BUSINESS VALUE CREATION: ESTIMATION AND MEASUREMENT IN E-BUSINESS AGILE PROJECTS

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In January 2015 I came in contact with an e-commerce organization regarding my graduation for the study Business Administration with a specialization in Business Information Management at the University of Twente. The organization came up with the request to find a solution for the measurement of business value in agile projects. Such research calls for issues regarding business administration, for which it provides a perfect connection with my study. Furthermore, the context of this research is very focused on software development, through which my study could be combined with my interests in web development and computer science. This led to my master thesis project on which I have been able to work on with full engagement and interest starting mid-February 2016.

I would like to thank several people who supported me during this master thesis project. First of all, I would like to thank my first supervisor Ton Spil and second supervisor Björn Kijl from the University of Twente for all the useful comments, remarks and engagement during the research process. Secondly, I would like to thank Gerhard van der Bijl who offered me the opportunity to finish my graduation assignment, and for all the good support and advices during my master thesis. Thanks also to my other colleagues who supported me in finishing this research. Last but definitely not least, I would like to thank my family and friends for their continuous support during my study.

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ABSTRACT

E-business organizations are increasingly adapting agile software development methods to develop and improve their software. Iterative cycles make it possible to prioritize features early in development that quickly deliver the most business value to the customer. However, determining business value for that purpose can be a very difficult matter. Without a determination approach, agile practitioners are trusting on their own intuition to estimate the business value of a software feature, and management does not know how their organization is performing regarding business value delivery to the customer. Although agile software development and business value are extensively researched, literature on how business value should be determined exactly is relatively scarce. This research has been set up to design an approach for determining business value in e-business organizations. The following main research question has been formulated: *How can business value be determined for agile software development in e-business organizations?*

To tackle the research problem, the research was set up as a design science process, consisting of a couple of steps to provide a solution for the problem. The research process involved a systematic literature review to come up with a prototype, working towards the ultimate artefact through semi-structured internal and external interviews.

The proposed artefact consists of three main results which are interrelated. First of all, a business value model was proposed to represent the (potential) value of a feature in the context of e-business agile software development. This model consists of all the constructs that encapsulate value, including product and customer value, feature complementarity, and delivery and sustain duration. The sum and multiplication of the various constructs should then lead to the financial representation of business value now and in the future. Second, a method was proposed for estimating the business value using the proposed model for the purpose of feature prioritization. This method consists of guidelines regarding value assignment, and how specific roles need to be involved. The constructs of the business value model can then be used to estimate the potential business value of a feature during the prioritization phase of development. Third and last, a method to measure the business value for the purpose of evaluation was proposed, consisting of the formulation of a measurement plan.

The results of this study contribute to the agile software development and business value literature by providing new insights in how estimating and measuring business value should be carried out exactly. It is a first attempt in offering a complete approach to determine business value in agile projects. Furthermore, the results enable organizations to develop the most valuable features first in a structural manner, by comparing the potential business value with involved costs. It provides more objectivity and transparency during and after the prioritization process, by translating gut feeling into actual numbers and getting insight into those numbers and the corresponding decision making.

CONTENTS

1 INTRODUCTION

Many organizations invest in new technology to search for new value-creating opportunities (Adner & Kapoor, 2010). E-business organizations in particular are continuously striving to improve their software to cope with their ever-changing internet environment (Amit & Zott, 2001). For this purpose, agile software development methods are increasingly being adapted, which originated and popularized through the last few decades (Abrahamsson, Salo, Ronkainen, & Warsta, 2002; Beck et al., 2001). The agile methods introduce many specific practices that offer flexibility for turbulent environments, driven by the idea of self-organized and multi-disciplined teams, few documentation, and effective communication (Abrahamsson et al., 2002). Iterative cycles make it possible to prioritize features early in development that quickly deliver the most business value to the customer, which is the main pursuit of agile methods (Heidenberg, Weijola, Mikkonen, & Porres, 2012; Kumar, Nagar, & Baghel, 2014; Qumer & Henderson-Sellers, 2008; Z. Racheva, Daneva, Sikkel, & Buglione, 2010). Ultimately, this should lead to the most qualitative software, but also requires a business value determination method for software features, serving a multifarious purpose in agile organizations.

One of the main purposes of business value determination is decision making during the planning process. As mentioned before, agile methods implement iterative development cycles to develop features in a short period of time (Abrahamsson et al., 2002; Cockburn & Highsmith, 2001; J Highsmith & Cockburn, 2001; Jim Highsmith, 2002; Vidgen & Wang, 2009). At the beginning of each cycle, it is decided upon which feature should be developed first during the cycle (J Highsmith & Cockburn, 2001). This enables development teams to cope with unpredictable situations by adapting to changes in the environment and customer needs, making the development process flexible to unpredictable situations (J Highsmith & Cockburn, 2001). This is also known as feature prioritization – or requirements engineering – and plays a key role in agile methods. The decision making process during the prioritization of features should be guided by business value as according to the customer (Heidenberg et al., 2012; Qumer & Henderson-Sellers, 2008; Z. . Z. Racheva, Daneva, & Buglione, 2008; Z. Racheva, Daneva, Sikkel, Herrmann, & Wieringa, 2010). This includes the estimation of business value per feature, and requires extensive knowledge of what satisfies the customer. Thus, properly estimating business value for prioritization of features can maximize the value to the customer early in the process.

Another main purpose of business value measurement is managing business performance of agile software development (Frolick & Ariyachandra, 2006). Within organizations performance management is being used to improve business performance on the long term, striving to certain performance goals as defined in key performance indicators. Performance measurement can be used by management to (1) evaluate; (2)

control; (3) budget; (4) motivate; (5) promote; (6) celebrate; (7) learn; and (8) improve (Behn, 2003). As the focus on creating the business value is key in agile projects, performance should be measured on this aspect. Providing key performance indicators on this matter may give handles for performance management in organizations to take corrective actions and eventually improve the agile organization.

1.1 PROBLEM STATEMENT

Determining business value, however, can be a very difficult matter (Dingsøyr & Lassenius, 2016; Logue & McDaid, 2008). Business value is a diverse concept, not simply being observable as for instance conversion rates, revenues, or other financial measures (Heidenberg et al., 2012; Z. Racheva, Daneva, & Sikkel, 2009; Z. Racheva, Daneva, Sikkel, & Buglione, 2010). It requires thorough knowledge about what drives business value in organizations, and which constructs it consists of. Without a determination method, development teams are trusting on their own intuition or gut feeling to estimate business value (Z. Racheva, Daneva, Herrmann, & Wieringa, 2010), or are not estimating business value at all. Furthermore, management does not know whether their agile organization is doing the right thing and how it is performing regarding business value delivery. This is also the case within the e-commerce organization subject to this study, operating in the Dutch online retail market. They have their own custom e-commerce platform in development, partly powered by third-party software suppliers. The platform is being maintained by several diverse agile software development teams, each being focused on particular software component(s). The technology department wants to know where they are currently standing with their agile organization regarding business value, and whether there is room for improvement. Therefore, a solution is needed to facilitate the measurement of business value in agile projects.

Although the literature discusses the importance of maximizing business value in agile projects, there still is a lack of a complete determination method. Some guidelines for estimating business value were proposed by academics and practitioners recently (Heidenberg et al., 2012; Jamieson, Vinsen, & Callender, 2006; Rico, 2010), but it is still not clear how it should be carried out exactly (Torrecilla-Salinas et al., 2015). Furthermore, none have been proposing a method for measuring the delivery of business value after a feature release for performance evaluation, despite the mentions by some authors (Hartmann & Dymond, 2006; Jim Highsmith, 2009; Kautz, Johansen, & Uldahl, 2014; Qumer & Henderson-Sellers, 2008; Rico, 2010; Torrecilla-Salinas et al., 2015). What you do not want is a method that requires various handles for the two different purposes. Although such a multiple applicable method is needed to eventually maximize business value in agile software projects, there is no such concrete business value determination method that takes into account both the prioritization and evaluation purposes.

1.2 RESEARCH QUESTIONS

The goal of this study is to design an artefact for determining business value in e-business organizations. The following main research question has been formulated:

How can business value be determined for agile software development in
e-business organizations?

To answer this question, one needs to know what encompasses agile software development and business value, what methods are already proposed by agile practitioners and academics to build on, and how this should be carried out in practice. For the purpose of answering the main research question, the following sub-questions are formulated:

1. What is business value in relation with agile software development?
   1.1. What is agile software development?
   1.2. What is business value?
2. What methods already exist for measuring business value for agile software development?
3. How should business value be estimated for the purpose of feature prioritization?
4. How should business value be measured for the purpose of performance evaluation?

To provide an answer to these questions, a design science process by Peffers et al. (2006) was used as a research guidance. The research process consisted of a couple of steps to propose an artefact for the research problem (Figure 1). First of all, a literature review was carried out to design a prototype for the artefact. Next, semi-structured interviews were being used to further elaborate and complement the prototype into a proof-of-concept. As a last step, the proof-of-concept was being evaluated in other organizations. This resulted in the proposal of an ultimate artefact that consists of a business value model, and an estimation and measurement method.

The structure of this document follows the design science process step-by-step. It starts off with the theoretical background that is used for this study, resulting in a conceptual framework that is used as a prototype design for the artefact. This is followed by the methodology section, discussing the design science research process in further detail. The interview results are discussed next, which are being used as input for further design decisions. This document concludes by the ultimate artefact for the problem, furthermore discussing the applicability, implications, limitations, and recommendations.
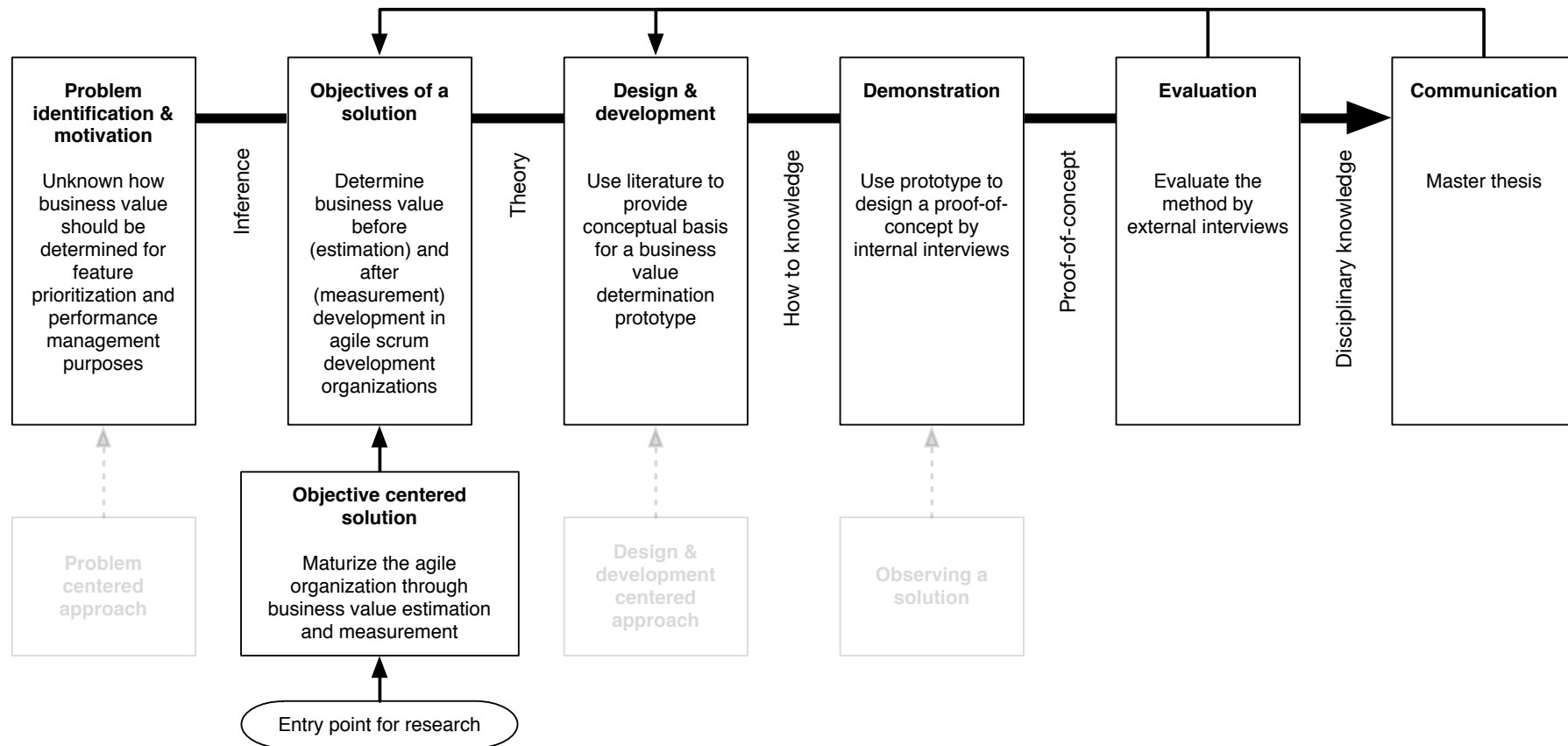
Figure 1: Research design based on Peffers et al. (2007)

2 LITERATURE REVIEW

A literature review is required to get a good understanding on what is already researched on the relevant subjects. It is part of the 'design and development' phase of the research design, of which the purpose is to deliver an initial artefact to tackle the research problem. By checking what encompasses business value for agile software development and what methods were already proposed, a proper prototype can be designed that provides a good starting point for the artefact.

The main goal of this literature review is to find out how agile software development connects to business value, and how it should be estimated or measured according to relevant studies. To get a general idea of the problem context, the first part of the literature review comprises a brief exploration of the main topics, which are agile software development and business value. Both are richly researched topics, for which a semi-systematic inquiry of only the key literature was sufficient. To properly design a prototype for the research problem, the second part of the literature review consisted of a more in-depth review of the combination of agile software development and business value, and already existing determination methods. In contrary to the first part of the literature review, the inquiry was guided by a systematic approach to make sure that all relevant literature is considered. The literature review approach was based on the systematic approach as described by Wolfswinkel, Furtmueller, & Wilderom (2013), for which a detailed description can be found in appendix A.

This chapter continues by describing the conclusions of the complete literature review, which can be found in appendix B. First of all, the key literature on agile software development will be described, followed by the key literature on business value. This is followed by the relation of agile software development with business value, which includes how the agile literature relates to delivering business value, and how and when it is addressed in the agile processes. Next, the literature mentioning any guidelines or methods in determining business value will be further discussed and analysed. Based on this inquiry, the conceptual framework will be highlighted at last, functioning as a prototype for the next step in the research process.

2.1 AGILE SOFTWARE DEVELOPMENT

It's important to know what encompasses agile software development to determine business value within agile projects. Because it is the main focus of this study, only the most cited articles on this research area revealed to be sufficient to get a complete understanding of agile software development. As relevant for determining business value, it consists of taking into account all the values, principles, and practices that drive agile methods.

One of the key characteristics in agile software development methods is the quick and continuous delivery of valuable software to the client organization (Abrahamsson et al., 2002, p. 68; Beck et al., 2001; Jim Highsmith, 2002, p. 9; Pikkarainen, Haikara, Salo, Abrahamsson, & Still, 2008, p. 81; Vidgen & Wang, 2009, p. 373). In literature this is also mentioned as the delivery of customer value (Jim Highsmith, 2002) or business value (Vidgen & Wang, 2009). Another key aspect is its flexibility and adaptability to change, being very useful for messy, ever-changing and turbulent environments (Boehm, 2002, p. 68; Cockburn & Highsmith, 2001, p. 133; J Highsmith & Cockburn, 2001, p. 122; Jim Highsmith, 2002, p. 9). This is all achieved by integrating a couple of common practices.

Agile teams are supposed to be working in iterative short and fixed-length development cycles (Abrahamsson et al., 2002, p. 97; Cockburn & Highsmith, 2001, p. 131; J Highsmith & Cockburn, 2001; Jim Highsmith, 2002, p. 6; Vidgen & Wang, 2009, p. 373). The development cycles introduced by iterative development enable development teams and customers to define which features should be delivered at the end of a short cycle, making it possible to get feedback more often and rapidly change its requirements.

Traditional extensive planning, little standardized processes, and documentation are discouraged by many authors (Beck et al., 2001; Cockburn & Highsmith, 2001, p. 131; Jim Highsmith, 2002; Pikkarainen et al., 2008, p. 82). This makes development more flexible and adaptable to the environment

Furthermore, setting up autonomous and self-organized teams is also part of being agile (Cockburn & Highsmith, 2001, p. 132; Pikkarainen et al., 2008, p. 82). This means that team members get shared responsibility (Vidgen & Wang, 2009, p. 373), however not being leaderless (Cockburn & Highsmith, 2001, p. 132). Another key feature of the agile approach is that members in the agile teams should collaborate intensively with short and close communication (Boehm, 2002, p. 68; Cockburn & Highsmith, 2001, p. 132; J Highsmith & Cockburn, 2001, p. 122; Jim Highsmith, 2002, p. 9; Pikkarainen et al., 2008, p. 82). Beside team collaboration, developers and customers (or business owners) are closely collaborating to deliver qualitative and valuable software to the customer (Abrahamsson et al., 2002, p. 96; Beck et al., 2001; Boehm, 2002, p. 68; J Highsmith & Cockburn, 2001, p. 122; Jim Highsmith, 2002, p. 9; Pikkarainen et al., 2008, p. 81; Vidgen & Wang, 2009, p. 374).This collaboration is often carried out by a representative role, such as a product owner, who is tightly coupled to a development team.

