is beneficial to make use of a combination of the advice of a consultant and visual aids in the decision-making process. This research only covered advice regarding established pre-allocation of resources and a sequence of executing projects.

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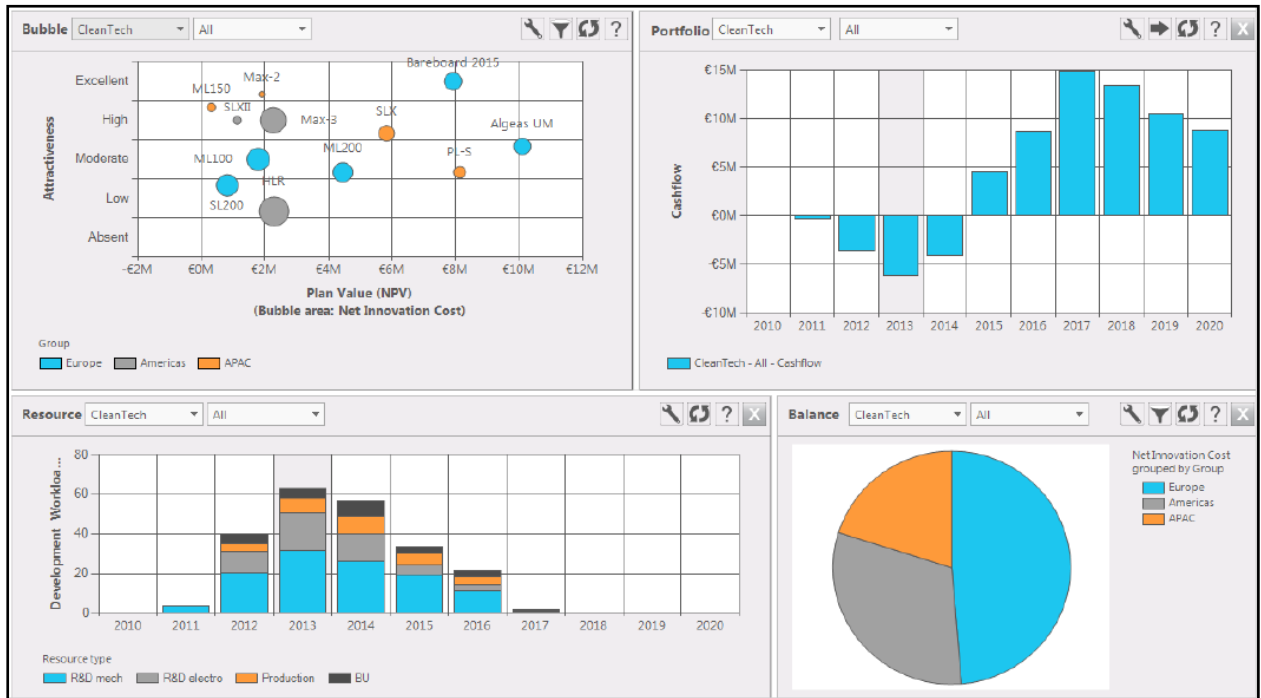
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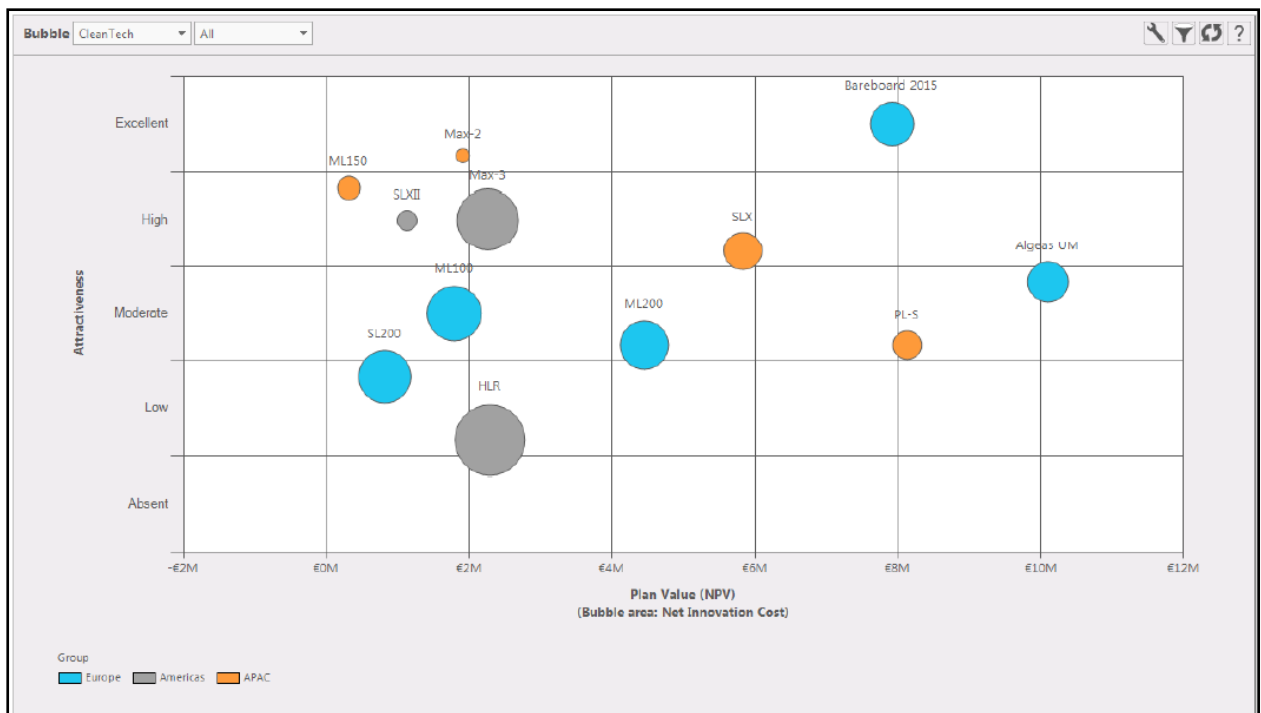
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Appendix A – Flightmap captures

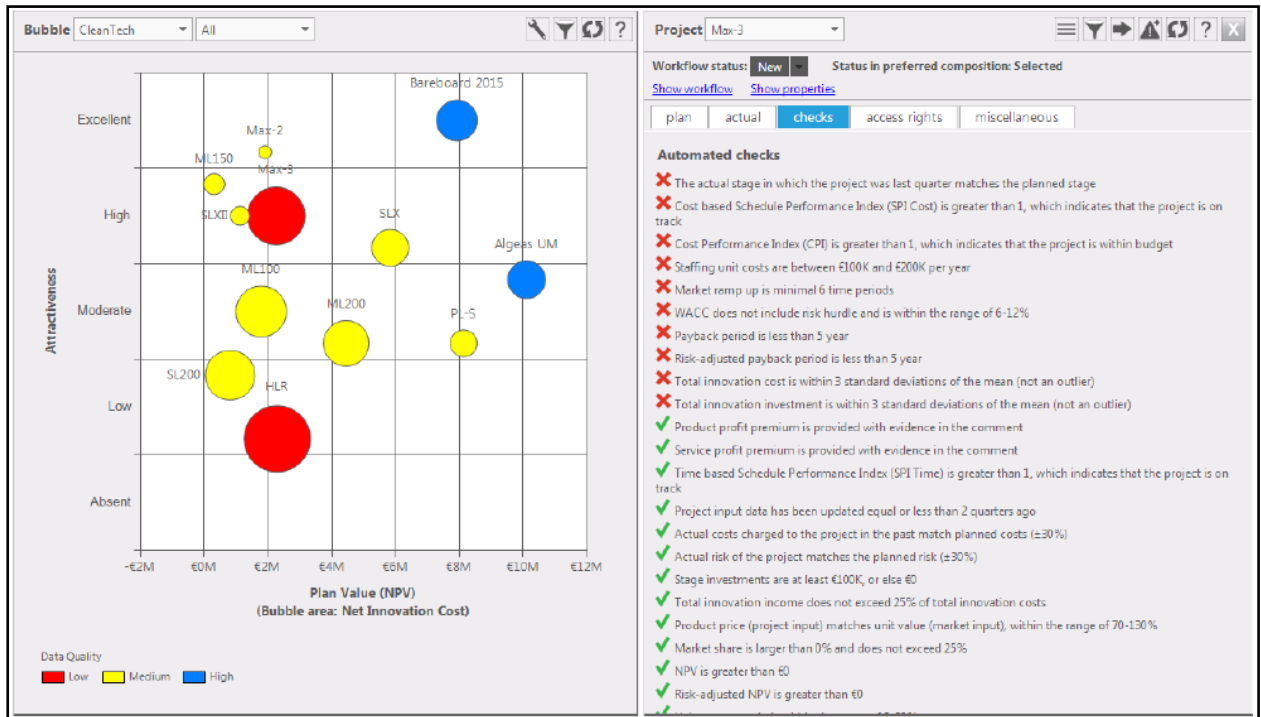
- ❖ Split screen with several visual aids presented: attractiveness bubble plot; cash flow per year; resource allocation graph; innovation costs balance.