Evaluating and learning is also at the core of the agile development activities (Beck et al., 2001). This includes practices to evaluate and eventually improve the process, its effectiveness, and the produced code (Beck et al., 2001; Pikkarainen et al., 2008). The

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practices mainly encompass regular team learning by evaluating together, but also includes individual learning. Doing so, research time is allocated in the development process (Vidgen & Wang, 2009).

2.2 BUSINESS VALUE

As with agile software development, business value is another thoroughly discussed topic in the literature. Likewise, only the most cited literature are needed to be included in the review about business value. In the found literature for this review, business value seems to be mostly referred to by information technology, e-business and e-commerce. However, to form a general definition from a more management and financial economics perspective, it is considered as "an informal term that includes all forms of value that determine the health and well-being of the firm in the long-run" (Z. Racheva et al., 2009).

Business value is linked to the financial worth of the organization, and that it should be measured as such (Williams & Williams, 2003), especially for e-commerce value (Kevin Zhu & Kraemer, 2002, p. 281). However, as it also applies to other definitions, business value can be considered as a multi-dimensional concept that consists of more than just a financial perspective (Kaplan & Norton, 1992; Tosic, Suleiman, & Lutfiyya, 2007), and furthermore it can be specific to the type of organization (Rusnjak, Kharbili, Hristov, & Speck, 2010) and its strategy (Matts & Pols, 2004). It is spread over tangible and intangible values, and something that eventually should be captured in a model (Rusnjak et al., 2010).

Of which dimensions it consists exactly, very much depends on the branch or context in which the business operates (e.g. IT, e-business), but is also considered to be specific to the perspective of an organization. Regardless of context and perspective, the business value concept is also linked to the balanced scorecard (Kaplan & Norton, 1992) (Martinsons, Davison, & Tse, 1999, p. 75), value chain (2001) (K.a Zhu & Kraemer, 2005), and resource based view (Barney, 1991). However, in the context of e-business organizations, the constructs of business value are obviously linked to internet and digital activities. The most notable conclusion in this context is that there are four drivers that enhance value creation in e-business (Amit & Zott, 2001, p. 516), which are efficiency, complementarities, lock-in, and novelty. In the IT context, business value is more considered as the impacted organization performance (in terms of cost reduction and profit creation (Lee, 2001)), through IT-specific processes and systems (Martinsons et al., 1999; Melville, Kraemer, & Gurbaxani, 2004). More specifically, IT business value comprises efficiency impacts (e.g. productivity enhancement, cost reduction) and competitive impacts (e.g. competitive advantage, profitability improvement) as a result of IT at both the process and the organizational-wide level (Melville et al., 2004, p. 15).

2.3 BUSINESS VALUE AND AGILE SOFTWARE DEVELOPMENT

As also found in the general business value literature, business value is a very dynamic construct that consists of dimensions other than just financial value (Heidenberg et al., 2012; Z. Racheva et al., 2009, p. 4; Z. Racheva, Daneva, Sikkel, & Buglione, 2010). However, it is being viewed as a concept that eventually creates financial benefits to the organization over time, whether it is directly or indirectly (Hartmann & Dymond, 2006, p. 4). As such it should be translated into a monetary value in the end (Z. Racheva et al., 2009, p. 4). The various constructs for business value found in the literature are viewed by the IT taxonomy of business value: value to team, process, workspace, external, customer and product (Qumer & Henderson-Sellers, 2007a, 2008), being tangible (financial) or intangible (non-financial) of nature (Kautz et al., 2014; Patton, 2008; Z. Racheva, Daneva, Sikkel, & Buglione, 2010; Schryen, 2013). The definition of business value varies within the same organization among clients and projects (Z. Racheva, Daneva, Sikkel, & Buglione, 2010). For the purpose of this study, and based on what is discussed in the literature, business value is best defined as *software developed by agile development processes that is considered valuable to both in- and external stakeholders*. Both kind of stakeholders are explicitly mentioned as not only the external customer this case, but also the developing agile organization striving for continuous learning and improvement (Qumer & Henderson-Sellers, 2007b, p. 227, 2008).

The aim is to maximize the creation of business value for the client as soon as possible (Heidenberg et al., 2012; Kumar et al., 2014; Qumer & Henderson-Sellers, 2008, p. 1916; Z. Racheva, Daneva, Sikkel, & Buglione, 2010). Fast value delivery to the client is also one of the most considerable drivers that determine the maturity level of an agile organization (Tuan & Thang, 2013, p. 273). The key ingredients for ensuring business value seems to be testing and validation of software, and reflective improvement in teams; self-organization however seems to have no significant impact (Balijepally, Sugumaran, De Hondt, & Nerur, 2014, p. 11). In the end, business value is realized when the working software enters production (Hartmann & Dymond, 2006, p. 5).

Most of the literature about the subject in agile software development seem to mention that business value is the key decision factor in the prioritization process (Heidenberg et al., 2012, p. 49; Kumar et al., 2014; Z. . Z. Racheva et al., 2008, p. 459; Z. Racheva et al., 2009, p. 3; Z. Racheva, Daneva, Sikkel, Herrmann, et al., 2010, p. 3; Torrecilla-Salinas et al., 2015, p. 129). It is a very subjective concept (Z. Racheva, Daneva, Sikkel, Herrmann, et al., 2010, p. 9) that is very difficult to estimate for the purpose of prioritization (Logue & McDaid, 2008, p. 439). According to some authors, business value is best determined by business representatives and the main stakeholders

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of business value (Heidenberg et al., 2012, p. 49; Qumer & Henderson-Sellers, 2008, p. 1901; Z. . Z. Racheva et al., 2008, p. 459; Z. Racheva, Daneva, Sikkel, Herrmann, et al., 2010, p. 9), eventually with developers involved (Hartmann & Dymond, 2006, p. 2). However, it is not clear how the value is to be estimated exactly (Heidenberg et al., 2012, p. 51; Jamieson et al., 2006, p. 6; Rico, 2010, p. 65; Torrecilla-Salinas et al., 2015, p. 125). Business value is also mentioned in combination with evaluation, however not extensively, and only by concluding that (a) it should be done, and (b) in what metrics it should be represented in.

2.4 DETERMINING BUSINESS VALUE IN AGILE PROJECTS

The last and main focus of the literature review was to find methods, frameworks, or models for determining business value within agile software development organizations. All the papers that are implicating some kind of methods, guidelines, procedures, or recommendations for measuring business value will be included in this part of the review.

There were found eleven articles in the literature review that mention a method to determine or measure business value in agile projects. Very much in the last years of academic research on the context, the methods became more interested in how business value should be determined. Some are more concrete than others however, that is, some are discussing how calculation should be carried out exactly, or are just describing the concept or idea behind it. There is consensus in the design choices of academics on some aspects, yet there are also substantial differences that should be observed.

Almost all articles explicitly mention the estimation of features as the main measurement purpose, and some are mentioning a more general purpose (Z. . Z. Racheva et al., 2008; Rusnjak et al., 2010). However, all of the estimation methods seem to be all general enough so they can be used for evaluation purposes, eventually with modifications.

Looking at the articles, one can indeed conclude that business value is more than just an absolute value and consists of multiple dimensions, which all should be observed for determination (Heidenberg et al., 2012; Jim Highsmith, 2009; Hoff, Fruhling, & Ward, 2008; Rusnjak et al., 2010; Sobiech, Eilermann, & Rausch, 2015).

Beside customer related components, also organizational and IT affairs should be considered. However, some argue that the measured business value should be kept as close to finance as possible in the end (Favaro, 2003; Hartmann & Dymond, 2006).

One should account for the varying contribution to business value per dimension among organizations (Jim Highsmith, 2009; Sobiech et al., 2015). Which dimensions can be considered as more or less valuable than others, differs per organization. Here, the organization's goals and objectives as defined in their strategy should be taken into account (Favaro, 2003), which might eventually be coped with by using weights per dimension in the business value calculation (Sobiech et al., 2015).

Most authors mention that only the customer or their representatives are able to determine the business value (Favaro, 2003; Hartmann & Dymond, 2006; Z. . Z.

Racheva et al., 2008; Torrecilla-Salinas et al., 2015), however they should determine business value in collaboration with developers (Jim Highsmith, 2009). Beside the business perspective, many articles discuss that the development perspective should be taken into account as well (Heidenberg et al., 2012; Jim Highsmith, 2009; Logue & McDaid, 2008; Z. . Z. Racheva et al., 2008; Z. Racheva, Daneva, Sikkel, Herrmann, et al., 2010; Sobiech et al., 2015; Torrecilla-Salinas et al., 2015). Most of them also mention the additional measurement of size/effort per feature, so a cost-benefit analysis can be carried out (Jim Highsmith, 2009; Torrecilla-Salinas et al., 2015).

Many of the articles explicitly mention that business value should be determined per feature, and later on summing them to measure the total delivered business value (Favaro, 2003; Hartmann & Dymond, 2006; Z. . Z. Racheva et al., 2008; Torrecilla-Salinas et al., 2015). This provides the most flexibility, as you can determine the delivered business value, per team, project, or time span. Most of the authors do mention that business value should be determined by assigning value points to each feature to cope with the subjective characteristics of business value (Z. Racheva, Daneva, Sikkel, Herrmann, et al., 2010). The following (differing) characteristics per approach were found:

- Value points as a generic number, eventually relatable to monetary value (Jim Highsmith, 2009; Z. . Z. Racheva et al., 2008; Sobiech et al., 2015; Torrecilla-Salinas et al., 2015),
- Value points should be comparable with the size/effort of a feature for cost-benefit analysis purposes (Jim Highsmith, 2009; Torrecilla-Salinas et al., 2015),
- Value points assignment should be limited to a set of possible values (Heidenberg et al., 2012; Jim Highsmith, 2009; Torrecilla-Salinas et al., 2015),
- Value points should be presented as value options that have a textual name coupled to it (Logue & McDaid, 2008), or each value point should represent a specific tangible or intangible value in the background per attribute/dimension (Heidenberg et al., 2012).

One additional point to mention is that that the methods should be creating little overhead and be as lightweight as possible, to stay within the agile development principles (Logue & McDaid, 2008).

2.5 CONCEPTUAL FRAMEWORK

A conceptual framework can be set up based on the research problem and the literature review. The conceptual framework is shown in Figure 2 and depicts all the relations between the components in this study. There is the iterative development process as can

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be observed in a normal agile development environment. The "corrective action" as part of performance management is added to represent feature evaluation, and eventually interferes in the agile development process. The determination method subject to this study eventually should be able to provide estimation and performance metrics, which respectively can be used during feature prioritization and feature evaluation. Cost analysis has been included for these metrics as well, as it is mandatory to calculate metrics such as the ROI.

Figure 2: Conceptual framework for determining business value in agile projects

To make sure that business value can be determined in agile projects, a model needs to be proposed to represent the (potential) business value of features in the determination method. As concluded during this literature review, business value is a multi-dimensional concept. To come to a solution for the determination of business value, the dimensions of the business value need to be mapped in the context of agile software development in e-business. For this purpose, this literature review includes an analysis of all the dimensions, leading to a set of merged business value dimensions as shown in Table 1. Consequently, the various dimensions form a first understanding of the multi-dimensional business value concept, eventually creating a fundament for a business value model to represent business value in agile projects. The merged dimensions can only be grouped by the main dimensions as depicted by Qumer & Henderson-Sellers (2007), and as such will be used in conjunction with the merged dimensions for further analysis in this study.

The business value model is then to be used to determine the business value into estimation and measurement metrics. This requires a determination method that is specifically applicable to agile projects. Based on what is mentioned in the literature, a table with the theoretical guidelines are summarized regarding determining business value in agile projects Table 2. This summarizes what is already known about determining business value in agile projects, providing a good starting point for the estimation and measurement methods.

Table 1: Business Value Dimensions

DIMENSIONS	SOBIECH, EILERMANN, RAUCH (2015)	KAUTZ ET AL., (2014)	HEIDENBERG ET AL. (2012)	RUSNJAK ET AL. (2010)	RUSNJAK ET AL. (2010)	RACHEVA ET AL. (2010)	HOFF, FRUHLING, & WARD (2008)	QUMER & HENDERSON-SELLERS (2007)	MELVILLE ET AL. (2004)	FAVARO (2003)	AMIT & ZOTT (2002)	LEE (2001)
PROFIT CREATION	Financial value		Monetary value	Company	tangible value internal value		Cost-benefit to the organization	**Value to Customer**	Profitability improvement		Lock-in	Profit creation
COST REDUCTION	Financial value		Monetary value	Company	tangible value internal value		Cost-benefit to the organization	**Value to Customer**	Cost reduction		Efficiency	Cost reduction
INVENTORY REDUCTION	Strategic value (IT)			Company	tangible value internal value		Impact to the organization	**Value to Process**	Inventory reduction		Efficiency	
MARKET ENABLER	Strategic value (Customer)		Market enabler	Environment	intangible value external value		Impact to the organization	**Value to Customer**	Competitive advantage	Market economics	Novelty	
COMPETITIVE POSITION	Strategic value (Customer)			Environment	intangible value external value		Impact to the organization	**Value to Customer**	Competitive advantage	Competitive position	Novelty	
COMPETENCE GROWTH	Strategic value (Customer)		Competence growth	Company	intangible value external value		Impact to the organization	**Value to Team**				
PRODUCTIVITY ENHANCEMENT	Work organizational value	productivity		Environment	tangible value internal value		Impact to the organization	**Value to Process**	Productivity enhancement		Efficiency	
STRATEGIC VALUE (IT)	Strategic value (IT)			Company	intangible value internal value		Impact to the organization	**Value to Process**			Efficiency	
NEGATIVE VALUE	Negative value			Company	intangible value internal value	Negative value	Impact to the organization	**Value to Customer**			Efficiency	
FIXES ERRORS	Software qualitative value	quality		Technology	intangible value external value		Fixes Errors	**Value to Product**			Efficiency	
TECHNICAL ENABLER	Strategic value (IT)	quality	Technical enabler	Technology	intangible value external value			**Value to Product**			Novelty	
EMPLOYEE SATISFACTION	Strategic value (IT)	employee satisfaction	Employee satisfaction	Environment	intangible value internal value		Impact to the organization	**Value to Team**			Efficiency	
CUSTOMER SATISFACTION	Strategic value (Customer)		Customer satisfaction	Company	intangible value external value			**Value to Customer**			Lock-in	
SOFTWARE QUALITY	Software qualitative value	quality		Company	intangible value external value			**Value to Product**				
COMPLEMENTARITIES	Software qualitative value	quality		Company	intangible value external value			**Value to Product**			Complementarities	
TERTIARY VALUE	Tertiary value			Company	intangible value external value		Impact to the organization	**Value to Customer**			Lock-in	
VALUE TO WORKSPACE				Environment	intangible value internal value		Impact to the organization	**Value to Workspace**			Efficiency	

Table 2: Theoretical guidelines for determining feature business value in agile projects

Theoretical guidelines		Supporting Literature
Feature business value in agile projects		
TG1a	The definition of business value varies within the same organization among clients and projects	(Z. Racheva, Daneva, Sikkel, & Buglione, 2010)
TG1b	Business value is the key decision factor in the prioritization process	(Heidenberg et al., 2012; Kumar et al., 2014; Z. . Z. Racheva et al., 2008; Z. Racheva et al., 2009; Z. Racheva, Daneva, Sikkel, Herrmann, et al., 2010; Torrecilla-Salinas et al., 2015)
TG1c	Beside customer related components, also organizational and IT affairs should be considered	(Favaro, 2003; Hartmann & Dymond, 2006)
TG1d	Business value is more than just an absolute value and consists of multiple dimensions, which all should be observed for determination	(Heidenberg et al., 2012; Jim Highsmith, 2009; Hoff et al., 2008; Rusnjak et al., 2010; Sobiech et al., 2015)
TG1e	Which dimensions can be considered as more or less valuable than others, differs per organization	(Jim Highsmith, 2009; Sobiech et al., 2015)
TG1f	The organization's goals as defined in their strategy should be taken into account	(Favaro, 2003; Matts & Pols, 2004)
TG1g	Use weights per dimension in the business value calculation to cope with different concerns	(Sobiech et al., 2015)
TG1h	Business value changes over time	(Hartmann & Dymond, 2006)
Estimation of business value		
TG2a	Only the business (customer) or their representatives are able to determine the business value of a feature	(Favaro, 2003; Hartmann & Dymond, 2006; Z. . Z. Racheva et al., 2008; Torrecilla-Salinas et al., 2015)
TG2b	The business should determine the business value of a feature in collaboration with development	(Jim Highsmith, 2009)
TG2c	Beside the business perspective, the development perspective should be taken into account as well.	(Heidenberg et al., 2012; Jim Highsmith, 2009; Logue & McDaid, 2008; Z. . Z. Racheva et al., 2008; Z. Racheva, Daneva, Sikkel, Herrmann, et al., 2010; Sobiech et al., 2015; Torrecilla-Salinas et al., 2015)
TG2d	Value points as a generic number, eventually relatable to monetary value	(Jim Highsmith, 2009; Z. . Z. Racheva et al., 2008; Sobiech et al., 2015; Torrecilla-Salinas et al., 2015)
TG2e	Value points assignment should be limited to a set of possible values	(Heidenberg et al., 2012; Jim Highsmith, 2009; Torrecilla-Salinas et al., 2015)
TG2f	Value points should be presented as value options that have a textual name coupled to it	(Logue & McDaid, 2008)
TG2g	Value points should be assigned relative to a key scenario/feature	(Torrecilla-Salinas et al., 2015)
TG2h	The methods should be creating little overhead and be as lightweight as possible	(Logue & McDaid, 2008)
Measurement of business value		
TG3b	Measured business value should be kept as close to finance as possible in the end	(Favaro, 2003; Hartmann & Dymond, 2006; Z. Racheva et al., 2009)

3 METHODOLOGY

This chapter describes the methodology of the research, explaining how the research was carried out and eventually results in a solution for the problem. The chapter will be structured as follows. First, the unit of analysis will be discussed, which includes the requirements and characteristics of the subject organization. This is then followed by the complete research design set up in this study. At last, the chapter explains the complete research design and what it consists of.