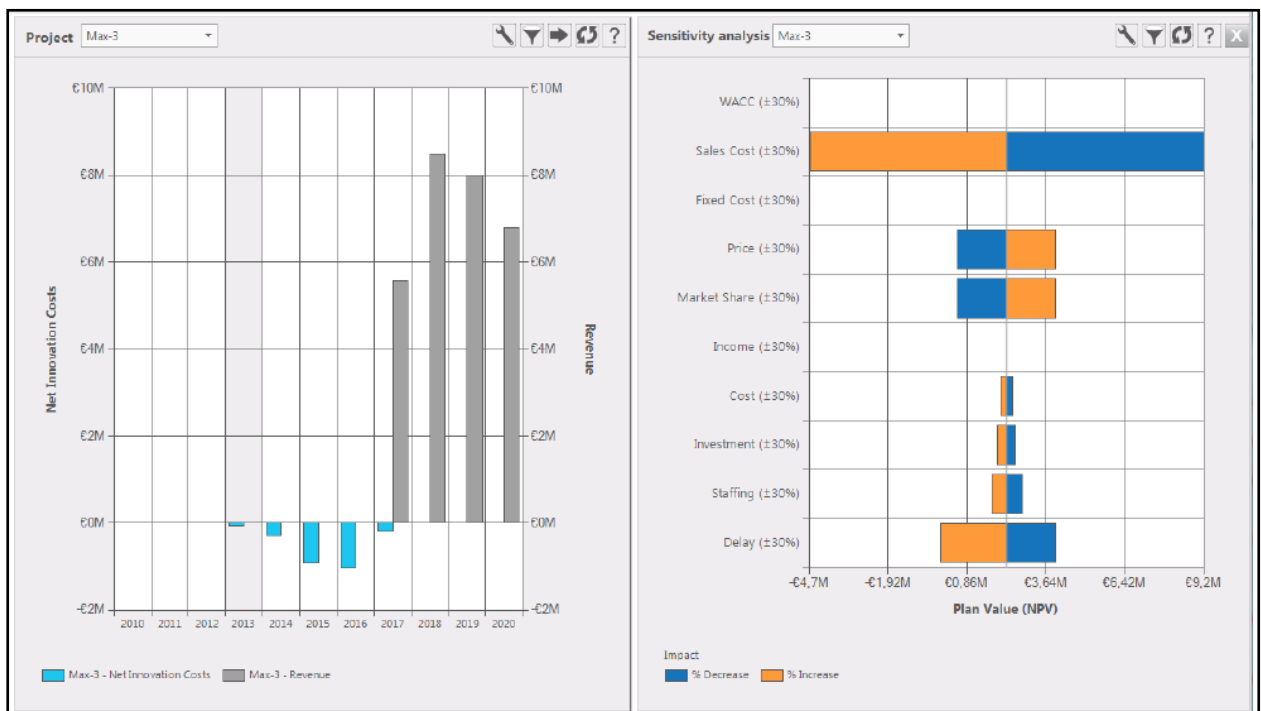
- ❖ Plan value attractiveness presented in a bubble plot.



- ❖ Data quality check for up-to-date data and implemented checks for outliers or noteworthy input compared to the mean or average.



- ❖ Innovation costs overview and sensitivity analysis



Appendix B – Framework in Flightmap

Presets Portfolio Project Market Technology Partnering Reports
FLIGHTMAP v4.4 Beta

Project: Machine

Workflow status: **New** Status in preferred composition: New

[Show workflow](#) [Show properties](#)

plan actual checks access rights links

base development **external market**

Activate market 2

Target Market: ? POD Coffee Machines

Business model: Product-based

Installed Base or New Sales: New Sales

Lifecycle stages (q): Rampup: 12 At maximum: 40 Rampdown: 4

Base Share: ? 37.70 %

Additional Share: ? 45.00 %

Market: POD Coffee Machine

forecast documents alerts

Name: ? POD Coffee Machines

Description: ?

Business Model: Product-based Subscription-based Transaction-based

Reference Time	Ref Time 1	Ref Time 2	Ref Time 3	Ref Time 4
?	2014	2015	2016	2017
Installed Base (units)	26.500.000	30.000.000	37.800.000	44.500.000
New Sales (units)	3.500.000	7.800.000	6.700.000	4.100.000
Product Price	€59,95	€59,95	€59,95	€59,95
Product Profitability	5 %	5 %	5 %	5 %

Project: Machine

Quarter	Cashflow (M)
Q1 2013	0.00
Q2 2013	0.00
Q3 2013	0.00
Q4 2013	0.00
Q1 2014	0.10
Q2 2014	0.12
Q3 2014	0.14
Q4 2014	0.16
Q1 2015	0.30
Q2 2015	0.35
Q3 2015	0.38
Q4 2015	0.35
Q1 2016	0.38

Appendix C – Interview design findings phase

Introduction

- ❖ Introduce myself and ask permission to record the interview.
- ❖ Purpose of the research and interview.
- ❖ Structure of the interview (participant, portfolio, framework, combination, strategic projects).
- ❖ Can you introduce shortly the company and yourself?

1. Portfolio management

1. How is the portfolio management (explain term used in the research) process structured in the company?
2. Can you define the role of decision support systems in the company?
3. To what extent are you familiar with Flightmap? (Not; Use output; provide input; etc.)
4. How important are the portfolio decisions in the company?

2. Business model

5. Encounters the research problem? (Clarify)
If not, ask whether it is understood and thinkable of as a problem?
6. Which characterisations do you think are most important when comparing business models? (explain definition used of a business model)
When the respondent states characterisation of profit, explain that this is the end of the chain and needs underlying structure.
7. Show and explain framework and discuss; suggestions for extra characterisations or less?
How to display?

3. Framework

8. Market discussion (explain the argumentation with growth perspective).
9. Cost structure now is with sales dependent and independent costs; this may be further specified, suggestions?
10. Partner discussion (explain trade-off for presenting this way).
11. Which revenue models does the company use? In which state of experience are these?
12. Currently these revenue models are included in the prototype (short explanation): *product based, subscription, licensing, usage fee, lending/leasing, intermediation fee, freemium,*

advertising, performance-based (milestone), cost price (time-and-materials).

Does the company you work in use one of these models forgot to mention in the previous question?

Can you think of extra models you would like to add to these? If yes, can you explain the principles of this model?