3.1 UNIT OF ANALYSIS

To design the artefact, the subject organization needs to meet certain requirements. The organization needs to have a development department that implements an agile software development method. It needs to have the intention to be implementing an agile method conform the general stated principles and values. As the research problem concerns the determination of business value, the organizations especially needs to admit the focus on business value concept as part of their agile method. Furthermore, an organization with an agile development department focused on business value is required.

This research is commissioned by an e-commerce organization focused on the consumer market. As main commissioner and stakeholder of the study, the organization will be used as main unit of analysis. They have their own software being developed and maintained by ten different internal agile software development teams of various sizes, each being focused on particular component(s) of the software. SCRUM is being practiced as the agile method in their development department. Their main need for a business value determination method underlines their focus on business value. Looking at the requirements, it makes it the ideal agile organization to design upon such a method.

3.2 RESEARCH DESIGN

Following the problem statement, the solution should be focused on determining business value for both estimation and evaluation purposes. The research questions of this study are best answered by designing a method that offers certain guidelines, procedures or handles for the agile organization. To come to such a method the study needs to diverge from normal exploratory research. In this case design science research fits best, which is aimed at pragmatically developing solution-oriented research products to understand and improve human performance (Van Aken, 2005), making it ideal to design a method for determining business value in agile projects focused on using available theory in practice.

To arrive at an ultimate design solution for determining business value through design science, the conceptual research process model by Peffers et al. (2007) was used

as a research guidance. They proposed a roadmap to carry out design science research in Information Systems (IS), providing six main steps to design an artefact to fulfil a predefined set of objectives. The objectives of the artefact in this research as derived from the problem statement are as follows:

- The artefact should make it possible to estimate business value per feature for the purpose of requirement prioritization;
- The artefact should make it possible to measure and compare business value per development team;
- The artefact should fit into the agile scrum methodology in the first place;
- The artefact should fit into e-business organizations.

To meet these objectives, the roadmap as applied to this research involved three main design steps (see Figure 3). The first step was to design and develop an initial artefact – or prototype – based on the acquired knowledge from the conducted literature review. Thereafter, this prototype was demonstrated to the potential end-users through internal interviews to further extend the design into an improved artefact – or the so-called proof-of-concept. In the last step, the improved artefact was evaluated through external interviews in two other organizations. These last two steps are discussed in further detail in the two upcoming sections.
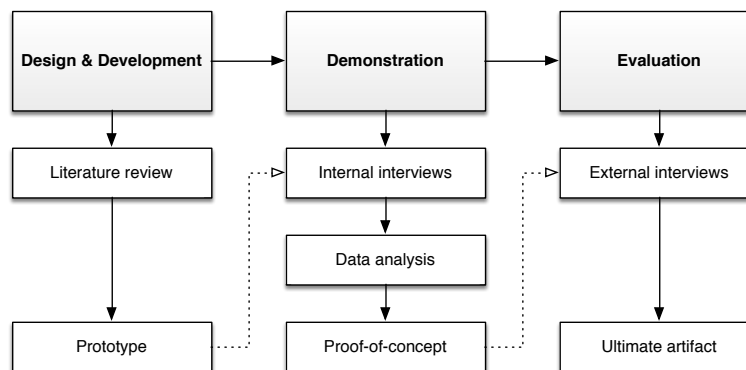

Figure 3: The research design

3.3 DEMONSTRATION PHASE: INTERNAL INTERVIEWS

The initial artefact that resulted from the literature review was being used in the next phase of the research design. It is important to know how the design should fit into the agile organization and how it should solve the problem in practice. Therefore, the initially designed prototype was being demonstrated to potential end-users to further complement to a more definite solution.

To make sure that all potential end-users or stakeholders are covered in this research, all the key roles involved in the prioritization and development of features in an agile project were observed. These include business owners/stakeholders, product owners, business analysts, scrum masters – or team leaders – and a developer. The roles were selected based on the agile team structure of the organization, which can be found

in appendix E. The respondents were selected based on individuals that are closely working with each other as teams. Three teams were selected in total, each being focused on different aspects within the organization: customer service, product management, and the checkout system. The analysed couples consisted of at least one individual per role, whereby the roles were interviewed separately. In a period of four weeks, a total of 15 individuals were interviewed team by team (Table 3).

Table 3: The respondents for the internal interviews

Team	Role	Function
Customer service	Business owner	Manager Customer Services Support
	Business owner	Manager Customer Service
	Product owner	
	Scrum master	
	Business analyst	
	Developer	Data Engineer
Product management	Business owner	Unit Manager
	Product owner	
	Scrum master	
	Business analyst	
Checkout system	Business owner	Managing Director and Manager Corporate Finance
	Business owner	Business Development Manager
	Product owner	
	Scrum master	
	Business analyst	*Role combined with team customer service*
No specific team	Business owner	Strategy Consultant Supply Chain

The respondents were interviewed using a semi-structured interview approach. This approach was preferred over other types of interviews, as it is best used when there is only one or a few chances to interview an individual whilst still offering the flexibility of unstructured interviews (Bernard, 1988). An interview framework of predefined questions was used to guide the interview process. The asked questions involved acquiring context information, their definition of business value, how business value is constructed according to them, mapping the initial artefact to their workflow, and retrieving general feedback on the initial artefact. The last part also consists of getting a good understanding of the respondents' view on the multi-dimensional business value concept to eventually propose a model for it. This includes the demonstration of the business value dimensions of the conceptual framework. For the demonstration of the all the dimensions, they dimensions were grouped by the five dimensions as stated by

Qumer & Henderson-Sellers (2007). One should refer to appendix C for more information about the interview framework.

The interviews were recorded on tape and transcribed afterwards for further analysis. For the data analysis, a grounded theory approach was being used to analyse the gathered qualitative data (Corbin & Strauss, 1990). This consists of open coding, axial coding, and selective coding, which was approached as searching the data for codes, and further looking for relationships among the codes. This way it was possible to make sense out of the data in a structural manner and not miss out on results.

3.4 EVALUATION PHASE: EXTERNAL INTERVIEWS

The artefact needs to be evaluated to make sure that it is indeed a proper solution for the problem. To make sure that the business value model and estimation method would work in practice, the artefact were presented to external e-business organizations also working with the agile scrum method. This was done to make sure that the artefact can be generalized to other situations. For this, one small and one large business to business organizations were selected. Agile managers within the external organizations were interviewed using a semi-structured interview approach. An interview guide is set up that involves context information about their agile organization, but furthermore includes gathering information about their view on business value, their current state of business value measurement, the applicability of the artefact to their agile organization, and general feedback on the method. For the complete interview framework, see appendix D.

3.5 RELIABILITY AND VALIDITY

The following should be noted regarding the reliability and validity of this research:

- To make sure that the interview data is correct, the interviews were recorded and transcribed. A comprehensive summary was made after each interview and complemented by listening the audio files from beginning to end. A summary of the interview was sent to each respondent for feedback to make sure that the data is correct.
- The respondents were divided over three groups individuals that work together, so their results can be related to each other and exclude for any discrepancy.
- Each interview group was focused on three different aspects within the organization, to get a broad view on the business value definition and their view on estimating and measuring. The groups primarily differ in operations close to the financial results of the organizations, to cope with the tangible and intangible value characteristics of business value. They groups consisted of business as well of development stakeholders to make sure that all possible aspects of business value are captured during the interviews.
- The interview questions were explorative of nature. That is, the questions were not tightly coupled to theoretical guidelines in the conceptual framework,

but more embedded inside broader questions. This had to be done because of the limited available amount of time for the interviews, yet get the most valuable output.

- The research was solely focused on the online retail market working with the agile SCRUM software methodology, because there was only access to the information of a single organization having those characteristics. The evaluation phase of the research was carried out to check whether it is also applicable to other organizations with different characteristics.

To sum up, this research mainly involves the design, demonstration, and evaluation of the artefact through literature, internal interviews and external interviews. Once the six steps were followed, an ultimate artefact was designed eventually, which will be described in the next chapters.

4 INTERVIEW RESULTS

The results depicted in this chapter are mainly based on the interviews during the demonstration phase. The results of the interviews are clustered by the codes that were found during the analysis of the data. As a result, this chapter consists of three main sections that in turn correspond to the main aspects of the conceptual framework. First of all, the definition of business value according to the participants will be discussed. This is followed by how the respondents generally think about what the analysis or determination of business value entails. Lastly, the feedback regarding the estimation method and measurement method will be discussed.

4.1 BUSINESS VALUE

To draft a model for value creation in the organization, the respondents were asked about the business value from their perspective. They were asked for the dimensions and constructs business value consists of, based on the dimensions as retrieved from the literature. Furthermore, they were interviewed about what encompasses business value analysis in general according to them. Based on this data, the following findings can be summed up regarding the definitions of business value, its dimensions, and its determination in general.

4.1.1 DEFINITION

Financial value as a result

Ten respondents recognized the creation of business value as the creation of financial value for the company. It consists of revenue creation and cost reduction, and as such is a result of the business operations. One of the findings is that financial value is not just part of the business value, it is a result of all the activities that directly or indirectly create profit or reduce cost. A business owner stated that "all business value dimensions are eventually reducing costs or generating revenue", which was also indirectly stated by other respondents. Another business owner called this build-up as a driver tree, whereby each driver impacts the financial value in terms of revenue generation and cost reduction. Others have mentioned this also by varying statements.

Customer satisfaction

Nine of the respondents from the business as well as the development perspective mentioned that the creation of business value is about serving the consumer as external customer. Most of them view them as the main reason of existence, as they are the ones that buy the products from the organization and thus create revenue. The customer iterates the whole customer journey, from entering the website and browsing product to placing an order and delivering the product. Value creation to the business is then all about anticipating to what the customer demands. In line with this customer journey,

the customer satisfaction is mentioned as "the most important factor of business value creation". For them, the customer satisfaction directly creates the profit for the organization. A satisfied customer is considered to be purchasing more products, and thus increasing profit creation, and is more likely to come back in the future. Three business owners and three product owners do mention this. As two of the business owners and product owners mentioned, one part of the business value formula is acquiring new customers, and furthermore making and keeping them satisfied. All the activities done within the organization are actually directly or indirectly focused on making the customer satisfied and make them buy more products, and thus in the end make more revenue.

Tangible and intangible value

Among the interviewed couples, a difference in types of business value can be observed. Two of the three interview couples are concerned with features that are very difficult to observe in practice and no hard monetary value or number can be assessed. The other interview couple is involved with subjects where it is actually possible to observe value, through for instance metrics in the applications, simulation, and A/B testing. These types of business value can be distinguished as respectively intangible (soft) value and tangible (hard) value. Eight respondents mention this difference in business value directly or indirectly. As mentioned by two business owners representing the intangible business value, "this might be the reason why it is much harder to justify a feature proposal in comparison with features where you can actually observe the value". One given example was that it is easier for conversion rate to be translated into a monetary value than for customer satisfaction. They thereby mentioned that they welcomed the idea of making their intangibly valuable features tangible for the outside, and "finally making intangible value comparable with tangible value". This is in contrast with the tangible group, whereby a product owner mentioned that there is no need for any type of value assignment. The respondent mentioned that they are actually able to prove the value for themselves and to others through tested hypotheses.

4.1.2 DIMENSIONS

Customer value

As part of the business value of a feature, the customer value is approved by all the respondents. Two business owners even pointed out that "everything is somehow traceable to the customer value dimensions". One of the dimensions as part of customer value is customer satisfaction, which was mentioned earlier in the definition section. Negative value is another dimension that was directly or indirectly stated by three respondents. Two of them directly acknowledge such a dimension, and another mentions that one should consider business value also as the value one loses when not implementing a feature, or the delta of the value of the software when implementing and not implementing a feature. The value of a feature should also be related with the influence on the competitive position of the organization. Implementing a feature that the competition has but you do not, offers a competitive advantage to a certain extent.

As a business value dimension, improving the competitive position was mentioned three times, by statements such as "implementing a feature the competition does not have".

Product value
Business and development are considered to be two substantial different aspects in feature development. All the respondents confirm the distinction between product and customer value. Product value is considered as a different part of the business value that cannot be captured by customer value. Product value was especially marked as important from the development perspective. As one of the respondents mentioned: "It is more than just euros, it is also about improving code". When only the customer value is represented in the business value construct, many of the features now being developed cannot be justified. There were many statements by six respondents regarding development dimensions that support this as follows: (a) software quality including performance, (b) technical enabler, whether a feature offers a technique that enables software related opportunities in the future, and (c) technical debt, which is improving old code that requires refactoring before moving on. Also architecture and building software from scratch was mentioned, which generally speaking can also be seen as technical enabler.

Relation between customer and product value
Creating value to the customer is most important according to all respondents. As part of that, statements such as "the IT facilitates the business" and "development is an important side issue", and "development indirectly adds value to the customer" were commonly heard. From the business as well as the development perspective, the relation between business and development in business value is mainly in favour of the business, but the ratio varies. Ratios indicating the share in business value of business/development varied from around 80/20% as stated by business owners, to 60/40% and 50/50% by the others. A product owner thereby mentioned that "although product value is important, you don't want to focus too much on technology and as a result lose customers".

Internal value
Employee satisfaction is one of the internal value dimensions that is being recognized by ten respondents over difference roles, with the development team in particular. For instance, two team leaders and a business owner consider it as fairly important, as "unsatisfied and/or unmotivated personnel work less efficiently and thus create less value". According a team leader and a product owner productivity and efficiency was also mentioned as important. They consider it as part of the value to a business, as it might reduce costs by being more productive and efficient. However, five respondents also consider the internal dimensions subservient to the creation business value. For instance, it is stated that "the internal value must be in place before and during feature development". They consider it as something that is self-evident. For instance, in the case of employee satisfaction, it was stated that "personnel should just do what they are asked for".

Time dimensions

According to some respondents, time as an influencer on the value should be included as well. Five respondents mentioned that it takes time to deliver a determinable amount of value after release. It was argued that a feature may not realize its value directly after release. This also relates to what some have mentioned, which was that it takes time to actually develop and release the feature so it takes time for a feature to deliver its value. Another part of the time dimension was the issue of a feature becoming technical debt at one time in the future, and also the sustainment of competitive advantage over time. This was mentioned by two team leaders and one business analyst. Furthermore, one of the business owners mentioned this whole time dimensional concept as the (Net) Present Value, and confirms that for feature development a feature might lose its value during a certain amount of time.

Conditionality and impact

Something that was mentioned six times during the interviews, was the (technological) conditionality of features. Some features are required to be implemented first before other future features can be developed. Another remarkable thing was that the impact of a particular feature upon other implemented features was also mentioned by a product owner and a business owner. For instance, earlier implemented features may benefit or eventually be harmed by to-be-implemented features, making the bundle of the two or more features more worth than each feature individually.

Weighing dimensions and business strategy

Although it was not a broadly discussed matter, weighing of each small business value component was discouraged. One of the respondents mentioned that adding weight to a certain dimension would not work. This because of the differences within the organization about what is important over the many stakeholders. However, this cannot be confirmed by others. If weighing is to be carried out, the opinions among the stakeholders first need to be aligned, creating consensus on what is important and what is not. This also corresponds to something that other respondents pointed out, which was that the strategy within the organization should determine the focus on certain business value aspects.

4.1.3 DETERMINATION IN GENERAL

Cost analysis

Seven of the respondents also mentioned that business value cannot be separated from an analysis of cost and effort to generate the value. Although it was not the main focus of the interviews, the respondents mentioned the needed effort in hours to develop a feature, and extra costs such as licence costs, server costs, et cetera.

Risk analysis

Something that was mentioned by three respondents, was that risk analysis cannot be separated from business value and should be included as well. During the prioritization process, it is important to know apart from what it values and costs, how much risk there is of implementing the feature. Risk in this case was defined by the respondents as the

likelihood of actually losing value because something was implemented in such way that it is leading to a negative effect. This then should be complemented by the impact of the risk, by estimating how much value is possibly being lost.

Formulation of a business case

Eight respondents made the connection of business value analysis with a business case. Three of them pointed out that the determination of business value of a feature prior to development should actually be the formulation of a mini business case. In such a business case, the costs and profits of a feature are being calculated to justify the realization feature prior to development. According to one of them, it usually takes a lot of time to do this precisely. However, according to a business owner they are very good in formulating the business cases, mentioning a deviation of 10% in estimated value and costs. The estimation of business value without formulating a whole business case is an operation that is determined to cost less time, but as such also brings an uncertainty factor of actually achieving the estimated business value in the end. Two of the respondents mentioned that it might be useful to include a factor that accounts for the uncertainty that a given business value will be delivered.

Learning

Seven respondents mentioned that being agile in software development is also about learning. This includes two parts. The first part is learning after a feature is released, so the estimation and prioritization might be improved in the future. The second part is during the prioritization and the development of a feature. This was mentioned as trial-and-error, which is a cooperation of development and the business in whether a feature would work or not. This way, one can then attempt to see whether a feature indeed has the potential to deliver its value or not, and as such learning by trying.