13. Combined revenue model: acceptable idea? Appreciated?

4. Strategic projects

14. Explain strategic projects, which may be financially unattractive. (Show the MacMillan & McGrath example)

15. Recognise these projects out of own experience in business?

16. Comparing to previous discussed business models, what are the most important differences?

17. What is your idea how to display this option?

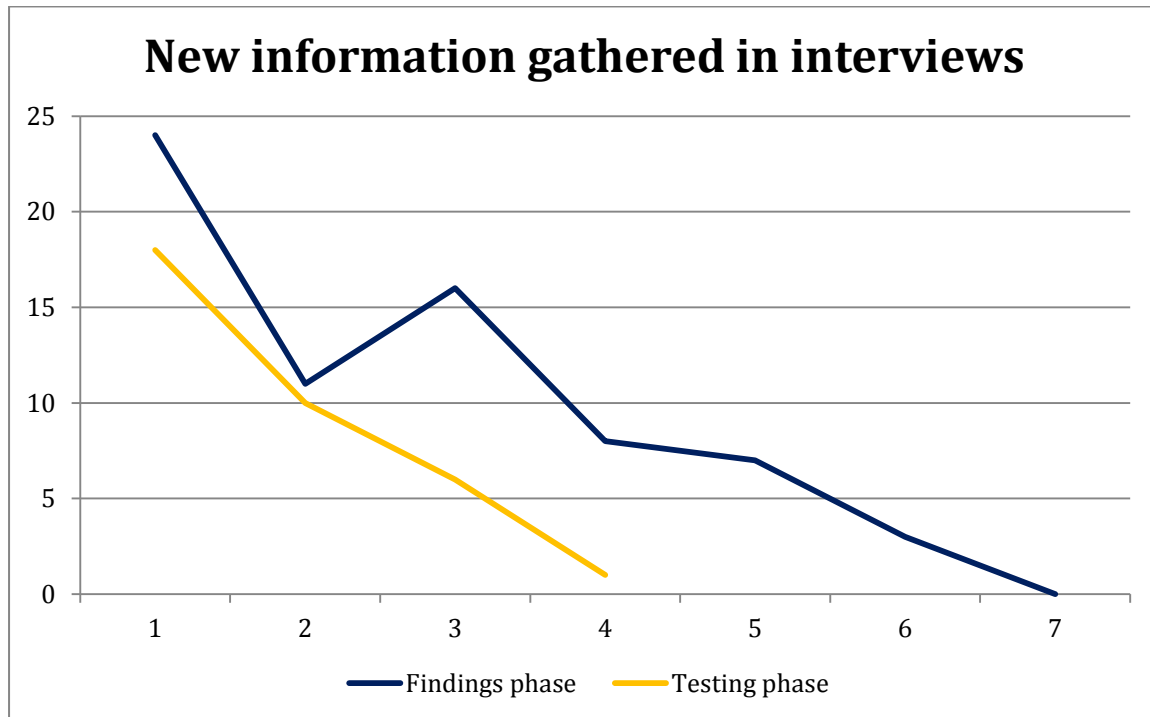
18. Would you appreciate an advice pop-up? (Explain Van Bommel et *al.* + pre-defined resource allocation MacMillan & McGrath and Chao & Kavadias)

Ending

- ❖ Thank the interviewee for participation.
- ❖ Should the name of the company and of you remain anonymously or may they be mentioned?
- ❖ Would you like to receive the outcomes of the research?

Appendix D – Saturation process interviews

The figure includes the saturation of the second sample as well. The y-axis represents the amount of new pieces of information counted; the x-axis the number of the interview.



Appendix E – Interview summaries findings phase

Interview 1

The portfolio management process is determined by the different Business Units apart. Based on their insights and information they manage their portfolio. We plan the strategic scope, so everything outside the scope of the BUs is our case. We determine certain fields, which offer space for growth. The BUs work with a Stage-Gate system. We do not work with a DSS at the moment; however, I have some experience with Flightmap. In our portfolio process we have many decisions to be made: incremental improvements, new markets to address, et cetera. These are, of course, important decisions for the company.

I definitely recognise your research problem, however, in our case this is more a strategic problem. Portfolio management for us is more if we notice a market desire for a new machine, we are going to develop a new machine. Then, these decisions regarding the business model are already taken. When I would consider alternatives I think most important is the way the customers are addressed, whether this is done in a good way or not; the channels are very important, but these are elaborated very well in the company. This is something that we are good at. 'So the most important characterisations would be the value proposition and the different revenue models, such as the choice between product based or subscription based and which added value this would add in the value proposition.' Perhaps you could take the business model canvas in your framework, however, some are qualitative and perhaps harder to implement or superfluous in a software system. But 'Channels' is an aspect I am missing and activities, and perhaps the type of relationship with the customer.

The market displayed this way is a good way to do it in a traditional market. We are currently involved in many new markets and then you make use of customer insights. 'In new business development markets I do not think this is possible, you use customer insights which provide guidelines for what to do.' Regarding the costs you should make some kind of division, initial investment and variable costs for example. The partners I would consider in a qualitative way, OEM and suppliers are considered as costs. Other partners may offer extra revenue or market access, but this can be implemented in your prototype; for the other aspects they are regarded in qualitative manners. The combination of revenue models should definitely be included. 'Many companies use multiple revenue models, such as pay an initial fee and later pay for performance.' In addition, it should also be possible to see the revenue models separate from each other.

The strategic projects are important for every company I think. Additionally, I think these projects are becoming more important in time. Traditional markets and business models are

'collapsing', and therefore companies have to focus on new business models. But regarding different alternatives in this aspect I cannot say what characterisations would be most important to compare these. It is a total different way to approach the market. We always make use of a 2X2 matrix, such as the 'Ansoff matrix'. But the borders are more like 'grey zones'. At the beginning of the cycle proposals are presented, and then the projects that are most in line with the strategy and fit within our resource possibilities are selected. An advice pop-up based on such a figure would not be appreciated. Business modelling is gaining more importance; perhaps you could implement 'process and governance.' The difference between portfolio management and innovation management should be clear. The portfolio process is more aimed at making a new version of your product for example; the business model is secondary in this process. The innovation process is aimed at the new projects (strategic projects): these are more concerned with business models; a qualitative process.

Interview 2

The product management in our company regards to strategy, projects, road maps, and markets. The portfolio management process may be improved. It is not quite structured; before it was project per project. Now it is a product development company with developers, testers, programmers in a team, structured. This way we check whether it is possible to start a new project with the resources available. The product managers provide the business plans. However, we want to have a more long-term vision on this aspect: check new markets et cetera; this happens once a year at the moment. We do not use a decision support system for this project. I am familiar with Flightmap, we also used this in the previous company I worked in. The portfolio decisions are always very important. There are many ideas that cannot be executed all together, due to possibilities.

I recognise the problem. The world is changing; therefore, new business models can be very interesting. We want to check what yield us the most? There is more and more aim for the 'cloud'. This way we would move more towards the service revenue model. This is an actual dilemma in our company. 'I think this will be a very good and helpful addition to the program'. Comparing such possibilities I would want to compare on margins, costs, and revenue; thus profit. One must also consider that providing a service in the cloud means heading towards a 24/7 availability. Therefore, you could compare on customer satisfaction as well; delivered value. We always make use of partners at the moment. That is, in this framework it is a good addition but we do not take this aspect in our financial aspects. 'An addition for your framework would be channels; how do we reach the market?'

The market determines the price, such as competitors, the positioning in the market, and the value delivered to satisfy the customer. That is in our market important when we want to offer our value as a service, that will, namely, mean that the third party (that sells the product at the moment) will be superfluous and therefore no longer exist. Therefore, we would have a larger margin or able to sell the service cheaper. In the prototype the market is displayed in a good way. 'I would like to see the total market and growth together with your own cash flow (or profit) in one graph. This way you are able to see the developments of the market and of the company. This visualisation will offer you more insights. You have to be able to explain why you are losing market share or gaining market share for example'. The costs I would consider as one total post. We use three ways: the first is a quick scan, and every step further contains more detail. This is nice displayed in a typical graph that first is negative, reaches the point of return in an amount of time, and later will be positive. The extra aspects that should be taken into account are the total cash flow (need to survive) and the depreciations; these depreciations are spread over multiple years. I would appreciate the addition of partners. Not OEMs, those are considered as costs. But the total project should be considered as a whole, but the partner should also be isolated when possible to check the wealth of your own business. The individual revenues are important, but the total project regards to the market. Therefore, a company should consider the total project with a partner as well. In the revenue models you could add 'revenue share': like an app market. Apple takes care of the market and therefore gets a fee for the money the apps gain via their market. This is some kind of intermediation fee. Regarding the possibility to combine revenue models I think you choose one model to gain your revenue. However, comparing different alternatives this may be an interesting option; then I would combine the different models.

I recognise the strategic projects you mention. However, regarding these projects we do not use established numbers or borders; these projects happen on trial. You try some ideas on new markets for example, invest a little bit and check how the market reacts; learn from these projects. The aspects of these projects are hard to measure or forecast; this is more pioneering. Sometimes companies have separate business units or product areas for this; we do not have such units. We would like to have such a unit, which needs to be developed in our company. Regarding an advice pop-up I do not think this will have a positive effect, perhaps you could add a kind of risk flag with low, medium, and high risk colors. But the other aspects are not regulated via tight borders, and will not be relevant for the business.

Interview 3

Interviewee introduced himself as a manager with experience in the field of portfolio management and business models for many years within different companies and sectors.

The company did a pilot in Flightmap, and the interviewee indicated he was knowledgeable with Flightmap. The company had a need for an “off-the-shelf tool” for portfolio management. An important aspect of portfolio management is the task of the manager when projects in execution do not go as planned; this is often a reason to check to whole portfolio. In the company we want to standardise the portfolio management process; more structure. We use a certain cycle, but the validation, however, lacks in this cycle. We call portfolio management “the programming of the projects”. In this process is the resource check quite important, whether we can handle it or not. There is no such thing as a decision support system in place. We would like to use such a program, but currently it is not used. A tool that adds all business cases together to provide an overview would be exquisite. The importance of the process differs per time. Once a year there is a strategic evaluation, which is very important. Everything needs to be orderly by then.