Simplicity

Other important feedback from multiple respondents was that the method should be kept as light and simple as possible. When the assignment method requires too much work or is too comprehensive, it will basically not be used, or only partly, or rushed through leading to incorrect data. As three respondents noted: "keep it simple", "keep it agile" and "do not surpass its purpose". As part of that, the method should be as little paperwork as possible, and requiring minimum standardized procedures with few extra regular consultations. This was pointed out by two respondents as otherwise this would work as a disadvantage to the adoption of the method in the agile organization.

Support and adoption

The interviewees unanimously responded positive to a method in value assignment during the prioritization process. According to the business owners, there is no transparency in the decision making of feature prioritization. Business owners do not know how features are being prioritized, and mostly do not understand how a certain feature was prioritized before another. Furthermore, there is a lack of objectivity in how the prioritization is carried out. Three business owners mention the political influence of individuals on which features should be developed first, although the same feature

deliver less value for money than others. Some of the development roles mention that they sometimes doubt certain decisions. As such, there is a great need for a solution that ensures the provisioning of transparency and objectivity in feature business value, so the prioritization will be less impressionable. Despite the encouragement of determining business value in software development, one product owner had a mixed feeling about such an assignment method, as the person was not a supporter of standardized forms.

4.2 ESTIMATION OF BUSINESS VALUE

During the interviews, the respondents were asked about how some aspects regarding the estimation of business value. First, the roles and responsibilities for the method are being summed up. This is then followed by how the input for business value of a feature should be derived. Last of all, the output of the business value will be discussed.

4.2.1 ROLES AND RESPONSIBILITIES

Business owner

As noted by all respondents, the business owner is seen as the main stakeholder and client in developing features. To take that even further, according to the business owners and the product owners, the business owners should be the ones that are mainly responsible for achieving the results of a feature. Furthermore, according to two of the business owners they are the only ones that can determine how valuable a feature really is, especially from the business perspective. However, development affairs are considered to be something that the business owner has less affinity with and should be handled by the ones that do have the expertise in technology. As a business analyst and a team leader stated, "the business knows too few to say something meaningful about technology issues". The data thus suggest that business owners should only focus on business affairs, leaving the development and technology affairs up to the product owners and the development teams.

Product owner

The product owner is seen as a representative for the business owner. The business owner has not enough time and knowledge to manage their product ownership in a proper way, thus delegation is needed. The respondents agree that the product owner is responsible for determining the definition of a feature, the "what", and furthermore to prioritize the features in the backlog. Especially the prioritization of features was mentioned as their main responsibility, which was directly stated by five respondents. According to a business owner, they are supposed to be responsible for mapping the ROI of all features as part of the prioritization, which suggests the analysis of the potential business value and the associated costs. The respondents further suggest that the product owner therefore should be the one that is the owner of the value assignment and the whole process around it. However, how valuable a feature really is, is something that should be discussed with the business owner for the business aspects and the development team for the technology value. On the other hand, two respondents (a business analyst and a team leader) addressed the potential risk of a product owner

focusing too much on the business side. In addition, it was pointed out that external product owners might only look at the short term effect of a feature, due to a temporary contract and self-interest.

Development team

Three main roles within the development teams can be distinguished among the respondents: The team leader (or scrum master), the business analyst, and the developer. Among these roles there is a mixed opinion about whether or not the development team should be consulted for business value assignment.

According to the team leaders, they are mainly focused on the internals of the team, such as streamlining the process and offering the best workspace for the developers. They make sure the developers can do their work properly. As such, the leader of the time is able to provide input on the contribution of a feature to the internals of the development team, and less on the contribution to content, technology and development.

Business analysts have a special purpose within the development team. According to them, they are appointed to analyse the technical and business requirements of a features, its impact on other features and process in the organization, and how in which order and manner the development of multiple stories should be approached. They are also involved in estimating the effort and are aware of general technology affairs, such as the technical debt of software and technical enabling abilities of upcoming features. According to a business analyst, "they should be the ones that are to be primarily consulted about value assignment regarding technology", all-in-all suggesting more of an advisory role.

Developers have a lot of knowledge about technology that may be of use for business value estimation. During the interviews this was mentioned as an opportunity multiple times, as it can be used as a technology push towards the business. For instance, developers know more about how a feature should be approached using techniques that might shorten development time for its value, or might enable other features in the future. They also know more about the technical debt of certain implemented technology, in terms of aging, possibilities, etc. On the other side, business aspects are not one of the main interests and is also not supposed to be within their expertise. Their input on the business matter is thus very questionable, and as such can only give valuable input on technology contribution. As also mentioned by four respondents, the developers should therefore be involved as a secondary advisory role on technology, eventually on demand of the value assigner. According to a team leader, the development team should be more focused on the costs and effort to develop a feature besides the required technology.

Dedicated assignment role

A remarkable statement of two respondents was that there should also be a dedicated role for the assignment of value. This role is mentioned separately from the product owner role, whom was also mentioned as part of the value assignment process by the same respondent. The dedicated assignment role should then secure for independency

during the value assignment. However, it was not further discussed how this should take place in practice.

Interaction between roles
As noted by three respondents, involving too many people into the value assignment process may slow down the acceptation of a feature, and create a lot of overhead on the roles involved. It should be kept as simple as possible. However, to make sure that value assignment is conducted correctly, respondents mention that the value assignment should be split into multiple roles and phases. First of all, business owners should be mutually in discussion about their demands and get consensus about it. It was mentioned by a business owner that strategy alignment is required first, otherwise no consensus can be achieved in which features are currently important. Secondly, all business owners note that the business owners should also be cooperating with the product owner in assigning value and prioritizing features based on business value. The business owner knows a lot about what they require from a business perspective, and the product owner knows about the business as well as the development perspective. As such, the business owners and the product owners should be working together. Lastly, the product owners should be cooperating with the development team about the cost structure in terms of effort, and what the value is from the product technology perspective.

4.2.2 INPUT
To make the business value assignment possible, a means to enter the data over the different stakeholders should be offered. During the interviews, the usage of a form or canvas to enter the required data for business value revealed inevitable. Whether the data is hard or soft, somehow both the data should be resembled into one place for later (manual or automatic) analysis. In which way the data entry should take place according to the respondent, will be discussed in the upcoming sections.

Value assignment
Eight of the respondents mention that it is much easier to assign value in relation to a certain baseline rather than exactly shouting a potential value. Especially among the product owners, business analysts, and team leaders, relative assignment seems to be the preferred way of assigning value to a feature. Two types of relating were mentioned in the interviews, which are 'relative to key-feature' and 'relative to competition'. According to the respondents in favour of relative assignment, it is easier to say that a feature delivers more or less value than an earlier widely familiar situation, requiring less skills of estimation. However, a business analyst mentioned that there might be interpretation differences of a certain baseline, and as such recommends the usage a monetary or point assignment. On the other hand, a product owner mentioned that absolute assignment of business value may be prone to invalid input as well, as the assigner may be favourably assigning towards a certain desired output. Furthermore, a product owner stated that "absolute assignment greatly depends on the ability of the assigner in calculating the exact potential value of a feature".

A business owner and a product owner gave the feedback to work from abstract to concrete in value assignment. This way a feature can be tackled early in the acceptation phase, preventing a lot of work to estimate in detail how much value it delivers.

Value on (non-)implementation
Something that was mentioned four times during the interviews, was that value should not be assigned just by how much it delivers. As part of the negative value, one should also assign how valuable your software is when you not implement a certain feature. This covers the value you lose when you not implement a feature. However as mentioned by two respondents, this kind of value assignment should also be accompanied by the amount of value you realize when you actually implement the feature.

Descriptive choices for soft value components
For features that are too soft or intangible for respondents to assign a value, one of the respondents mentioned that the usage of descriptive labels would be more appropriate and intuitive. The assigner then receives a range of descriptions to choose from, and pick the description that is closest to the potential value of feature. However, this was pointed out only once.

Guidance through questions
Three respondents mentioned that the usage of questions instead of value components might work more intuitive. It was stated as "filling in a form of a predetermined list of questions (…) resulting in a certain amount of business value". Questions give the ability to describe the aspect, where just using dimensions is more open to interpretation issues. The direct usage of dimensions or components of the model therefore is discouraged by some respondents.

Requiring descriptive input
Three respondents mentioned that it should be required for the assigner to write a short description per business value aspect. A product owner thereby mentioned its purpose of "making the assigner actually think thoroughly about how the value is being created", "explaining what you have filled in to others", and "feed for discussion". Furthermore, another respondent mentioned that it makes sure that the value assigners "are not just filling in something just to be done with it".

4.2.3 OUTPUT
When all the data regarding the business value components are gathered, all the business value components should also be presented to the different stakeholders. All the respondents preferred business value in the form of a monetary unit. As mentioned, "money as a unit has a meaning in itself", and "everyone can relate how big a certain monetary value is".

One of the business owners mentioned that normalizing the business value to a single monetary value hides the underlying structure. This structure however is important for decision-making during the prioritization process. For instance, when a feature has roughly the same output as another feature, how do you still prioritize the

two objectively? Then it would help to have insight in the variables that build up the output, and as such have extra tools for decision making. The same respondent proposes the use of a Pugh-matrix, which displays per value component its positive and negative influencers.

Beside the monetary value, a product owner mentioned that business value is not only money but also emotion. Mainly for prioritization purposes it is important to capture emotion in the output in the form of quotes, eventually per value component. Then the decision maker can interpret the component each by each, primarily based on exact values, and secondarily on emotion. However, this may then be vulnerable to subjectivity and political decisions, whereas objectivity in decision making was one of the requirements from some business owners.

4.3 MEASUREMENT OF BUSINESS VALUE
After a feature has been released, the features should be measured to make it possible to evaluate afterwards how well the estimation performed. Less feedback was retrieved from the interviews about measurement than for estimation. However, there are some valuable remarks regarding the input, output, and usage of the data during the evaluation. This section will be discussed in that sequence as follows.

4.3.1 INPUT
Three respondents mentioned that the measurement of business value should be based on hard rather than soft value assignment. Furthermore, seven respondents agree upon the activity of making a measurement plan, consisting of what is measured, how and when the data should be retrieved, and what the target is. According to three of them, the measurement plan should be formulated in the feature definition stage. This way the measurement is approved upon right before development, and cannot be manipulated during the development process. If done correctly, it should be possible to relate the gathered data with the predefined target. The relation between the observed data and the target can then be expressed as a percentage of achieved value.

4.3.2 OUTPUT
The respondents mentioned that the achieved business value is best presented in a monetary unit. According to two business owners, one way to do this is by taking measures which are close to the financial value of the organization, and as such trace it down and outputting the contribution in a monetary unit.

According to the respondents, the measured business value is something that should be presented to the business as well as development. The respondent from the development teams mentioned that they want to know what they do it for and what they have achieved by developing a certain feature. Although more part of business value estimation, they also mentioned that they want to know prior and during the development process how much value is going to be created, for which the estimates can be used. According to three of them, it has motivational purposes for the development teams.

4.4 SUMMARY

A lot of statements have been done about the business value in general, how it should be estimated, and how measurement should take place. Regarding the business value concept, the respondents have mentioned matters concerning the definition, dimensions and the its determination in practice. By demonstrating the business value dimensions, they were giving sufficient feedback regarding business value as a multidimensional concept so a business value model can be proposed based on this. Concerning the estimation and measurement method, the most feedback was gathered about how the estimation should take place. The results about the estimation method mainly concern the roles, the assignment of business value, and how it should be outputted. However, the results for the measurement method are less explicit, and basically implies the formulation and execution of a measurement plan for each feature.

The next chapter will continue by how these results come together. It will further analyse the data and put it in relation with the literature and the theoretical guidelines as stated in the conceptual framework. This eventually results in a proposal of a business value model and a set of guidelines for determining business value in agile projects.

5   ULTIMATE ARTEFACT

Based on the interview results of the previous chapter and what is discussed in the literature, an artefact can be designed to make it possible to determine business value in agile projects. The artefact mainly consists of three main parts that are interrelated and correspond to the main parts of the conceptual framework. The first part is a proposed model for representing the business value of a feature in agile projects. The second and third part are the business value estimation and measurement method, which use the proposed model. This chapter will discuss the results in relation to the conceptual framework. It will end by discussing its intended use in practice and the evaluation of the artefact regarding its objectives.

5.1   BUSINESS VALUE MODEL

To draft the model, the respondents were asked about their definition of business value from their perspective. They were also asked for the dimensions and constructs business value consists of, based on the dimensions in the conceptual framework. Figure 4 depicts the business value model that emerged from the analysis showing the relations between the components. Business value in the context of agile software development is a comprehensive construct that is not only a financial affair. It consists of various components that sum up to a certain financial value, complying to theoretical guideline TG1d.
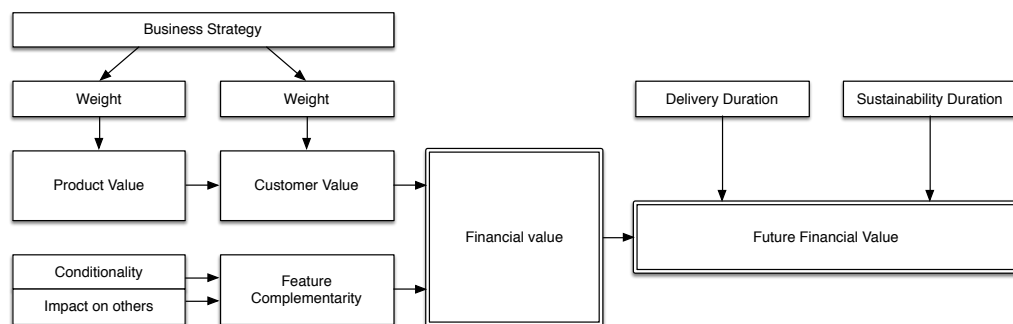

Figure 4: Feature business value in Agile projects

Internal dimensions such as employee satisfaction and competence growth are not considered part of the business value construct, as was stated otherwise in literature (Heidenberg et al., 2012; Qumer & Henderson-Sellers, 2007b). Instead, they were seen by the respondents as a phenomenon that is evident prior to development and is not part of the value that is being realized by the development of a single feature. Although one can consider it as part of the value to businesses in general (satisfied employees might work more productive and efficient in the end), it is not something that is contributed to

by feature development. This means that employee satisfaction, competence growth, but also value to team/process/workspace are not included in the business value model. When looking into the proposed business value model, one can observe the constructs that are included – which are product value, customer value, feature complementarity – and the output (future) financial value that results from these dimensions. Each of the constructs and the linkages among them are further discussed below.

Financial Value
The business value of a feature is the financial impact to the organization to which the feature is developed for. Many respondents mentioned that financial value is not part of the multidimensional concept of business value, it is a result of all the activities that directly or indirectly create profit or reduce cost. This is also in accordance to literature, mentioning that business value is purely the financial impacts on an organization (Lee, 2001), meaning that all the dimensions in the business value model are summing up to a final financial outcome through cost reduction or profit creation (Amit & Zott, 2001). In the literature, the financial dimensions 'revenue creation' and 'cost reduction' were sometimes mentioned as part of the multidimensional concept of business value (Sobiech et al., 2015), together with other non-financial dimensions. Cost reduction and revenue creation should then be captured in dimensions that are indirectly involved in contributing to these two dimensions, such as 'sales creation' for revenue creation, and 'efficiency', 'productivity', 'inventory reduction' for cost reduction.

Future Financial Value
By analysis of the data, the model includes two time dimensions that influence the business value over time after release. This also complies to theoretical guideline TG1h, stating that business value changes over time (Hartmann & Dymond, 2006). The two dimensions found in the results affect how the maximum financial business value of a feature increases and decreases over time.

The first dimension is the delivery duration, which is the required time to deliver a certain value after release. Business value is considered not just to be delivered directly at release, but it may take some time for it to manifest. One can also think of development time in this case, as it takes time to develop a feature. However, this can also be seen as part of the cost analysis of a feature.

The second dimension is sustainability, or the amortization over time, which is the amount of time a feature sustains its value after release. A feature will eventually amortize over time, whereby one feature sustains its value longer than others. For instance, when a feature mainly delivers value by having advantage over the competition, the value will vanish when the competition imitates or substitutes the feature. When not including the sustainability of a feature, it is implied to sustain forever in the organization. Especially in the e-business environment, the software is built on software technology that is vulnerable to change and will be deprecated at some time in the future.

However, one can argue about whether the two time dimensions are actually part of the business value, or that it is an external factor that just should be taken in

consideration during the prioritization process. They at least offer opportunities for decision-making during the prioritization process regarding how the business value of a feature behaves over time. For instance, two or more features with the same amount of value may now be distinguished from each other by preferring a feature with quicker delivery duration and longer sustainability over the other.

Customer Value
The customer value construct consists of all dimensions that create value for the internal customers – or the business owners – by increasing revenue and reducing costs.

Most of the respondents mention serving the external customer and customer satisfaction as the most important aspects in creating the value to the e-business. This can be explained by the assumption that a satisfied customer is more willing to (re)participate in a transaction. For instance, new customers that come to the website only purchase products when they are satisfied enough. Furthermore, when customers were satisfied with their last purchase, they are more likely to come back in the future and purchase even more products. This is also explained by Amit & Zott's value driver 'lock-in' (2001, p. 13), which states that "*value-creating potential of an e-business is enhanced by the extent to which customers are motivated to engage in repeat transactions (which tends to increase transaction volume)*". This regards the features that are directly exposing functionality to the user of the software to make new customers purchase products, and satisfying them to return again and increasing the chance of the customer to return and buy again.