I recognise the research problem as is. However, currently when we execute a project the business model is established as is. We are the “cash cow of the company with a business model that exists for a long period”. We sell our systems, and also a service subscription that covers the ongoing costs. Certain specific parts will cost extra money due to their known wear and tear. Making our business cases we have few degrees of freedom. This is also due to the coherence between the business model and the product and the market. The market has a certain history, certainly with older markets. The development of a new business model in these cases is not related to the development of new products. We disconnected this process. We are developing new business models, but try these out on existing projects in pilots. We use the calculation of NPV over 5 years with an exit rate. The development, however, already covers 3 years. That is, there are first 3 years of costs making, while the most actual revenue is gained by the service. This revenue is gained after 5 years, meaning this calculation has many disadvantages. But in what sense do we need to optimise these methods? Most revenue is gained by service, thus making our products more reliable would slink our profit. However, the experience learns that the reason triumphs: products should be made more reliable. This offers the customers more value, making them willingly to keep paying for the products. It is the matter of companies to find alternative ways to gain their profit. Comparing different business models I think the most important characterisation is the value that is delivered. That is, the value in the perception of the customer; the amount of money the customer wants to pay for that value. There is a certain

overlap between business models and new products. Again, the business model is related to a certain product. Other models need to focus on the added value delivered to the customer this way. They can also offer the company possibilities as more flexibility, in resources for example. Agreeing on a subscription model may give the company the opportunity to sell another customer a used product, when both parties agree. A very good aspect of your framework is the adding of the partner characterisation. This can be very important seen that we almost never operate in a project alone. The most important question is where to earn the money. In companies there are often many business units with their own managers. Those managers want to optimise their unit. That is, the product unit does not earn money from the spare parts that are sold. It is very essential to oversee the whole. See the company as a whole; otherwise you will get sub-optimisation for the different business units. The business model should not be led by individuals. "We should find the optimal synergy between us as a company and the customer". However, the business model is also dependent on the competition and the perception of the customers. There are few degrees of freedom.

Within the market aspect of your prototype I think it is not necessary that the price of the product should be indicated under the 'project' tab. "Price is determined by the market and thus the customers, not on basis of the costs made". Costs are an independent characterisation. The competition will have similar cost structures and in a healthy market not sell their products under cost-price meaning that companies are able to make profit in such a market. But the price is set by the market. When we add a new feature to the product, we check the amount of added value that can be sold. We do not even talk with our sales department in those situations. "The costs do not matter, the added value does". In business models the two units come together. Sales must be informed about the business model and the production unit is responsible for the total revenue. The business model in this aspect is the responsibility of the business unit, but in a tight cooperation with the sales unit. The sales unit must be able to justify this in the market. We try to standardise the business models; when a new product is launched the business unit may then choose between the different business models according to the standards. Currently we make use of the product based and subscription based revenue model for a longer period. New revenue models we are exploring are consulting (cost-price), usage fee, freemium, and performance based. I do not think you forgot an important revenue model in your list. Performance based can be very important in the near future: many companies want to offer a sort of subscription model based on uptime for example. However, many new business models are most of the time overhyped, especially in B2B market linked to tangible products. There are just a few examples of markets this had a great impact; the smart phone industry is one of these. Regarding to the combination of revenue models, combine absolutely. This is what I meant by

getting the total picture complete of the company and creating synergy instead of sub-optimisations. The revenue on different partners can be arranged by agreements on royalties.

I certainly recognise the strategic projects. This example is very common, and also the way we look at this. However, for scouting of positioning projects no business cases are developed or business models are assigned. These projects are just tried out in the field based on 'good feeling'; there are not many monetary resources involved. These are not needed to be displayed in such a system. Therefore, I would not appreciate an advice pop-up. In practice these boundaries are not as exact as the scientific literature states. At the start of the year the division is roughly made, and at the end of the year the actual division is evaluated. This is seen in a more qualitative way. Not many companies apply this knowledge in practice, especially not when it happens in a mechanistic way supported by a tool. "The projects are executed and appear to be divided in a certain manner instead they are divided by a pre-allocation".

Interview 4

We are starting to implement portfolio management in a structural way. Finding content, and later on give meaning to this content to do 'something' with it. This is because at this moment the portfolio management process is not structured. For some of our businesses we received the total portfolio. That is, we know what we are doing, why we are doing this, and what this should yield us. Every business, of course, had some sort of process to deal with the portfolio decisions. However, at this moment we want to professionalise and ensure that all business use the same process, uniform it. We plan to do this with Flightmap. We are a multi-technology enterprise, within every sector we need to make choices out of all projects.

Starting a project it is not determined what the business model will be. We are a production company, but we also provide services. Furthermore, we have different options to complete a project. Sometimes we just produce, other times we have to make the design as well. Therefore, we make choices per situation what additional value we want to offer. It happens that the situations and the project decisions are very hard, also to predict. We make different 'scenarios' to create options next to each other because we want to have an alternative plan when things do not go the way we would like. Comparing these options next to each other, we are very cautious. In this company we are looking for growth and results. But there are more important aspects, like the investment, risk, and available resources. The investment portfolio needs to be balanced as well, not all the budget should be spent on a single project. We want to cover the high risk projects with low risk projects, which are also profitable for possible bad outcomes. 'We strive to have a balanced portfolio, and never put all our eggs in one basket.' We rather participate in all projects in our sector than execute one big project with a large return. In the framework

presented we would like to add financiers or subsidies, who take a part of the costs for their account. This way we make a difference between gross and net costs.

We do not use the market perspective this way. But that is due to our business sector. We are a very large company; however, we only have 2 or 3 big customers. Therefore, we look at the 'market' in a total different way. We relate this to programs (that is our name for projects), which may last for 15 years. That is no exception. 'We only use market share for the policy and governance regarding monopoly'. It is important for our business to participate in a program. In general, when the company participates in a program, it is for a life-time; long-term agreements. Regarding the market share one should be careful; it should be clear, again, what do you want to achieve with it? A large market share does not imply that the company is healthy; it just means you are big not a success rate. I do not know what it would mean for the portfolio decisions. A company should prioritise her customer segments, instead of the total market. Check the customer timely. This also accounts for the risk. We see in Flightmap the risk divided in high, average, low. Later on we noticed this is built upon smaller parts/parameters. These are much more interesting. One should know what he wants to achieve with this 'knowledge'. What does 30% risk mean? What are the actions we are going to execute; now we know this? This accounts for all information received from a tool. The relative time to each other is important. The nice thing about Flightmap is, you can adapt one of your assumptions and immediately see what the influence is. This way it is possible to estimate some risks in a better way. What happens when the introduction date is shuffled for example? Regarding the costs we want to split these in investment costs and interest. Our projects last a long time, implying the interest for such a period is an important factor. This differs per sector. 'We make a difference between gross and net costs, where gross costs account for the total endeavour and the net costs for the actual costs we have to take for our account.' Regarding the partners, we always execute projects with partners. However, we do not take these into account in the financials, only in the commercial and technological aspect. 'When a partner does not achieve the goal or runs bankrupt for example, we need to have an alternative.' Supply chain is taken into account in the financials, partners are not. 'I think the only time you should include a partner in the financials is when you are in a joint-venture.' I doubt the notion of advertising in this bullet list; I do not think this is a real revenue model.

In different phases of a program, different revenue models may be used. However, this needs to be offered again, in a new procedure. We do not use Flightmap in that way; the decision whether we are going to invest in R&D does not depend on the revenue model we plan to use. We make a total forecast on the margins and base the decision on that forecast. You could combine different

revenue models together to see the big picture, but also see them separately; it depends. The customer determines the boundaries, which business models may fit.

We use Flightmap for strategic purposes. Regarding the strategic projects, we have the problem that we are investing in projects of which we do not know whether these are going to be profitable. So that is the game we play. We consider these projects; taken risks et cetera as mentioned before into account, and predict the outcomes. Then, we decide in which projects we want to invest. Due to the large time-to-market we cannot afford to wait. We have to decide whether to start or not, otherwise we miss the window of opportunity. When you succeed, you have the first-mover-advantage. Not everything we discuss should be implemented in Flightmap. The right parts should be included, other parts not. We review the portfolio once a year.

Interview 5

Every unit decides about their own portfolio, on their own way; some via Excel, another via Stage-Gate for example. We want top-down one uniform system for doing this. We are starting with Flightmap for two units to check whether it provides us the output as we expect it will do. Furthermore, I attended the presentation of Flightmap with commercial aspect, to check the market criteria such as PEST. I did not use the output nor provide input myself. Our portfolio decisions are not very structured, however important they are. Therefore, we have selected criteria in line with our strategy. Every project needs to receive a quotation on all these criteria, including the sub-criteria. Some projects we need to execute due to legal aspects. However, taken this into account we want to create a balance in the total portfolio following the criteria to make it in line with the strategy. Also, we want to check which competencies are important to create this balance.

Business models in this aspect are very important. We look at the TRL (Technology Readiness Level) to rank the projects as whether they are ready to sell as a product, service, or et cetera. In the past the business model was pre-determined. We want to change that perspective and 'I think the proposition of offering alternatives may be very helpful there.' We often work with the business canvas (Osterwalder). When we compare different projects we have the difference between strategic projects and consult projects we gain direct profit from. 'The canvas may be a tool to implement in Flightmap, as a total business model summary.' In the framework the value can be opposed to other aspects as the costs and revenue. Some of the value needs to be delivered due to legal aspects or regulations. This implies that another dimension should be added to the framework, the value that is delivered to others than the market. We compare the possible projects on the chance of success, e.g. risk. Another aspect is the future resources

needed: investment; human resources; operating costs; co-financing (subsidies); and time-to-market.

An addition to the current revenue models may be 'spin-off creation'. This means we invest resources in a project to make it a stand-alone project that may evolve in a spin-off. For the other part I do not have additions. The costs I would consider as a whole, but the investment to start should be separated.

Regarding the combination different revenue models or not, I think the combination could be available. The total project is the business model with the different revenue models. But in the example of Philips and Sara Lee (Senseo), I think it would not be interesting for Philips to see the evolution of the coffee pads. On the other hand you are right when you say companies want to compare their share and whether the division is fair or not. That means it should be possible to do both options: see it as a whole, and see it as a separate project.

The strategic projects are for the long-term. These should be in line with the strategy. I do not think you create a business model for these projects. We look at the possible advantages or learning points we may get from these projects. The best projects, according to the forecasts, are then selected. The risk should be taken into account. If the commercial risk is 70% and the technological risk is also 70%, you should not calculate with the total market as 1000€, but 490€. However, this is a very mathematical sketch of the world. The strategic projects are considered as how are we going to make profit with these projects in the future, how do we achieve our strategic goals? Maybe you could add a third dimension to this figure you are showing me: strategic leverage. To check whether the strategic project will offer the company the strategic goals as aimed for. I think it is not as straight as depicted in this picture; it is more a transitional area. So an advice pop-up would not be appreciated; that may imply this is a strict instead of a flexible border.

Interview 6

There are a number of product lines in the strategic planning with a yearly revision. We make proposals for certain projects and check the way those fit with the strategy of the company. Due to the fact the company has many teams within every Business Unit the whole process is very complex. We use some of a DSS, but not regularly the same system; usually a self-developed. These software systems are especially important in the financial aspect. I know Flightmap, and have some experience working with the tool. In the importance of the portfolio decisions it is our job to take the constraints and strategic fit into account. We have multiple scenarios we can consider, but we have to choose the best set.

We also want to check projects on the best alternative. We already do something comparable to that. You do a business case calculation in these cases. To compare different possibilities we check financially on ROI, NPV, and cash flow; let us say the initial costs and the revenue. On non-financial aspects we especially check the strategic fit, and implications. The framework you show me seems right to me, I do not think you miss a certain aspect at this level.

For the market I think you captured a good way to display it for stable or traditional markets, but it should also be possible to only display your volumes. Some markets are namely totally different and need to be considered in a total different way; in these cases the total market is not known yet. In these types of projects you just estimate the number of customers you think to address. Regarding the costs in the system we use very complex structures. 'I think there should definitely be a division between innovation costs and product costs'. The innovation costs are the costs for the research and made towards a market, and the product costs are the costs that need to be made to produce the product. The innovation costs could also be considered as initial investment. I would not include partners very specific in this model. These can be regarded qualitatively; the quantitative aspects can be adopted in the other inputs. Partners may increase revenue through new market access for example; someone could higher the volumes, and then consider the partner qualitatively. The list of revenue models you show me seems quite complete to me, I cannot think of one model you are missing right now. I do not know whether to combine revenue models or not. When you combine it may happen that there will be an overflow of variables, if you do not offer the possibility to combine it may oversimplify the total. Maybe initially I would leave it out; in a more sophisticated version you could include the option.

We have many strategic projects, so I recognise these projects. When we compare such projects we mainly check the strategic fit, later we check whether we are possible to execute the project regarding resources and available time for example. There are no clear borders between the allocation of strategic and platform projects. Therefore, I would not implement such strict advice pop-ups. We have a guidance in the beginning of the process, but this is more an indication.

Interview 7

The participant introduced himself as a product planner, as the link between market and development. They have a yearly budget that can be spent on different desires from the market; of course there are more desires than budget, therefore a selection must take place. This can be done in Flightmap. Certain projects are mandatory; this could be due to legal aspects as well as to strategic aspects. We work with a 10 year product plan consisting of certain big projects and

small change projects. These small sub projects are selected with the help of a DSS, Flightmap. I am quite familiar with Flightmap. In the portfolio process we elaborate different alternatives and present this to the managers. They make the eventual decision. We check the costs and the revenue and oppose the ROI to the legal aspects. The mandatory projects, due to legal aspects, often have a very low ROI but have to be executed anyway. Therefore, we have a separate part of the budget for these projects reserved.

The research problem as described is a very actual problem in our company. We want to sketch alternatives to make the best choice. Therefore, we make different scenarios. Different possibilities arise between the boundaries of the resources, which points to the question what do you want? This should be based on what is best for the company. How do we create the most value? Comparing the different business cases to each other the most important part is revenue, but this could be with zero margins. Therefore, we compare on profit. But market share is also an important issue; however, eventually you want to maximise the profit for the shareholders. When I look at your scheme, I think this can be very helpful in the way one can sketch different scenarios or alternatives. Currently, we mostly use one revenue model: product based and we do not really have partners. Of our end product 80% is procured. That may be considered a dilemma: do it yourself or outsource it? In addition, we sell our products also via a third party, also so-called 'builders' buy the blank product and build it themselves applied to the function. These could be seen as partners and therefore maybe placed next to each other. For other projects it is more likely that we compare the projects with each other. But in the near future this may be very helpful, seen the fluctuations in the market regarding to new business models.

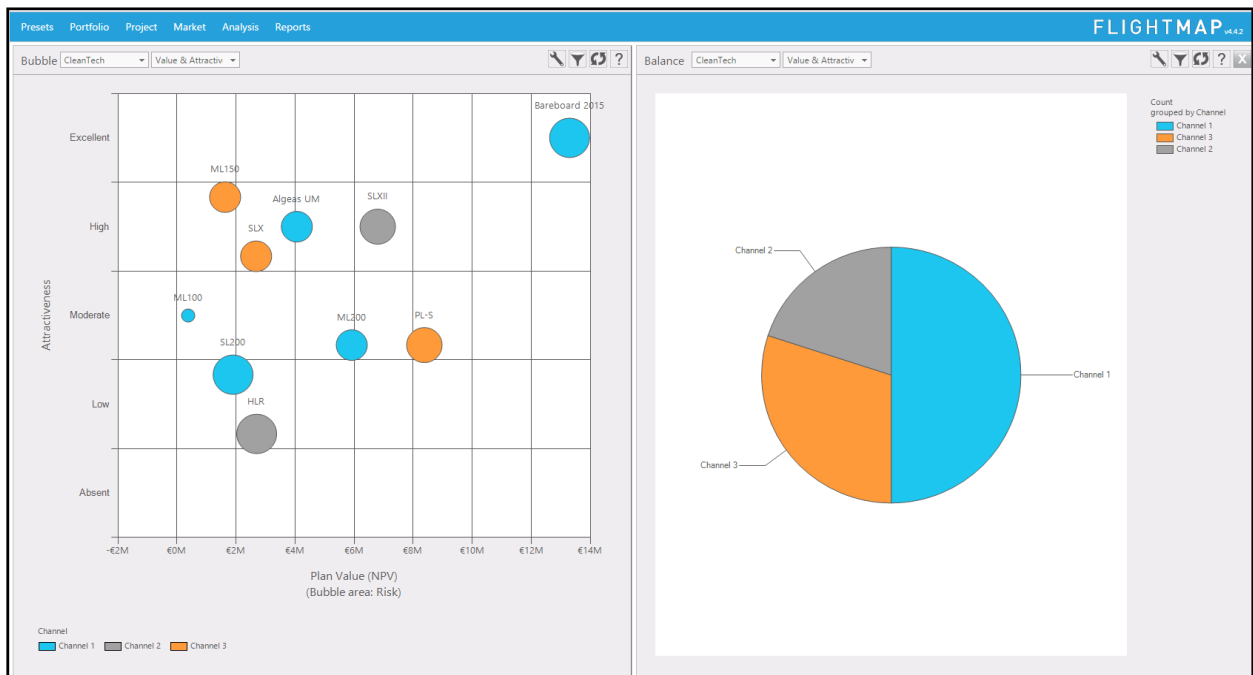
We use the volume we reach of the market in our calculations. But this way of estimating the total market and your own market share seems better to me. It is more clear and transparent this way; the visualisation is better displayed following the market as shown in the prototype. Regarding to the costs I think it is most convenient to look at the total costs per project and not a split in fixed and variable costs. To make profit you have to sell your products, hopefully for a higher price than the costs. We use a product based revenue model and subscription based revenue model, including the sales of spare parts and after-sales. When I look at your revenue models I do not think you miss certain models, especially because we do not use such complicated revenue models. In the screen capture of your prototype I think it is good that the price is placed on the market side. The market determines the price. That is, the competitors and the price customers want to pay for the value they perceive. In a healthy market environment this price is higher than the costs made. This is dependent of different aspects. The costs made and the price for a product are two clearly separate entities. Regarding the possibilities to combine business models, it seems more appropriate to see this as a whole. I