As part of the customer value construct, the following dimensions can be distinguished:

- Customer satisfaction (main driver)
- Competitive position
- Strategic value
- Market enabler
- Tertiary value
- Sales creation (e.g. conversion rate)
- Efficiency (as part of cost reduction)

Product Value
One of the constructs of business value is the product value, which includes all the value that is created for the software. This relates to any kind of mutations to the software which are required to indirectly support and enable the transactions between the external customer and the organization. The mutations regard invisible changes to the architecture, fundamentals, and code of a product that don't directly affect the user in any way. Likewise, the product value can be considered as the value that is being added by providing an environment to enable the creation of customer value.

When business value does not include for product value, one is missing on a substantial part of the business value. In fact, the unit of analysis is currently renewing their software architecture for the sake of being more flexible in the future and having better software performance. A substantial part of the capacity of the development

teams are concerned with this renewal. If this technology affair was not part of the business value, then building the new architecture could never be justified. This is also in accordance to theoretical guideline TG1c, stating that IT affair also should be considered in feature business value (Favaro, 2003; Hartmann & Dymond, 2006).

As part of the product value construct, the following dimensions can be concluded from the literature review and from the interviews that should sum up to the resulting product value:

- Software quality
- Fixes errors
- Technical debt
- Fixes errors
- Performance
- Technical enabler
- Efficiency

Business Strategy

The business strategy needs to be aligned and state clear how parts of the business value need focus. As also according to (Favaro, 2003; Matts & Pols, 2004), the objectives in the business strategy should be taken into account (guideline TG1f). This determines to what extent the product or customer are of value to the organization. Does the organization value future readability through implemented techniques, neat product code, or zero fault tolerance? Or is it more important to satisfy the customer? In the case of the unit of analysis, the business perspective of business value was considered most important and biggest influencer in business value creation, being the customer value of the model. Doing so, the development perspective in terms of product value was considered to be less valuable. The statements on these ratios and the importance of dimensions were mixed among the respondents. This suggests that the definition of business value and which dimensions are important, indeed varies within (Z. Racheva, Daneva, Sikkel, & Buglione, 2010) and presumably also among organizations (Jim Highsmith, 2009; Sobiech et al., 2015), complying respectively to guidelines TG1a and TG1e. Weighing as suggested by Sobiech et al. (2015) would provide a solution in this case, with the purpose to make some dimensions more important than others in (guideline TG1g). Likewise, weighing would also be applicable to one of the sub-dimensions in the product and customer dimensions that are part of these two dimensions. For instance, the customer satisfaction might be assigned a substantial higher weight than others, as it is marked as an important driver for the e-business organization.

Feature Complementarity

A feature may have positive/negative impact to the value of other existing features, which as such should be included as well. This component consists of two possible expressions, that is the impact on earlier features and the impact on future features. For instance, when a feature makes it possible to increase the usage of another feature,

because of a teaser or further linking, then that feature also benefits from the implementation. The impact on future features can be seen as a feature that is required to be implemented before another feature can be developed. Sometimes you have two features whereby the second feature has a greater value than the first feature. However, the first feature might be required to implement the second value with more value. You can consider the first feature as becoming more valuable, because of the existence of a future feature. If that future feature was not existent, there is less reason to develop the required feature, and thus degrading in business value to the business. Likewise, it should be possible that a feature due to conditionality can still be prioritized over others with higher potential value during the prioritization process. The impact on earlier and future features can be summarized as the value complementarity of a feature, which is also in accordance to Amit and Zott's e-business complementarity value driver (2001), mentioning that making the bundle of multiple features more worth than each feature individually.

5.2 ESTIMATION METHOD

Business value estimation takes place by using a form – or some other kind of input device – to manually assign value to a feature during the prioritization phase. Using the multidimensional model for this purpose, it is possible to split the estimation of business value into several components – in this case the dimensions – and progressively coming towards a more comprehensive estimation outcome. Based on what is discussed in the interview results and in the literature, an estimation method can be proposed to guide the value assignment process. This method consists of guidelines for estimation regarding the involved roles, handling of input, and the desired output of the estimation. These guidelines are put in relation with the conceptual framework as resulted from the literature review, and with the proposed business value model. The twelve guidelines that resulted from this study are further discussed in the next sections.

5.2.1 ROLE GUIDELINES

Guideline 1: Determine a dedicated role functioning as business value intermediary

One of the things that was stated by the respondents is that there should be a dedicated independent role for determining business value. Most ideal would be to have an independent role that knows both sides of the business value, which is the business and the development parts. He or she is then suggested to gather information from all the stakeholders, and assign the value to all the dimensions of business value. According to the literature (Favaro, 2003; Hartmann & Dymond, 2006; Z. . Z. Racheva et al., 2008; Torrecilla-Salinas et al., 2015) only the business or any of their representatives are able to determine the business value of a feature (guideline TG2a). After analysis of the interview data, the product owner is considered to be the representative of the business stakeholders and also the appointed role for assigning business value to features.

Guideline 2: Business stakeholders should mutually discuss before doing a feature request

The business owners should first discuss with each other which features should be requested. This guideline is only applicable to situations where there are multiple business stakeholders concerned with requesting features at the agile organization. Multiple stakeholders probably have multiple interests, which in turn means various different kind of features being requested. Each stakeholder has a lot of features in the pipeline they want in the software, however there is not always sufficient capacity to cope with all the features. This is also the case for estimating business value: it will be too much work to estimate the business value for all the features at once. This is also in line with the feedback of two respondents about that estimating should be done first in an abstract manner, and making it concrete eventually.

Guideline 3: The business stakeholder is the main owner of business value

As resulted from the interviews, the business owner, if any, is considered to be the main stakeholder of the business value a feature delivers. They are the ones who came with the feature request after all. However, not all parts of the business value model are within their reach, especially the technology parts. Therefore, they are recommended to determine the customer value of the feature only, either together with the product owner, or at least give advice about the customer value.

Guideline 4: Development teams as advisors for technology

The business doesn't know enough about technology to make proper assumptions about feature business value, which was mentioned by some of the business owner roles. This also connects to what was said about leaving everyone in their expertise. It suggests that the development perspective should be taken into account as well, corresponding to guideline TG2c (Heidenberg et al., 2012; Jim Highsmith, 2009; Logue & McDaid, 2008; Z. . Z. Racheva et al., 2008; Z. Racheva, Daneva, Sikkel, Herrmann, et al., 2010; Sobiech et al., 2015; Torrecilla-Salinas et al., 2015).

When looking at the business value model, the developers might give valuable feedback on the sustainability/amortization of the used technology for a feature. Furthermore, they can advise on how big a feature's impact will be on product value in terms of development productivity, impact on the performance of the software, quality of the code, and how great the need is to fix technical debt or errors. This confirms theoretical guideline TG2b that the business should determine the business value of a feature in collaboration with development (Jim Highsmith, 2009). It is however slightly in contradiction with guideline TG2a, stating that only the business or one of their representatives should be able to determine business value (Favaro, 2003; Hartmann & Dymond, 2006; Z. . Z. Racheva et al., 2008; Torrecilla-Salinas et al., 2015). However, in this case development teams are only advising on business value, not determining it.

Guideline 5: Gain support among participants

Transparency calls for challenges regarding the adoption of the method. Due to the exposed objectivity during the decision making of prioritized features, there is less

chance of political influence to succeed. This might lead to resistance among the ones that are usually dependent on such influence. Furthermore, resistance among the ones that should use the method is also inevitable. Despite the encouragement of making business value hard during the whole development process, one of the respondents had a mixed feeling about an assignment method, as the person was not a supporter of standardized forms. This corresponds to what another respondent mentioned: everyone should be willing and dedicated to the task of value assignment, otherwise it will just not be used, or only temporary. Creating consensus among the users and convincing of the goal of such a method is thus an important aspect. Convincing all the users and stakeholders of the benefits of the method and reserving time for the usage of the method is therefore key to correctly implement the method.

5.2.2 INPUT GUIDELINES

Guideline 6: Use relative value assignment with the business value model

It is recommended by the respondents to use relative business value assignment for business value estimation. Relative assignment comprises the comparison of a subject feature with a generally familiar key scenario or feature. In comparison with relative assignment, absolute assignment includes assigning hard output numbers to a feature, having no baseline to compare to. The relative assignment have some benefits over absolute assignment, as also corresponding to guideline TG2g (Jim Highsmith, 2009; Torrecilla-Salinas et al., 2015), which will be discussed as follows.

Relative assignment is mentioned by the respondents to be less dependent on estimation skills. One can indeed say that it is easier to estimate that a feature is two times better than another feature, than to say exactly how much money it might bring up based on assumptions. Furthermore, favouring towards a desired outcome might be reduced by not showing directly how much value is being realized by the feature. Thus, relative assignment might make the estimation of business value more accurate and valid compared to absolute assignment.

In line with accuracy, another benefit can be implied. According to the interview results and the literature (Kautz et al., 2014; Patton, 2008; Z. Racheva, Daneva, Sikkel, & Buglione, 2010; Schryen, 2013), the method needs to deal with the assignment of tangible as well as intangible values. The former group is often more easy to estimate or even measure than the other, because it is more close to the financial results of the organization or directly observable. Both the tangible and intangible business value types then require different data entry possibilities, which are hard and soft value assignment. However, you generally want to represent both value groups, in a way that they are comparable but both groups are satisfied with the assignment. For this relative value assignment is applicable to both.

Guideline 7: Use questions to guide the value dimensions

It was preferred to use questions in a form for the business value assignment of a feature. It was mentioned that it would eventually introduce the assigner into the topic, and it guides the assigner towards the output business value in a more user friendly way. Just

asking how much business value a feature potentially delivers compared to a baseline feature in percentages might evoke questions. For instance, what does that dimension actually mean? What does that baseline feature mean? Using questions to introduce business value dimensions might help to prevent interpretation issues in this case, as the meaning of a dimension is more explained.

Guideline 8: Use positive and negative value assignment
It is not only about the value you deliver with a feature, but also about the value you actually lose when you not implement the feature. By literature this is mentioned as the negative value of a feature (Z. Racheva, Daneva, Sikkel, & Buglione, 2010; Sobiech et al., 2015). In most cases the state of the software remains the same when a feature is not being implemented. Then, when a new feature is being added, the total value of the software will probably increase. However, some features being proposed might increase the total value of a product, but also decreases a software's value if not implemented. For instance, when a feature is already implemented by the competition, the competition has an advantage. When not implementing the feature, the value will lose value regarding competitive position over time.

Guideline 9: Describe and explain the value assignment
The value assigner should write down his or her assumptions about the value assignment to each dimension of the business value. This makes the value assigner think about how the value is actually created, and as such justify it on paper. This also captures the emotion and intangibleness behind certain aspects of business value, which was also a requirement among multiple respondents. The written descriptions can be used to better interpret the business value that was assigned to a feature during the prioritization process, also making it feed for discussion.

Guideline 10: Cope with uncertainty
Many of the respondents mentioned that the determination of business value of a feature prior to development is actually the formulation of a mini business case. In such a business case, the costs and profits of a feature are being calculated to justify the realization feature prior to development. According to one of them, it usually takes a lot of time to do precisely. The estimation of business value on the other hand is based on quick assumptions and something that is supposed to cost less time, but as such also brings an uncertainty factor of actually achieving the estimated value. Therefore, some of the respondents mentioned that it might be useful to include a factor that accounts for the uncertainty that a given business value will be delivered.

5.2.3 OUTPUT GUIDELINES

Guideline 11: Represent business value as a monetary value
Although the business value was also presented in the business value model as a financial result or impact to the organization, it also needs to be presented as such. Everyone knows what monetary value means. When presenting business value as value points for instance, it is still left to an individual's imagination of what a point means making it prone to interpretations issues.

Guideline 12: Provide meta information with the estimation outcome

The business value of a feature should not only be shown as a single monetary value output, but should also be accompanied by meta information. This was not hypothesized beforehand, but was mentioned by the respondents. The meta information includes all the constructs that resulted in the final output, for instance the value assigned to each dimension of the business value model. Furthermore, the justification for the business value assignment should also be included as a result of guideline 9. The meta information guides the interpreter or decision maker by clarifying the assigned value to the dimensions during the decision making process.

5.3 MEASUREMENT METHOD

In this study, a method is proposed as an attempt to make business value measurement possible after feature release, as there were no concrete proposals found in literature. One guideline can be concluded, which will be discussed next.

Guideline 13: Formulate and execute a measurement plan for every feature

Business value should be kept close to the financial results of the organization, as was mentioned by the respondents and also by literature (Favaro, 2003; Hartmann & Dymond, 2006; Z. Racheva et al., 2009) in guideline TG3b. Furthermore, according to the respondents the business value should be measured by pure data hard instead of soft value assignment, to provide for objectivity, more valuable inferences and making it less prone to bias by interest in a positive outcome. However, it is hard to make inferences about how the data financial results of an organization relate to the release of a certain feature. To overcome this, the formulation of a measurement plan during the definition phase – prior to development – is proposed, comprising the following aspects:

- What is exactly being measured?
- How should the data be gathered?
- When should the data be gathered?
- What is the target of 100% business value?

However, it is questionable whether the execution of the measurement plan provides a reliable insight into the achievement of the business value. Tracing feature business value in financial results of an organization is too specific to the implemented feature and cannot be simply generalized into a single method. It leaves the measurement up to be determined per situation by the different stakeholders. When it is not possible to conclude the business value as financial outcome from the available data, another way to consider is to take the percentage of achieved value from the target value, and layer it over the estimated value for that same business value.

5.4 INTENDED USE

This section discusses how the business value model and the guidelines within the estimation and measurement method come together in practice, and how it applies to the agile workflow.

The proposed business value model is to be used explicitly for building up and finally representing the business value of a feature during software development within an agile organization in particular. The business value model can be used as a means to the input and output device for the estimation and measurement. The components of the model – product value, customer value, their weights, feature complementarity, delivery duration, and sustain duration – can be used to build a formula that results in the business value outcome of a feature. An example of the formula would be as follows:

$$ProductValue = \sum Dimensions * ProductWeight$$

$$CustomerValue = \sum Dimensions * CustomerWeight$$

$$BV = ProductValue + CustomerValue + ComplementarityValue$$

$$BVOverTime = BV * (1 - \max_{0 \leq x \leq 1}(DeliveryDuration - t))$$
$$* (1 - \max_{0 \leq x \leq 1}(SustainDuration - t))$$

The input guidelines for the estimation method can be combined into a form or canvas to guide the value assignment in conjunction with the business value model. Following the guidelines of relative value assignment in its simplest form and presenting the business value as a monetary value, a proposal for usage would be as follows. (1) determine a widely familiar baseline feature; (2) define the actual business value for each dimension as a monetary value based on real measurements or valid assumptions; (3) estimate the business value of a feature by assigning an outcome-ratio to each dimension related to the baseline feature; (4) multiply the ratios assigned to the dimensions with the actual corresponding outcomes of a given baseline feature. To explain this a bit further, say for instance that a subject feature is supposed to have 10% more value than a baseline feature on a certain dimension. Then, when the baseline feature has € 10,000 of value assigned to that dimension, the value of the subject feature's dimension can be estimated on € 11,000. Finally, (5) when done correctly, the sum of all calculated dimensions should lead to the monetary representation of the business value of a feature. While the example exclusively explains the estimation method, the model can also be used in the same way for the measurement of business value by assigning the observed value for each dimension.

Once the estimation and measurement methods are implemented correctly, it should provide a couple of key metrics during prioritization and performance evaluation. The methods should result in respectively *Estimated Business Value* and *Actual Business Value* per feature. When having those metrics, one can also calculate the *Estimation Accuracy* (*Estimated Business Value / Actual Business Value*), getting insight into under-estimation (outcome < 1) or over-estimation (outcome > 1). This can then be used to further evaluate and improve the performance of the estimation process.

Although the model and methods can be used to determine business value during the prioritization and evaluation of features, it involves more than just determining and using business value. Most of the respondents agreed upon the fact that business value analysis cannot separated from an analysis of cost or effort to generate the value. The respondents mentioned the needed effort in hours to develop a feature, and extra costs such as licence costs, server costs, et cetera. This also corresponds to what other authors mentioned (Jim Highsmith, 2009; Torrecilla-Salinas et al., 2015). Provided that cost estimation and measurement are also included, the business value metrics can be complemented by *Estimated Costs* and *Actual Costs* to consequently calculate the *Estimated ROI* and *Actual ROI*. Furthermore, risk analysis is also mentioned as something that should be included as well. Risk in this case was defined by the respondents as the chance of actually losing value, or something being implemented in such way that it is leading to a negative effect. Consequently, the metrics for business value, costs, and risk are effecting the decision making of feature prioritization: when there are features which are very valuable but also have high costs and/or have high risks, other features should be considered with better ratios of value, risk and cost. However, as also pointed out, it is not only about metrics: for prioritization purposes it should be complemented by meta information, showing all the variables and justifications for the estimated business value to support the decision making.

How the estimation and measurement method are interacting with the business value model in an agile project is depicted in Figure 5. The flow diagram implements the guidelines as depicted in this study, combined with the proposed business value model. It shows how the roles are involved in the process of estimating and measuring business value.