would always combine to consider the project as a whole; you get a better overview. Also, when you include the option to combine the business models, companies are still able to create another project as an alternative and compare the different 'sub-project' to each other. Then companies using Flightmap could never complain about this aspect.

In the topic of strategic projects: these projects are very common in our company. The technology develops rapidly and we have to keep up with this. We could focus on our current competitive points to make a nice profit the coming three or four years, but thereafter we are getting behind and the competition will outcompete us. I do not think one should compare these projects with each other; these are learning projects. We have a special department for those projects and their job is to come up with different projects and a corresponding budget. The manager, then, determines whether the project will be executed or not. I do not think an advice pop-up would be in place regarding strategic projects. The borders regarding the division of resources is not clear as is, it is more flexible and differs per year or per project. My opinion is that 'these projects cannot be selected with a portfolio management tool'. Perhaps the tool can show different (three) scenarios, that is already very hard to forecast.

Appendix F – Prototype captures

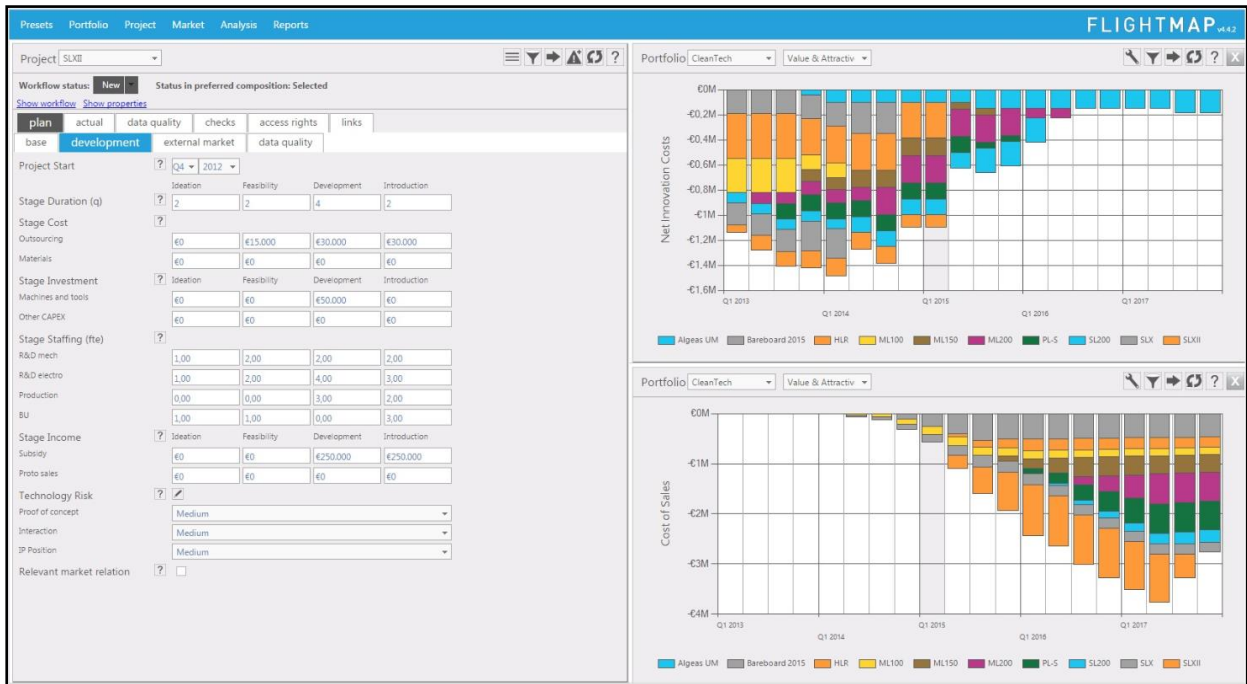
- ❖ Display of different channels in a bubble plot and a pie-chart. Different colours represent different channels.



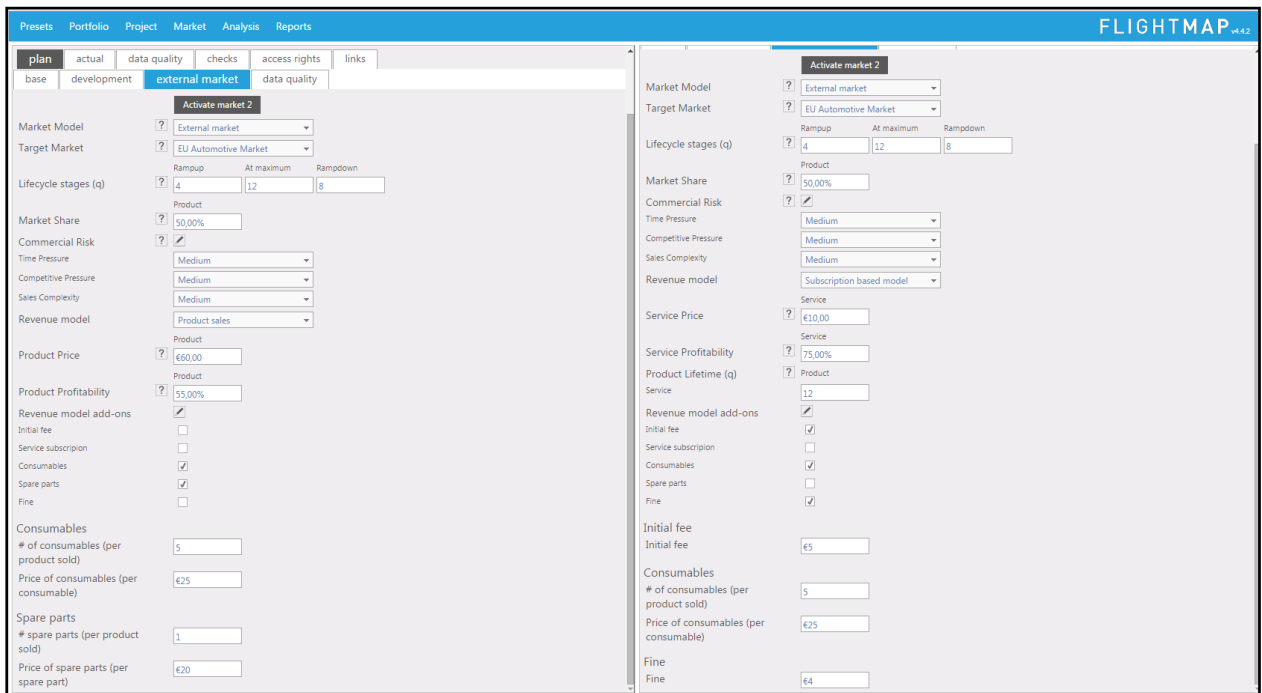
- ❖ Screen capture shows the dropdown menu to create a variant. Next to project 'Algeas UM' the field 'version 2' appeared, indicated that an alternative was created. On the downside the deltas tab is displayed. On the right side the market is displayed. In this example the external market is displayed.

The screenshot shows the FLIGHTMAP v4.4.2 interface for project 'Algeas UM' version 2. The 'deltas' tab is active, showing a list of changes: 'Attractiveness' for 'Time to deploy' changed from 'Moderate' to 'High', 'Attractiveness' for 'Expected market' changed from 'Moderate' to 'High', 'Stage Duration (q)' for 'Feasibility' changed from '5' to '6', and 'Stage Duration (q)' for 'Development' changed from '6' to '8'. The 'external market' is selected, and various market-related parameters are displayed, including Market Model (External market), Target Market (EU Automotive Market), Lifecycle stages (q) (Rampup: 5, At maximum: 18, Rampdown: 8), Market Share (50.00%), Commercial Risk (checked), Time Pressure (Medium), Competitive Pressure (Low), Sales Complexity (Low), Revenue model (Product sales), Product Price (€40.00), and Product Profitability (50.00%).

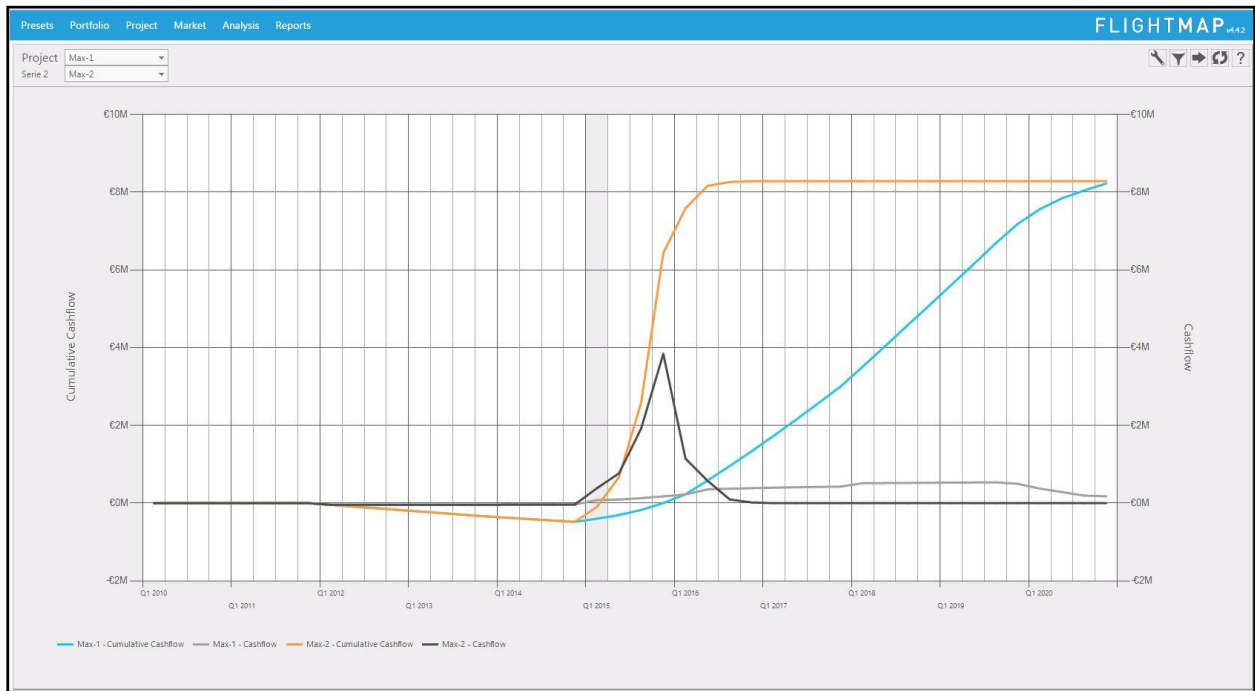
- ❖ The costs data fields and the two graphs with the divided costs: costs of innovation and costs of sales. The Graphs are stacked by project.



- ❖ Two examples of customised revenue models. The right screen displays a product based revenue model with consumables and spare parts as add-ons; the left screen a service based revenue model with an initial fee, consumables, and a fine included.



- ❖ Two variants opposed in one graph. The black line represents product sales together with the cumulative cash flow in the orange line. The gray line is the profit of the service variant, with the cumulative cash flow in the blue line.



Appendix G – Interview design testing phase

Introduction

- ❖ Introduce myself and ask permission to record the interview.
- ❖ Purpose of the research and interview.
- ❖ Structure of the interview (channels, variant, costs, revenue, business model portfolio).
- ❖ Can you introduce shortly the company and yourself?

1. Channels

1. Do you have Flightmap experience?
2. Are you involved in a 'servitization' process in the company, if the company is?
3. Show figure and explain. Do you think this is a clear way to display the different channels used? A label with the name of the channel can be attached to a project (check whether the participant mentions the use of multiple channels).

2. Create variant

4. Show figure and explain. Is it necessary to display all the data fields when creating a variable or are the fields that can really make the difference (such as risk and the market tab) sufficient?
5. The 'Deltas' tab provides textual information regarding the changes that have been logged. Nice feature or superfluous? Implemented in a functional way or needs improvement?

3. Costs

6. Show the figure and explain. The graphs show the difference between costs of innovation and costs of sales; do you think this separation is useful or rather as a whole? Separation is based on the phase of the project.
7. Regarding the market: the input provider is able to choose between an external market and a project specific market (explain if necessary). Do you think this possibility adds value to the program?

4. Revenue model

8. Show the 2 examples in the figure and explain. Do you think it is possible to create either a product based business model as well as a service based business model? Should it be adapted?
9. What do you think of the design you have to check a box to create different add-ons?
10. Is it detailed enough this way or are some parts missing?
11. Consumables (and spare parts) are limited to one price, while different consumables can be sold for 1 product; should this be designed more detailed or is this example detailed enough?
12. Would you like this way of creating your revenue model or would you rather see it designed differently?

5. Business model portfolio

13. Show the 2 projects combined in 1 graph and explain. Do you like this visualised comparison of different business models?
14. Do you think this adds value to the decision making process?
15. Ending open question: How would you visualise the use of different business models?
(Adding a label to a project like channel to visualise it in a bubble plot for example)

Ending

- ❖ Thank the interviewee for participation.
- ❖ Should the name of the company and of you remain anonymously or may they be mentioned?
- ❖ Would you like to receive the outcomes of the research?

Appendix H – Interview summaries testing phase

Interview 1

Especially in my previous role I was involved in servitization; I have no experience with Flightmap whatsoever. Regarding the channels I think the pie-chart is clearer than the bubble plot. Of course, multiple channels can be used to reach the customer, but I consider just my own situation. That is, we have three main market areas: North America, Europe, and Japan. In these areas the sales choose their own channels, which can be multiple. We care about the product development and produce a new product (or service) for one of these areas; they choose the subsequent steps to take. This means that regarding my role as portfolio manager we use only one 'channel' per product; for our case this design would be sufficient.

I like the design regarding the possibility to create a variant. It will be better to create the 'total' variant: people like to have the possibility to change every aspect after such duplications. If you decide to 'freeze' certain fields, some people will always show up with the complaints they would rather change the inputs of one of the frozen fields. The developers are charged with extra complexity, while it presumably is not very relevant for the user. The deltas tab is very useful I think. With these numbers of inputs that can be changed it is useful that the changes are logged. After a few months a person will probably not remember the exact things they changed. This certainly adds value to the program. This could be improved when you are able to visualise these changes, people like images and figures and prefer these above textual descriptions.

We use three different types of costs: during the development (initial investment), costs of goods sold, and overhead. The separation between the costs of innovation and sales costs is useful I think; we use this as well. We also use the overhead costs, but this seems appropriate to visualise the process and the development of the different costs. The choice between an external market and a project specific market is appropriate; we use this as well. Additionally, another limitation could be a limitation of the sales: the number of sales employees can handle a certain maximum of volume. However, this can be taken into account using the project specific market.

In a service model a company has multiple revenue streams: rent/lease, maintenance, consumables, and spare parts. Saying, this is designed well. However, more variables do exist but I do not know whether these should be included in such a model. In our contracts are also volume dependent components included. The customer pays a 'rent' that includes 100 usages per month for example. If the customer may only use the machine 80 times, he still pays for the 100; if the customer uses the machine 120 times, he has to pay the 20 extra usages. This gets even more complex during the year: the months the customer does not use the determined minimum compensate the months the customer exceeds this number. This is the part I miss in

your prototype. Additionally, you should look after the terms you use. These strongly aimed at hardware, a company may also provide customer support as extra service. The service calls may also be a separate revenue stream. From the bottom up these different models have the same kind of sub-parts, however the terms differ very much comparing hardware and software; this may be confusing for users of your prototype. The use of checking boxes, however, is very much focused; this is a good part of the prototype. The problem you should try to avoid that users have a cluttered vision. The view should be clear: if many variables are visible, the different options by checking different boxes must be clear. The things must be consequent and clear. I think this model will function in its purpose to compare different business models with each other. The part of the consumables and spare parts, however, may be further specified. In our company many differences in volumes and prices exist for these parts, therefore, more fields regarding this part of your model would be required. On the other hand, these examples I am thinking of are projects that are running and already introduced in the market. For projects that are in a previous stage or a pre-launch stage you may use averages to estimate the total value. In such a phase the details are not known yet. Our service department calculates business cases in many details, already in an early stage; however not before the launch of the project. Before, one should be able to work with averages and in that way this can be sufficient.