5.5 EVALUATION

To find out whether the artefact could be generalized, the artefact was presented to other organizations. Both organizations are comparable to the unit of analysis by the usage of the agile SCRUM method, however slightly differ in characteristics, business operations, and their agile organization maturity.

The first organization is a small organization of around 50 employees, of which the development director was interviewed. They are mainly focused on developing and providing ERP software for businesses. They are at the early stages of implementing the agile SCRUM software development methodology and allocated two dedicated development teams. The teams are currently renewing their software while maintaining the old, whereby the first team in particular is determining which features should be implemented first in the new environment. The business owners are recognized as internal (e.g. marketing managers) and external (customers buying the ERP software). There currently is no assigned dedicated product owner role active in the team.

The second organization as part of the evaluation is a large multinational e-commerce organization of over 2,500 employees, of which the product owner was interviewed. They are a wholesaler focused on providing products and services for
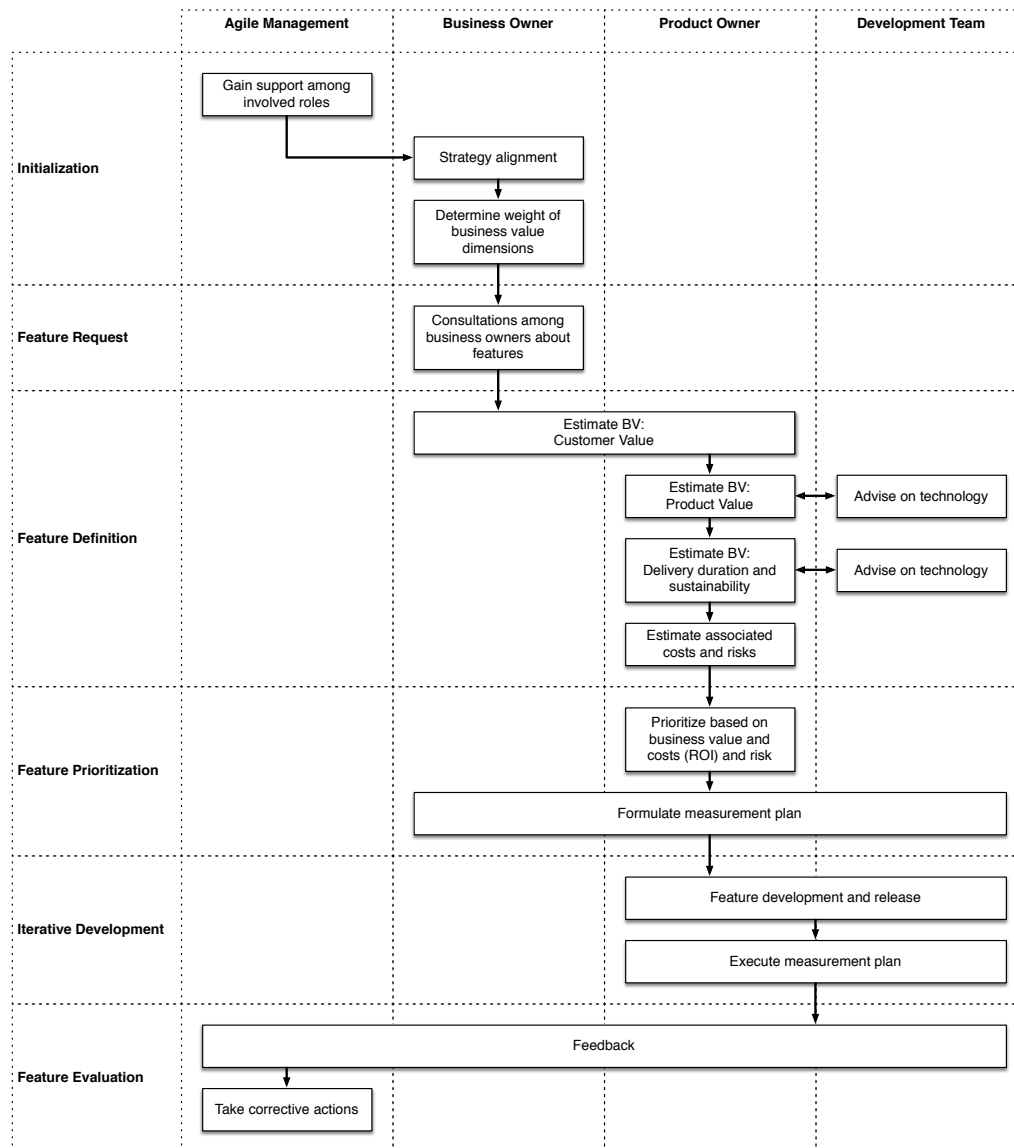
Figure 5: The Artefact in the Agile Process

agricultural businesses. Since three years they are implementing agile SCRUM to develop and maintain their software platform. The agile organization consists of nine teams with nine product owners and multiple business owners.

As to the definition of business value, the model was very much recognized. Both admit the distinction between product value and customer value, whereby the relation between product value and customer value was emphasized. For the first organization, the customer satisfaction and efficiency were recognized as the key drivers for business value. The interviewee of the second organization didn't mention any dimension in particular that was considered very important. Nevertheless, the interviewee very much recognized product value as an addition to customer value. Many features that just covers the software alone (architecture, framework, technology) are fundamental and required, but hard to justify to the business owners. He also wondered how this was justified in this model in the end. As an addition to this, the interviewee mentioned product value as mainly involving costs (low ROI) and the customer value as involved earnings (high ROI), thereby pointing to product value as a dimension that therefore

might be underrated in importance. He mentioned that the strategy therefore should be reserve budget for this dimension, mentioning an example of a ratio of 20/80 for product/customer value. As to the other constructs of the business value model, the feature complementarity was also recognized. But beside this dimension, the two time dimensions as part of future financial value were particularly emphasized by the first organization. The second organization also, but especially recognized the sustainability time of a feature as the amortization which is probably in a loop with the technical debt of another new feature. Both the interviewees affirmed that the internal dimensions are not part of the value delivered through feature development, although mention it as important in general. The second organization thereby added that productivity or efficiency should be an added dimension of product value, to cope with the value of faster development of features in the future.

Both very much welcomed the business value determination method for the prioritization of features. Currently, the first organization is prioritizing features by relative assigning points to benefit, penalty, cost, and risk to each feature, and as such determine which feature should be developed first. They mentioned that this relative assignment is used to make discussion easier, and as such affirmed the relative assignment in the determination method. The second organization didn't prefer absolute or relative assignment in particular, however mentioned that a form with a set of questions outputting the business value would be very helpful. Beside value assignment, both the organizations affirmed the interaction between the roles in the determination method.

It is hard to tell for both organizations whether the determination and especially the measurement method would work in their situation. The first organization is still struggling with the fundamentals of the agile methodology, and mentioned that they are not yet ready to actually implement the roles and teams are not in place as depicted in the method. However, they mention that the method might probably help them in their transition to further maturate their agile organization in the future. The other organization could not say for sure whether the method would fit into their organization, and especially whether business owners would actually adopt it.

Whether the determination method would work outside the organization is thus not tested in practice and therefore still open for discussion. Nevertheless, both organizations – small and big, e-business and non-e-business – encouraged and recognized the business value model and the determination method. This implies that the results might be generalized to other varying situations.

6 CONCLUSIONS

To support feature prioritization and evaluation during agile software development projects in e-business organizations, business value may play a substantial role. As related literature was very fragmented and described with a lack of consensus on this matter, this research has been set up to find out how business value should be estimated and measured. Therefore, the research question was stated as follows: *How can business value be determined for agile software development in e-business organizations?* To answer this question, a design science research process was set up, including a systematic literature review and semi-structured interviews, making it possible to design an artefact for the determination of business value. The results of this study were threefold.

First of all, a model is proposed to represent the business value of a feature in e-business agile projects, providing a foundation for its estimation and measurement. The model defines business value as a multi-dimensional construct having financial impacts on the client organization fluctuating over time, being the sum of product and customer value and its complementarity to other features. Customer value, and customer satisfaction in particular, is thereby considered as the main driver in value creation, requiring extra attention in its usage.

Second, a method is proposed offering twelve guidelines to implement the estimation of business value for the purpose of feature prioritization. The results suggest the assignment of value to the various components of the business value model relative to a certain baseline feature. This involves a product owner as dedicated value assigner cooperating with business owners and development teams to utilize their expertise in determining the customer value and product value respectively. Furthermore, it should be complemented by the estimation of costs and risks to provide useful metrics for the decision making during prioritization.

Lastly, a method is proposed to measure the business value for the purpose of evaluation and performance management. The findings imply that the measurement of business value after the release of a feature is very specific of nature, and requires the formulation and implementation of a measurement plan while keeping the measurement of business value as close as possible to the financial results of the organization.

6.1 CONTRIBUTIONS

This study makes several contributions to the literature. Previous literature emphasized business value creation as an important matter in agile software development. While the topics of business value and agile software development have been researched extensively, literature on the determination of business value in the same context is rather scarce and fragmented. The performed systematic literature review in this study

provides a concise overview of the current status on what is already known about the topic. Furthermore, the results of this study offer new insights into how people working in e-business agile organizations consider business value creation in general, and how its determination should be applied to the agile workflow. All in all, this study is a first attempt in offering a complete business value determination approach, hoping to stimulate other researchers to further explore the topic and provide a starting point through the proposed model and methods.

As for the practical contribution, the methods for determining business value in conjunction with the proposed model offer agile practitioners guidelines in implementing the estimation and measurement of business value in their workflow. The estimation method may help the e-business organizations that are struggling to work more defined during the feature prioritization process. Once implemented, organizations will be able to develop the most valuable features first. It should provide more objectivity and transparency during the prioritization process, by translating gut feeling into actual numbers and by providing insight into these numbers and the corresponding decision making. Compared to the formulation of a comprehensive business case for a feature, the estimation method is less time-consuming and therefore more flexible for use in turbulent ever-changing environment where e-businesses usually operate. In addition, it is also more easy to adopt and requires less estimation skills. Furthermore, the measurement method should provide practitioners to work towards a more sustainable agile organization, by managing and anticipating on the performance regarding business value creation after feature development.

6.2 LIMITATIONS & RECOMMENDATIONS

There are some limitations regarding this study that should be taken into account. Due to time constraints this research was not set up to test the model in practice, but to explore the business value concept and what encompasses its determination based on literature and interviews. As a consequence, it is not known how accurate its estimation is compared to the actual achieved business value. A workshop should be sufficient to further evaluate the method in future research, and as such validate the method and process the feedback into an improved design. As a next step, a very interesting study would be to test the artefact on a to-be prioritized feature list among different groups, and see how the groups differ in accuracy. The results in this study might provide an incentive to start with such research.

Regarding the business value model, it is not tested whether all the sub-dimensions of the customer and product dimensions are actually present, or that some are missing. However, the dimensions are to a large extent based on literature and partly confirmed and complemented by the interview results. Research is needed to further confirm or complement these sub-dimensions.

Risk and cost analysis were both not included in the research, although mentioned as required by the respondents. Cost analysis in particular is required to calculate the cost-benefit or ROI of a feature. Although effort and cost estimation is a subject that is

well researched in the agile literature, as well as risk analysis in general, further research might be needed to apply these methods to the prioritization process.

Regarding the generalizability of this study, the estimation and measurement methods resulted from this study are focused on the agile scrum methodology, and thus are only applicable to this context. This means that the results are focused on the development of software features in an iterative setting. This includes the process of feature prioritization and feature evaluation in iterative cycles, and the presence of roles and their responsibilities as depicted in this study. Nonetheless, it is probably also applicable to other software development methodology methods, provided that there are equivalents for the prioritization and evaluation processes, and the roles involved. The generalizability of the business value model to other situations can be considered as more comprehensive. While this research was focused on agile software development in e-business, the proposed business value model shows no specific agile or e-business characteristics which may contract to other situations. At the same time, it might also be of use for representing software features in general, and in domains other than e-business.

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Appendix A:
LITERATURE REVIEW APPROACH

This appendix discusses the literature review approach of the study, what it comprises, and which steps were used to come to the results. First, the literature review comprised the exploration of the main subjects in the problem context, which are agile software development and business value. Both are richly researched areas, however, the business value research area is full of ambiguity in terminology with little consensus among the authors depending on the context (software engineering, IT, business, and economics). For both these subjects, a semi-systematic approach should suffice to explore the key literature on these subjects and get a general idea of the problem context. The second part of the literature review is about bringing these two areas in connection with each other through a full systematic approach, deepening out the combination of agile software development and (measuring) business value.

Both the systematic and semi-systematic methods are derived from the concept in the article of Wolfswinkel et al. (2013), which provides guidelines in conducting a systematic literature review. The full systematic approach will be discussed first, which briefly explains how the main guidelines of the authors are applied to current literature review, and what the reasons were for some alterations. This is then followed by the description of the semi-systematic approach, which is simply stripped and simplified version of the systematic approach.

A.1 SYSTEMATIC APPROACH
The systematic literature review is based on the concept of Wolfswinkel et al. (2013). The author defines steps and guidelines to conduct a solid literature review. The literature review consists of the following steps: define, search, select, analyse, present.

A.1.1 STEP 1: DEFINE
The first step is set up to initiate the literature review and define what the review comprises. The following sub-steps were followed:

Define the criteria for inclusion/exclusion
The following questions are central in the literature review, and each have their own criteria to filter articles for the select step:

1. What is agile software development?
   1.1. The articles should have agile as its central topic
   1.2. The articles should be mentioning agile in the context of software development or any derivative, such as web development

1.3. The articles should provide definitions of and general information about agile software development

2. What is business value?
   2.1. The article should be about business value
   2.2. The article should be focused on the term Business Value in the context of value creation by organizations in general
   2.3. The business value mentioned in the article may only be focused on e-business, e-commerce, IT, and business in general

3. What is business value in relation with agile software development?
   3.1. The business value as mentioned in the articles must be focused on value creation by agile software development for the organization
   3.2. Business Value or value creation/delivery should be the central topic of the article, or should be part of the conclusion/results of the article
   3.3. The articles should be mentioning agile in the context of software development or any development derivative such as Web

4. What methods already exist for measuring business value?
   4.1. The article should not repeat or further elaborate earlier found methods
   4.2. Can the proposed method in the article be used for agile software development?
   4.3. The article should be about software engineering
   4.4. Is the method described as a concept, in abstract or concrete, or proposes a handles, guidelines, or criteria for one?

Identify the fields of research

This step consists of defining the key research areas that should be considered relevant to answer the literature review questions. The following areas are defined:

- Business
- Finance
- Information Technology
- Software Engineering

Determine the appropriate sources

Various article databases are currently available to search for academic articles. For the literature review, databases with flexible search options and a great article offerings were chosen, being the following:

- Scopus
- Web of Science
- Google Scholar (for complementing with less academic articles)

Decide on the specific search terms

The following search terms are defined as search queries to better describe the search approach. The queries are described for the Scopus database only, however have also been used to compose the queries for Web of Science, which is easily done by using

equivalent search functions and a slightly different syntax. The search queries were defined for each literature review question separately:

1. What is agile software development?

   KEY ("agile" "software" "development")

2. What is business value?

   TITLE-ABS-KEY ("business value")

3. What is business value in relation with agile software development?

   KEY ("agile") AND
   KEY ("business value" OR ("value" W/3 ("delivery" OR "creation" OR "deliver" OR
   "create")))

4. What methods already exist for measuring business value?

   TITLE-ABS-KEY ("agile") AND
   TITLE-ABS-KEY ("business value" OR ("value" W/3 ("delivery" OR "creation" OR
   "deliver" OR "create"))) AND
   TITLE-ABS-KEY ("value" W/5 ("capture" OR "capturing" OR "measure" OR
   "measurement" OR "calculation" OR "assign" OR "assignment" OR
   "communication" OR "definition" OR "formula" OR "analysis" OR "determine" OR
   "determining" OR "managing" OR "management" OR "planning" OR "based"))

A.1.2 STEP 2: SEARCH

Search the appropriate sources/databases

- Scopus
- Web of Science

Complement articles
Sometimes there are articles that are added to the selection in an unsystematic manner. It could be that these articles were found beyond the review process, for instance those that were already known to the researcher and were considered useful or important for the topic. This step was not mentioned in the official method, but was added to add some articles that couldn't be find in the specific article databases.

A.1.3 STEP 3: SELECT

Filter article meta
This step is not included in the original guidelines of Wolfswinkel, except the sub-step about filtering doubles, but were added to further narrow down the list of articles:

- Filter out doubles
- Filter out graduation theses
- Filter on accessibility/availability
- Filter on english and dutch language

Filter article content

- Filter by defined criteria on title and abstract
- Filter by defined criteria on full text
- First reading the conclusion, moving upwards into the article

Add articles by forward/backward citations

- Only on relevant parts of the article

A.1.4 STEP 4: ANALYSE

Wolfswinkel et al. defined the analysis step to make quick sense out of the content of all the articles. He proposes to use coding techniques as part of grounded theory to quickly walk through all the data and find relevant statements. It consists of **open coding**, **axial coding**, and **selective coding**, which are used in a more flexible way through the literature review.

First of all, the contents of the articles were searched for the keywords relevant to corresponding review question. The paragraph around the found keywords are read to find for any relevance to provide an answer. All the relevant statements were collected in an overview per article and review question, to find any relationships in the statements, and were grouped/categorized as such. The statements were logged with their corresponding article and page number in which it was found, so it can be referred to in the next step.

A.1.5 STEP 5: PRESENT

Represent and structure the content

All the statements that have been related with each other in the analyse step are being described in a readable paragraph. The statements that factually say the same, are being merged into one sentence, and being referred to all the relevant articles. Unique article identifiers were used to temporarily refer to articles, so in the next step the references can be replaced by the APA norm as used in the final document.

Structure the article

The paragraphs are being put in order of relevance in the chapter belonging to the literature review question.

A.2 SEMI-SYSTEMATIC APPROACH

The semi-systematic literature review deviates from the normal systematic review in ways of how searching is carried out. As the topics within this review are very common and broadly researched, and hard to narrow down using keywords, only the most cited articles will be used to make the review feasible but integral.

The search step is structured by searching the databases for the keywords, sorting on most-cited articles, and creating the article sample until at least 10 final articles will roll out per question that are filtered during on the select phase. In addition, articles were added in ad hoc fashion until enough sufficient information was retrieved to support the research.

Appendix B:
COMPLETE LITERATURE REVIEW

A literature review is needed to get a good understanding on what is already researched on the relevant subjects. By checking what encompasses business value for agile software development, and what methods are already proposed, an artefact can be properly designed. The main goal of this literature review is to find out how agile software development connects to business value, and how it should be determined or measured according to relevant studies. For the literature review, both a systematic and semi-systematic approach is used, based on the concept of Wolfswinkel, Furtmueller, & Wilderom (2013). A detailed description of the approach is put in a separate appendix.

First in this chapter, the agile software development literature will be described, followed by the theory on business value. This is then followed by the relation of agile software development with business value, which includes what the agile literature tells about delivering business value, and how and when in the agile processes it's being addressed. Then at last, the literature that mention the measurement, determination, modelling, or anything related to these terms, will be discussed and analysed.

B.1 AGILE SOFTWARE DEVELOPMENT

It's important to know what encompasses agile software development to determine business value within agile projects. However, as the characteristics of agile software development are not the main focus of this study, only the key articles on this research area will be discussed. The key articles are the ones that were most cited in software engineering research area, which revealed to be sufficient to get to know what encompasses and drives agile software development.

B.1.1 BEING AGILE

Many software methodologies were appearing over the decades to evolve the software engineering field to what it is now. Agile is one of the popular ones, which has matured since the Agile Software Development Manifesto in 2001 as published by a group of experts in that particular field (Beck et al., 2001).

Agile development is about quickly responding to change to cope with turbulent environments requiring extreme, complex, high-change software projects (Cockburn & Highsmith, 2001, p. 133; J Highsmith & Cockburn, 2001, p. 122). The emerging agile philosophy mainly depends on an organization's ability to nurture learning, teamwork, self-organization, and personal empowerment (Cockburn & Highsmith, 2001, p. 133; Pikkarainen et al., 2008, p. 82). Being agile is embedded in the values and principles as standardized at the agile manifesto, which were the first standardized guidelines for organizations that want to be agile in their software development now and in the future.

The key values and principles as discussed in the manifesto will be shortly mentioned in the next paragraph. They will be further discussed later on as all articles included in the review regarding software development are (indirectly) using or referring to the principles and values as defined at the manifesto.

Shortly, the four key values of agile software development as defined by the group of experts are as follows (Beck et al., 2001):

- "Individuals and interactions over processes and tools",
- "Working software over comprehensive documentation",
- "Customer collaboration over contract negotiation",
- "Responding to change over following a plan".

These values are interrelated with twelve agile principles. The key principles of agile software development as defined by the group of experts are as follows (Beck et al., 2001):

- "Our highest priority is to satisfy the customer through early and continuous delivery of valuable software."
- "Business people and developers must work together daily throughout the project."
- "Welcome changing requirements, even late in development."
- "Deliver working software frequently."
- "Working software is the primary measure of progress."
- "Build projects around motivated individuals. Give them the environment and support they need, and trust them to get the job done."
- "The best architectures, requirements, and designs emerge from self-organizing teams."
- "The most efficient and effective method of conveying information to and within a development team is face- to-face conversation."
- "Agile processes promote sustainable development."
- "Continuous attention to technical excellence and good design enhances agility."
- "Simplicity is essential."
- "Project teams evaluate their effectiveness at regular intervals and adjust their behaviour accordingly."

All the values and principles discussed at the agile manifesto are all, direct or indirectly, being related to in the upcoming paragraphs.

B.1.2 VALUE CREATION

Central in the agile software development methods is the quick and continuous delivery of valuable software to the client organization (Abrahamsson et al., 2002, p. 68; Beck et al., 2001; Jim Highsmith, 2002, p. 9; Pikkarainen et al., 2008, p. 81; Vidgen & Wang, 2009, p. 373). In the literature this is also called as the delivery of customer value (Jim Highsmith, 2002) or business value (Vidgen & Wang, 2009). The delivery of value to

the customer ultimately means the creation of a quality software product as satisfies the customer, which is then to be considered as valuable. To realize software as valuable and quick as possible, the software requirements need to be continuously gathered, delivered frequently and iteratively, and with close customer interaction to ensure that the client organization will get what he wants at the end of the development (Vidgen & Wang, 2009, p. 373). The general business value subject and the subject of business value creation within agile development will be discussed in more detail later in this literature review.

B.1.3 CUSTOMER COLLABORATION

To create the most valuable software for the customer, agile methods require organizations to work with customers to coevolve business value (Abrahamsson et al., 2002, p. 96; Boehm, 2002, p. 68; J Highsmith & Cockburn, 2001, p. 122; Jim Highsmith, 2002, p. 9; Vidgen & Wang, 2009, p. 374). This is also mentioned in one of the agile principles as "Business people and developers must work together daily throughout the project" (Beck et al., 2001) and in the key values as "Customer collaboration over contract negotiation" (Beck et al., 2001). In fact, some authors not only mention working together, but also intense, constant interaction with the customer (Jim Highsmith, 2002, p. 6). Customers should then ideally be made available to, or even better, be part of the agile team, calling for rapid feedback to the developers on the implications of their design choices (Cockburn & Highsmith, 2001, p. 131). The authors also mention that in that way the customer learns from what developers misunderstand and which features requests did not work in practice. Ultimately, active participation with concerned stakeholders provides the agile organization with higher customer satisfaction (Pikkarainen et al., 2008, p. 81).

B.1.4 FLEXIBLE TO CHANGING ENVIRONMENTS

As going through the articles in the literature, responding to change is a continuously returning subject. Agile software development is mentioned to be very useful for messy, ever-changing and turbulent environments (Boehm, 2002, p. 68; Cockburn & Highsmith, 2001, p. 133; J Highsmith & Cockburn, 2001, p. 122; Jim Highsmith, 2002, p. 9). In such environments, having a flexible software development process is key to survive (Cockburn & Highsmith, 2001, p. 131). Future requirements are then often unknown, making the agile approach is particularly suitable (Abrahamsson et al., 2002, p. 96; Boehm, 2002, p. 68). Organizations using the agile approach generally want to create change for their competitors and quickly respond to market conditions (Beck et al., 2001; Jim Highsmith, 2002, p. 9). In fact, agile methods even encourage change rather than discouraging it (J Highsmith & Cockburn, 2001, p. 122). This can also be found in the principles of agile, which mentions welcoming changing requirements, even late in development (Beck et al., 2001). Rigorous development methods are getting behind the agile approach in turbulent and changing situations, as these methods typically are trying to plan every single requirement and resource from the beginning to

the end of the development at project iteration (Jim Highsmith, 2002, p. 9; Pikkarainen et al., 2008, p. 83).

Also key in a turbulent competitive environment with changing market conditions is creating and maintaining the technical excellence to make sure that a qualitative product is created today and in the future (Jim Highsmith, 2002, p. 6). This is also mentioned at the agile manifesto as "Continuous attention to technical excellence and good design enhances agility" (Beck et al., 2001). The agile process therefore requires responsive people and organizations (Cockburn & Highsmith, 2001, p. 131), so agile teams do have the ability to create product innovations (Vidgen & Wang, 2009, p. 374).

B.1.5 ITERATIVE DEVELOPMENT

As mentioned before, agile projects are set up in a way that development copes with changes in requirements of the customer. In the literature, one of the ways to respond to the changing environment is by introducing iterative development cycles to shorten customer feedback time (Cockburn & Highsmith, 2001, p. 131; J Highsmith & Cockburn, 2001; Jim Highsmith, 2002, p. 6), which is implemented by all derived agile methods (Abrahamsson et al., 2002, p. 97).

Each iteration is recommended to be short and fixed-length (e.g. one week (Vidgen & Wang, 2009, p. 373), or two- to six-weeks (Abrahamsson et al., 2002, p. 97; J Highsmith & Cockburn, 2001, p. 121)), so the agile team can quickly adjust to new occurring information (J Highsmith & Cockburn, 2001, p. 121) and minimize the risk of slipping out of schedule (Abrahamsson et al., 2002, p. 97). These iterative cycles are combined with feature planning and dynamic prioritization, which is the participation with the customer to add or discard features to the feature planning (J Highsmith & Cockburn, 2001, p. 121) so that the features with the highest priority according to the customer get developed first and the most customer value is being created.

At the end of each iteration cycle, a small portion of features will be delivered to the customer, and a new iteration begins. Then this meets the agile principle of delivering working software frequently (Beck et al., 2001).

The feature list is also known as the feature backlog in the agile scrum method, wherein features can only be prioritized at the end of the iteration (J Highsmith & Cockburn, 2001, p. 121). In the literature many articles mention this feature prioritization process as requirements engineering. In general, roles are set up to cope with this process, which is commonly referred to as the product owner role.

B.1.6 SELF-ORGANIZED TEAMS

Agile's responsiveness and flexibility to change are also achieved by setting up autonomous and self-organized teams (Cockburn & Highsmith, 2001, p. 132; Pikkarainen et al., 2008, p. 82). This means that all team members get shared responsibility for project management and the progress of the development (Vidgen & Wang, 2009, p. 373), however not being leaderless (Cockburn & Highsmith, 2001, p. 132). In the end "Agility requires that teams have a common focus, mutual trust, and respect; a collaborative, but speedy, decision-making process; and the ability to deal with

ambiguity." (Cockburn & Highsmith, 2001, p. 132). Teams should have a culture that enables the interchangeability of roles inside the team among members (Pikkarainen et al., 2008, p. 82). This way "The best architectures, requirements, and designs emerge" according to the agile principles (Beck et al., 2001).

B.1.7 TEAM COLLABORATION

Another key feature of the agile approach is that members in the agile teams should collaborate intensively (Boehm, 2002, p. 68; Cockburn & Highsmith, 2001, p. 132; J Highsmith & Cockburn, 2001, p. 122; Jim Highsmith, 2002, p. 9; Pikkarainen et al., 2008, p. 82), as also being part of the key agile value (Beck et al., 2001). This can only be done if the environments the agile teams operate in enabled such collaboration and the required communication. In general this means that teams should be close to each other (Cockburn & Highsmith, 2001, p. 131; J Highsmith & Cockburn, 2001, p. 122) in open working spaces (Vidgen & Wang, 2009, p. 373). As a result communication lines are short, and face-to-face conversations are easily enabled, which are considered to be the most efficient and effective method of conveying information according to one of the agile principles (Beck et al., 2001). There should also be interconnected practices in place that enable team members to communicate with each other to enable constant feedback (e.g. through daily meeting) (Jim Highsmith, 2002, p. 6; Vidgen & Wang, 2009).

B.1.8 INDIVIDUAL COMPETENCES / SKILLS

Agile methods are set up in a way that puts the focus on the skills and capabilities of people (Beck et al., 2001; Cockburn & Highsmith, 2001, p. 131; J Highsmith & Cockburn, 2001, p. 122; Jim Highsmith, 2002, p. 9; Pikkarainen et al., 2008, p. 81) and increasing individual competencies (Cockburn & Highsmith, 2001, p. 132). Teams are built around the skill-set of people, with no separation of functional roles in a sense that individuals are multi-skilled and fulfil multiple roles if needed (Vidgen & Wang, 2009). Some authors make the comparison with rigorous development, where processes are originally designed to standardize people to the organization instead of capitalizing on each individual and exploit a team's collective strength (Cockburn & Highsmith, 2001, p. 132). In addition, as one of the agile principles, the organization should offer each individual the environment, support, and trust to get the job done and foster their motivation (Beck et al., 2001).

B.1.9 FEW PLANS AND EXTENSIVE DOCUMENTATION

To accommodate agile development in being flexible and responsive, traditional extensive planning and documentation are discouraged by many authors in the reviewed literature (Cockburn & Highsmith, 2001, p. 131; Jim Highsmith, 2002; Pikkarainen et al., 2008, p. 82), and by agile's value of "Responding to change over following a plan." (Beck et al., 2001). Planning often occurs only for the short-term using only small units of time, and do get replanned many times daily, at the beginning of an iteration, or after releases (Vidgen & Wang, 2009, p. 373). However, one should plan to

keep a sight at the long-term, agile practitioners are not blinded by those plans (Jim Highsmith, 2002, p. 9). Also agile's project initiation (scope, objectives, constraints, etc.) should just be briefly elaborated (Jim Highsmith, 2002, p. 6). Thus the same applies for documentation, which should take place however not extensively. One should just concentrate on working software, instead of elaborating models and blueprints (Jim Highsmith, 2002, p. 9) and creating huge granularity in requirements (Vidgen & Wang, 2009, p. 373), as part of agile's value of "Working software over comprehensive documentation" (Beck et al., 2001). In addition, defining all requirements at an early stage of development can constrain inventiveness of developers to be locally responsive to opportunities, decreasing innovation and creativity leading to less quality software (Pikkarainen et al., 2008, p. 83).

B.1.10 LEARNING

Evaluating and learning is at the core of the agile development activities (Beck et al., 2001). The development processes are reviewed and improved regularly to eventually adapt more to problem context and remove redundant activities and wastes (Vidgen & Wang, 2009). Agile teams take their time to evaluate their effectiveness and adjust accordingly as one of the agile principles (Beck et al., 2001). To accommodate to this principle, practices generally include "continuous code integration, refactoring to improve design and code, reflection workshops and stand-up meetings to determine what worked and what didn't, and instant feedback from participating stakeholders" (Pikkarainen et al., 2008, p. 83). Beside team learning, individual learning is also routinized by making studying part of the development process, allocating study time for both project and non-project investigations (Vidgen & Wang, 2009).

B.1.11 CRITICAL SUCCESS FACTORS

Looking at what is said about agile software development in the literature, one can conclude that all agile values and principles according to the agile manifesto (Beck et al., 2001) are considered as success factors for an agile development organization. Some factors were mentioned in the literature as success factor in particular. In a multiple regression analysis as done by (Chow & Cao, 2008), the only factors that could be called critical for success are found to be a correct delivery strategy, a proper practice of agile software engineering techniques, and a high-caliber team (Chow & Cao, 2008, p. 969). Connecting to a high-caliber team, some other authors were also mentioning the recognition of each individual competency as the primary driver of project success (Cockburn & Highsmith, 2001, p. 131; J Highsmith & Cockburn, 2001, p. 122). Other factors that could be critical to success are good agile project management process, an agile-friendly team environment, and a strong customer involvement (Chow & Cao, 2008, p. 969).

B.1.12 METHODS

During the era of agile software development many different methods arise that are introducing their own practices to implement agile's way of working. They approach

software engineering problems each from slightly different angle, one being more focused than the other (Abrahamsson et al., 2002, p. 98), they however do share a similar set of collaborative values and principles (Abrahamsson et al., 2002, p. 88). As reviewed by Abrahamsson et al. (2002) all agile methods can be characterized as being focused on the following aspects (Abrahamsson et al., 2002, p. 93):

- "delivering something useful",
- "reliance on people",
- "encouraging collaboration",
- "promoting technical excellence",
- "doing the simplest thing possible", and
- "being continuously adaptable".

They conclude that the following aspects make a development method an agile one:

- "incremental (small software releases, with rapid cycles only 2 to 6 weeks in duration)"
- "cooperative (customer and developers working constantly together with close communication)",
- "straightforward (the method itself is easy to learn and to modify, well documented)",
- "adaptive (able to make last moment changes)".

B.2 BUSINESS VALUE

By the most cited literature included in the review about business value, it was still difficult to find consensus in the statements about the definition of business value, or to find a clear definition at all. Business value was described and referred to in different contexts in the literature. When going through the literature it seems that business value is more of a synonym for value creation in organizations. Some of the key theory in this review also cover value creation in general, which will be briefly mentioned here to include a broader view on the business value subject. Still, however, business value is the main subject that should be covered in this paragraph.

B.2.1 GENERAL MANAGERIAL VIEW

During the literature review of business value in relation with agile software development, one article was also included that seemed relevant for the general business value subject. The article of (Z. Racheva et al., 2009) describe business value as used in management and financial economics as follows: "an informal term that includes all forms of value that determine the health and well-being of the firm in the long-run" (Z. Racheva et al., 2009, p. 4). The author who proposed a business value framework in their article (Rusnjak et al., 2010), mentioned that business value depends on one's perspective, but defined it as something that "spreads out into different dimensions of both tangible and intangible values with structural significance to the different stakeholders.". They furthermore add that business value should be captured in a model,

instead of a single statement, formula, or a number. Some authors give the definition in the nature of financial economics: "the net present value of the after-tax cash flows associated with the investment" (Williams & Williams, 2003). Others define business value in the context of project management, as "it increases or protects profit, cash flow or return on investment in alignment with the company's strategy" (Matts & Pols, 2004). Furthermore, some define business value as "a broad concept that refers to any measures of worth of business entity. It includes not only financial aspects (e.g., income, costs, profit) but also many other aspects (e.g., market share, customer satisfaction) important for business operations" (Tosic et al., 2007). That business value is more than just financial value is also argued by Kaplan & Norton (1992), who proposed a total of four aspects that contribute to business value:

1. *Customer perspective (value-adding view):* to achieve our vision, by delivering value to our customers
2. *Financial perspective (shareholders' view):* to succeed financially, by delivering value to our shareholders
3. *Internal perspective (process-based view):* to satisfy our shareholders and customers by promoting efficiency and effectiveness in our business processes
4. *Learning and growth (perspective future view):* to achieve our vision, by sustaining our innovation and change capabilities, through continuous improvement and preparation for future challenges

The various definitions from various perspectives and their slight inconsistency make business value a very vague subject. This is not bad on itself however, as business value is something that is very specific to the (type of) organization and their perspective (Rusnjak et al., 2010).