The visualisation does certainly add value. This is, however, just a single part of the total transformation of a company. Multiple factors are involved: are we able to change the market from let us say product sales to service agreements?; do we have the possibilities to provide a 24-hour customer support for example? These are questions that need to be evaluated as well; I recall the example of Adobe: they turned their business model to service based as well, but were only able to achieve this due to the fact they were, by far, the market leader. When all these factors are considered positively, such visualisation may be helpful. To compare two variants in one graph definitely adds value to the decision making process; figures trigger people more than tables and text. With less extreme examples these kinds of graphs will function even better. How I would visualise the use of different business models? I would like to see the different models in a graph. This way one can compare different totals with each other, I like this more than for example the bubble colours you used for the channels. I would like to see the total cumulated value of different business models compared with each other, the margins for example; rather than the number a certain business model is used.

Interview 2

I am familiar with Flightmap, the Flightmap user day was very interesting as well. Regarding servitization I have not really expanded knowledge. However, more customers ask for more

service based business models to improve their revenue streams. At the moment, we have a project-like business. We make agreements with different customers and specify a certain project regarding their requirements. We do not use different channels in that sense. Nevertheless, we have three main target markets or business units. These are divided in different segments. These could be considered as some sort of channels. It would be interesting to see the differences of one of our products in the different segments. There could be some sort of specification here. The first label would be the business unit and the secondary label the segment.

The way the variant can be created seems efficiently designed to me. This way, that every single field can be adapted, is necessary I think. The adaptations someone plans to make may differ per company or even per individual. The deltas tab is useful. The textual description that describes the adaptation made is sufficient.

You made a division between the innovation costs and the costs of sales. I would rather see these two types of costs both in 1 graph instead of two different costs. The difference made is useful I think, perhaps this is possible in some other way. For example, you could display the total costs over time and use a line to display the separation of these costs. The two types of markets (external market and project specific market) should be included. Different projects require different approaches. Sometimes we use another type of external market, due to our project aimed business: we compare the total amount of projects in a certain segment with our market share, which provides us with a target amount of projects. This way you are not calculating with volumes of sales, but a number of projects. Later, we calculate this for the product level and use the project specific market. You designed this correctly for our business.

The 'normal' business model can be designed in a proper manner. In the service part some additions should be added. We have thought about services: not selling the machine, but just the use. The energy usage is a significant expense on our side. You could also think of trainings, employees we install at the customer or logistics. The approach you designed is applicable, but we would need more variables. The use of checking boxes is efficient. Thinking of the switch to servitized business models, there are many different options. However, approaching it this way in the beginning is a good start. It is essential to see the big picture. The same holds for the fine clause; bonuses could be rewarded as well. But this would make the system too complex. For now this is sufficient. The possibility to provide input for 1 perhaps average consumable is sufficient. If you have to split all these inputs, the model will become too complex and it will not add significant value to the big picture. We started very complex as well, but this was too complex and therefore we used averages. This is sufficient to compare scenarios.

The possibility to compare the two variants in 1 graph adds value to as well the program as the decision making process. This visualisation is very helpful; it triggers more than a table. The use of different business models would be best visualised the way you visualised channels I think. If it is possible the different usage of the business models would be clear in a bubble plot and a pie-chart and the yield would be a clear way to display this.

Interview 3

I have some experience regarding Flightmap, but that is a while ago. My role within this company is purely aimed at servitization. This display of different channels is clear, but what do you want to do with it? In the B2B segment it is more complex. We sell our products to the chief procurement; for our services we need to have strategic discussions. You need to discuss on a higher level aiming for services. We miss these contacts. But if we sell to the same entity face to face but on a higher hierarchic level, is it the same channel? This means there are different layers, and these could be considered as different channels. The difference between a product sale and service sale is the channel conflict. But I do not know whether it could be possible to capture this problem in this design. If you offer one proposition that contains both services and products, you need multiple channels. Therefore, just adding one label to a project may be insufficient.

If you create a new variant it is definitely necessary that everything can be adapted. It is most user-friendly when all fields are copied from the previous version and just the fields that need to be changed are adapted to the other scenario. However, this will imply that input providers probably skip thinking about certain fields. If you want to make a new variant thoroughly, you should empty all fields when a variant is created. This will provoke irritations, but I think the scenario will be of higher quality. This is a choice that needs to be made: user-friendly or quality improvement. If you include deltas you assume working with a new version with all fields completed. If you start with a blank page, the system should be smart enough to check whether fields are equal or different. The difference should then be displayed. In this sense I think this is a good feature to the model; the differences are interesting.

The division in the costs is useful. The graphs should be on the same y-axis; therefore I would like to see it in one graph. In the graph you should be able to see the division, but one graph would be better. The separation in two different graphs should also be possible due to the use of different individuals, such as R&D and Sales. Furthermore, if you see this total view it would be nice to focus on 1 project: see the division of the different costs within that project. In this company the innovation costs are not interesting for the sales. A percentage of their profit is assigned to R&D and that is it. When we introduce a new proposition, they put it in the market

and concern about the costs of sales. So I would like to see the total picture and in further tabs more focus. The two markets you use are useful. We use both types per project. First we check with our market share the assumed 'normal' volume we would sell; then we check the expected volume of sales based on customer insights for example. We compare whether these numbers are in balance. If this is possible creating two variants with different markets it is useful.

Regarding your revenue model creating options I think it is possible to create different business models to compare different scenarios. For service based models many different options exist. The research of BICORE in the field of servitization offers many different possible additions to the model. For servitization extra features should be added, recycling fee for example. The terms may differ per company and this could also have implications for the balance sheet, like extended warranties. The consumables are averaged in your design; I would rather see that it would be possible to input more different types of consumables due to the allocation to the right business unit. In contrast, spare parts can be averaged. The design with the checking boxes and appearing data fields is useful and clear; well designed.

The graph with the two variants displayed really adds value to the decision making process. It would be even better if the crossing point was visible. You want to see the time-frame of the different cash flows. At which moment in time are we going to gain more money with this new business model, if that moment exists anyway; that would really add value. Comparing different business models I would like to see them cumulative in a line-chart over time: that would add the most value.

Interview 4

I have no experience with Flightmap and I am not involved in servitization. We do not use channels. We have different customers and certain employees are dedicated to that customer. Our customer relationships are very close. For some companies this could be interesting, especially for the commercial side of the company. I do not think it is an interesting feature for the New Product Development Portfolio; you should not add too many features to maintain the focus. I doubt the usability of this feature for the NPDP; the channel is determined in a later stage. The link from channels to the financial aspect is missing I think, if this could be added it could be useful. The choice between different business models is not determined on the channel that will be used; this is more interesting for the marketing employees. Then, the division over different channels could be useful; multiple channels, however, can be used in a single project.

For the other parts you must focus on the difference. The product development (R&D) makes product innovations with their own budget. The development time and costs are not interesting

for the commercial unit of the company. The commercial side just needs to sell the product and think of the costs of sales. These are two separate things. I question who would like to see all these details. (*Interviewer: different levels in the company would like to see another level of detail, based on our customer insights*). Hearing your explanation I can imagine it could be useful. Comparing different business models is especially useful due to the fact that the possibility exist to implement different business models. This means that the separation of the costs is useful, those types are interesting for different parts of the company. The innovations costs do not matter for the commercial sales; if the product has past the hurdle, the costs that already have been made do not matter anymore.

The revenue model creation is well designed. The checking boxes with appearing data fields are functional. For modelling services I think some variables are missing. I notice the fine that you implemented when the company does not achieve its SLAs. Therefore, extra procurement costs would be a logical addition. With these costs I aim at costs that are directly related to the sales (example: the procurement of mobile phones by telecom companies). It should be considered to make these inputs consequent. I think consumables and spare parts should not be split in more detail. You want to see the big picture and not create spurious accuracy.

Regarding the two variants in one graph there are two factors that are most important: do your customers accept a different kind of business model and the maximisation of the profit. This could be useful to visualise, however I doubt if such a decision would be made based on Flightmap. The total curve should be maximised for a company. But, the two projects combined in a graph is a useful feature for such a program. I would like to see different business models visualised in a line-chart over time.