B.2.2 E-BUSINESS AND E-COMMERCE VALUE

Business value is also described as value created by e-businesses and e-commerce organizations. One of the key literature is the article by (K.a Zhu & Kraemer, 2005), who analysed value creation within e-businesses. They argued that e-business organizations are "using the Internet to conduct or support business activities along the value chain", which is a concept described by Porter (2001), and as such value is created through these activities. They also see business value through the resource based view (Barney, 1991): "RBV of the firm posits that firms create value by combining heterogeneous resources that are economically valuable, difficult to imitate, or imperfectly mobile across firms" (K.a Zhu & Kraemer, 2005, p. 64). They eventually concluded that the unique characteristics of internet play a role in value creation, and create value in three ways: transactional efficiencies, market expansion, and information sharing (K.a Zhu & Kraemer, 2005, p. 65). However, one article (Amit & Zott, 2001) argues that value creation within e-business organizations goes beyond the value-chain or the resource based view, and refer to value as "the total value created in e-business transactions regardless of whether it is the firm, the customer, or any other participant in the transaction who appropriates that value" (Amit & Zott, 2001, p. 503). According

to their analysis, there are four drivers that enhance value creation in e-business (Amit & Zott, 2001, p. 516), which are (1) efficiency, transaction efficiency increases when the costs per transaction decrease; (2) complementarities, a bundle of goods together provide more value than the total value of having each of the goods separately; (3) lock-in, the extent to which customers want to engage in repeat transaction; and (4) novelty, the usage and exploitation of innovation. Other authors examined e-commerce value instead, and argue that "business value of Internet-enabled initiatives is best measured by gains in financial performance" (Kevin Zhu & Kraemer, 2002, p. 281), and as such used multiple financial measures to assess the value of e-commerce capability.

B.2.3 IT BUSINESS VALUE

Business value is also described a lot in relation with the research area of information technology (IT). According to one article (Melville et al., 2004), the term in IT is commonly used to refer to "the organizational performance impacts of IT, including productivity enhancement, profitability improvement, cost reduction, competitive advantage, inventory reduction, and other measures of performance" (Melville et al., 2004, p. 14). The same authors argue that IT business value comprises efficiency impacts and competitive impacts as a result of IT at both the process and the organizational-wide level (Melville et al., 2004, p. 15). Business value in IT is also described as cost reduction and profit creation for the organization (Lee, 2001). However, some authors (Martinsons et al., 1999) argue that business value in IT is not only about reducing costs and making money, but also about the general function of the information system (Martinsons et al., 1999, p. 75). As they say, "The value or contribution of IS to the business as a whole must be considered from top management's point of view". The delivery of value can be seen through the IS balanced scorecard they proposed. They argue that business value in IT is constructed and driven by the following perspectives which are all interrelated in the creation process:

- User orientation perspective (end-users' view): deliver value-adding products and services to end-users
- Business value perspective (management's view): contribute to the value of the business
- Internal processes perspective (operations-based view): deliver IT products and services in an efficient and effective manner
- Future readiness perspective (innovation and learning view): deliver continuous improvement and prepare for future challenges

These are four measures that, once these perspectives are improved, business value as a whole will improved (Martinsons et al., 1999, p. 75). They call this the IS balanced scorecard, which is based on the balanced scorecard concept (Kaplan & Norton, 1992). They recommend to use such a scorecard to measure and evaluate the positive and negative impacts of IT on the organization as a whole (Martinsons et al., 1999, p. 85).

B.3 BUSINESS VALUE AND AGILE SOFTWARE
    DEVELOPMENT

In the agile software development literature, business value was discussed very often. However, there seems to be little consensus in how they define it. One of the earlier studies that completely focused on the definition of business value in agile, is the article of Z. Racheva et al. (2009). They note that the definition of the term business value is vague and ambiguous, and that only five of the reviewed papers (before 2009) "include a definition of the term business value; in the rest of the papers the term is a "self-evident concept" (Z. Racheva et al., 2009).

One way of defining business value is by viewing it as financial benefits of the implemented features by agile development. One article, for instance, defined business value as "software put into production that can return an investment over time" (Hartmann & Dymond, 2006, p. 4). Others also mentions that business value can be reduced costs and increased revenues, or eventually some other added value (Heidenberg et al., 2012, p. 49). One author also mentions that business value is often seen as something that could or should be translated into dollar value, however mentioning that business value should be interpreted as a multi-dimensional concept (Z. Racheva et al., 2009, p. 4). Just having a financial view on business value is considered to be too narrow (Heidenberg et al., 2012; Z. Racheva, Daneva, Sikkel, & Buglione, 2010).

Some of the articles note that business value is more than a tangible (financial) value, and that it also consists of a intangible and subjective value requiring a deeper knowledge of the client's domain (Kautz et al., 2014; Patton, 2008; Z. Racheva, Daneva, Sikkel, & Buglione, 2010). Another article takes it a little bit further, which discusses that business value is not only delivered through features to the customer, but delivering value to the business that runs the agile processes (Qumer & Henderson-Sellers, 2007a, 2008). To them business value includes the following: Value to Customer, Value to Team, Value to Process, Value to Workspace, Value to Product. Other authors (Heidenberg et al., 2012, p. 50) see business value more in terms of a communication means to developers and stakeholders. As such they have built a model that represents business value.

In interviews done among practitioners, the definition of business value varies within the same organization among clients and projects (Z. Racheva, Daneva, Sikkel, & Buglione, 2010), and thus can be considered as a dynamic concept.

B.3.1 BUSINESS VALUE CREATION AND DELIVERY

As noted earlier in the literature review, business value is the central topic in agile software development. The aim is to maximize the creation of business value for the client as soon as possible (Heidenberg et al., 2012; Kumar et al., 2014; Qumer & Henderson-Sellers, 2008, p. 1916; Z. Racheva, Daneva, Sikkel, & Buglione, 2010), which is commonly accepted among the agile community (Qumer & Henderson-Sellers, 2008, p. 460). Fast value delivery to the client is also one of the most considerable drivers

that determine the maturity level of an agile organization (Tuan & Thang, 2013, p. 273). The delivery of business value takes place at the end of a development cycle/iteration. However, business value is only realized for the client when the working software enters production (Hartmann & Dymond, 2006, p. 5). According to the authors (Hartmann & Dymond, 2006, p. 4): "the more rapidly high-value software can be rolled out, the quicker value is realized".

However, it's hard to tell how business value is exactly created and keeps accumulating over time (Z. Racheva et al., 2009). One recent article tried to find out what kind of business value is being created by agile (scrum) processes (Kautz et al., 2014, p. 4). They used the taxonomy of IS business value (Schryen, 2013), consisting of internal value, external value, tangible value, and intangible value. However, the authors only investigated the internal value as part of a bigger framework and argue that more research is still needed to understand business value as a whole (Kautz et al., 2014, p. 17).

The key ingredients for ensuring business value seems to be testing and validation of software, and reflective improvement in teams; self-organization however has no significant impact (Balijepally et al., 2014, p. 11). What the same article also argues is that collaboration with stakeholders is essential in maximizing business value. An article mentions the stakeholders that are accountable and/or responsible for creating business value, which are the agile teams, managers, executive management, and the customer (Qumer & Henderson-Sellers, 2008, p. 1901). In interviews among agile practitioners, the involvement of clients is agreed to be consisting of approving plans and given feedback (Z. Racheva, Daneva, Sikkel, & Buglione, 2010).

B.3.2 FEATURE PRIORITIZATION

One of the moments where business value creation can be influenced, is during the planning or prioritization of features/specifications of the software. In these planning moments it is decided upon what features to build in the upcoming iteration(s), whether it is for the short-term (sprint planning) or the longer-term (release planning) (Kumar et al., 2014). Despite the vagueness of the definition of business value, most of the literature about the subject in agile software development seem to mention that business value is the key decision factor in the prioritization process (Heidenberg et al., 2012, p. 49; Kumar et al., 2014; Z. . Z. Racheva et al., 2008, p. 459; Z. Racheva et al., 2009, p. 3; Z. Racheva, Daneva, Sikkel, Herrmann, et al., 2010, p. 3; Torrecilla-Salinas et al., 2015, p. 129). Because of for instance the importance of time-to-market, building the features with the most value early in the development process is critical (Torrecilla-Salinas et al., 2015, p. 129). To guide the prioritization process by business value, one needs to estimate how much business value each feature is going to deliver (Logue & McDaid, 2008, p. 438) for which frameworks, guidelines, or tools are needed (Jamieson et al., 2006, p. 6; Torrecilla-Salinas et al., 2015, p. 125), eventually with comparison options for the required effort of each feature (Heidenberg et al., 2012, p. 51; Z. . Z. Racheva et al., 2008, p. 459).

B.3.3 Business value estimation

Whilst business value plays a key role in the prioritization of features, the estimation of how much business value is going to be created per feature can be extremely difficult (Logue & McDaid, 2008, p. 439). As business stakeholders are the ones that know what is most valuable to the business, they are expected to prioritize the features (Heidenberg et al., 2012, p. 49; Z. . Z. Racheva et al., 2008, p. 459; Z. Racheva, Daneva, Sikkel, Herrmann, et al., 2010, p. 9), eventually together with developers (Hartmann & Dymond, 2006, p. 2). In some agile methods (e.g. scrum) a separate role is accountable for the interests and expectations of all the business stakeholders, and assigned to determine the business value per feature (Kumar et al., 2014, p. 119; Rico, 2010, p. 65). However, it's not clearly defined how they are supposed to assess and decide the business value per feature (Heidenberg et al., 2012, p. 51; Rico, 2010, p. 65). The priority of a feature seems to be a combination of subjective value-based criteria (Z. Racheva, Daneva, Sikkel, Herrmann, et al., 2010, p. 9), sometimes even based on previous experience or intuitive feeling (Heidenberg et al., 2012, p. 49; Patton, 2008). Some recommend to use (strategic) goals to tackle the various business perspectives in agile projects (Rico, 2010, p. 65).

B.3.4 Business value evaluation

Besides the estimation of business value during the feature prioritization process, evaluation of whether business value is actually delivered is less of a subject in the reviewed literature, and as such also could benefit from techniques to allow for measurement (Torrecilla-Salinas et al., 2015, p. 125). However, some literature does mention evaluating and measuring business value, direct- or indirectly (Hartmann & Dymond, 2006; Jim Highsmith, 2009; Kautz et al., 2014; Qumer & Henderson-Sellers, 2008; Rico, 2010; Torrecilla-Salinas et al., 2015).

In one article it's mentioned that the business value that is realized can mainly be evaluated objectively when it has been used for a while (Rico, 2010, p. 60). One author mentions that business value could or should be translated into monetary value (Z. Racheva et al., 2009, p. 4). For evaluation purposes, it is argued that it would be helpful to use a cost-benefit analysis metric for the delivered business value (Qumer & Henderson-Sellers, 2008, p. 1902). As some being part of the cost-benefit analysis metric, one can think of measuring business value in terms of costs, benefits, breakeven points, benefit to cost ratio, return on investment, and net present value (Rico, 2010, p. 5). Some authors proposed somewhat more abstract value creating measures (Kautz et al., 2014, p. 16), in particular productivity, quality, and employee satisfaction, while admitting the lack economic value measures.

B.4 Determining Business Value in Agile Projects

The last and main focus of the literature review was to find methods, frameworks, or models for determining business value within agile software development organizations. All the papers that are implicating some kind of guidelines for measuring business value will be included in this part of the review. Some articles are more concrete in their

method than others, which will be mentioned. Each article proposing a method, model, concept, will be discussed per article.

Torrecilla-Salinas et al. (2015)

The authors aimed to make planning and managing releases in agile web projects easier by offering a framework, without increasing the overhead of the process significantly (p.129) This framework is guided by the estimation of business value on future feature releases, integrating an existing set of agile practices and techniques into a "continuous Plan and Estimate–Manage– Measure–Adapt cycle" (p.142).

Beside the estimation of business value, the framework also includes estimating the size/effort of each feature to organize the backlog (p.142). Their framework recommends the estimation of both measures, so a cost and benefit (Return on Investment) of every feature can be calculated to better guide the selection (p.129) and prioritization of features in the backlog. This allows for taking into account business and development perspectives, and could avoid frequent re-planning cycles by reducing overhead in the estimation process (p.133).

The size should be determined by the members of the development team, estimating the amount of work needed to develop the feature. According to them, classical estimation methods thereby focus on estimating the relative size of a feature in relation to other baseline features in story points. One of the baselines features is then being used to act as a reference for assigning points. They recommend through other literature to make use of a discrete set of points, proposing a predetermined Fibonacci point sequence (0; 1; 2; 3; 5; 8; 13; and 20) (p.133).

The business value of each feature is estimated by answering the question "How much value does this feature bring to the organization?". They argue that the "value point analysis" is key in addressing the issue (through Highsmith (2009), also discussed in this chapter), assigning value points to each feature using a discrete set of values (500; 1,000; 2,000; 5,000; 10,000; and 20;000). Only customers, users and their representatives are determined to assign these points, and should be limited in the total amount of points each can give to cope with the existence of limited resources in each project (p.133).

In the end the framework offers the following additional measures relevant to current study:

- ROI = Value (in value points) / Size (in story points)
- % Delivered Value = Total value of finished features / Total value of all features in the backlog

However, the framework does give guidelines in how to handle business value estimation, it doesn't give clarification in how business value is assigned to features, which is also recognized by the authors (p.142). The method is only providing handles for estimating features and organizing the feature backlog, and doesn't include the evaluation of business value delivery.

Sobiech, Eilermann, Rauch (2015)

The authors tried to make the selection of features in agile development easier, by finding out what is considered to be valuable when developing features according to business stakeholders and representatives (product owners). They defined seven business value dimensions for features, and analysed the impact of the value dimensions to the total value of a feature using an Analytic Hierarchy Process.

The following dimensions are proposed and cited from their article (p.20):

- *Financial value:* Due to the implementation of a User Story costs can directly be economized
- *Work organizational value:* Due to the implementation of a User Story a user is able to fulfil a task faster and/or easier
- *Negative value (if not implemented):* Describes the loss of value if the User Story or Requirement is not implemented which is in fact a positive value if implemented (example in the article)
- *Software qualitative value:* Due to the implementation of a User Story the quality of the software systems will be increased, referring to properties like reliability, data quality, availability, and self-descriptiveness
- *Tertiary value:* Defined as the intangible value regarding the public image.
- *Strategic value (customer):* Defined as the ability of the implemented requirement to support the goal attainment of a strategic goal of an organizational unit or to enable the measurement of the goal attainment.
- *Strategic value (IT):* Expresses the ability of a requirement to support the strategy or long term goals of a software system developed/maintained by the development department.

These dimensions can then be used during the feature estimation process to assign business value to a feature. They propose to estimate the value for each feature in the backlog by assigning value points (similar to the commonly known story points) to each value dimension. The authors also proposed to use weight factors for each value dimension, as one dimensions can be more important or have more impact than the other. When the value points and weight factors are in place, you're able to calculate the overall value of each feature by adding up all the assigned points per dimension multiplied by the corresponding weight factor. According to them, using value dimensions and weight factors offer advantages for value estimation, as stakeholders and representatives (such as product owners) don't have to argue about absolute dollar values which sometimes may be hard to define (p.21).

They researched the weight factors for their study context, and included the factors in their paper to exemplify the impact of each dimension on the total business value of a feature. From important to less important, the following are the weights per dimensions according to business stakeholders and representatives (p.21): negative value (0.229), work organizational value (0.173), strategic value (customer) (0.155), financial value (0.148), software qualitative value (0.111), strategic value (IT) (0.109), tertiary value (0.076).

Beside the assignment of value points to a feature, the author also argues that the effort for developing a features needs to be considered as well (p.22). Otherwise you will only take the business perspective into account when prioritizing features. However, they don't discuss how this should be carried out.

The value dimensions describe what comprises business value in agile development, which implies that the dimensions also eventually be used for other purposes than just estimation of features. However, some of the dimensions can only explicitly be used for estimation. The negative value for instance is assigned to features to describe the loss of value if the feature is not being implemented, which implies estimation and nothing else. However, the value dimensions may give implications of what stakeholders and representatives consider as valuable, and thus might eventually be used for evaluation purposes.

A limitation of their study in relation with current study, is that it is only applicable in the context of management information systems at an OEM in the automotive industry. Furthermore, the study was focused on the scrum methodology, which is based on agile software development but still has very specific processes in use. It's thus unknown whether this can be generalized to the development of other types of software systems in the general agile development context for other types of organizations.

Heidenberg et al. (2012)

The authors proposed a model for representing business value in agile software development. This model includes several factors to prioritize features in software development (p.53). Beside the monetary value that is considered to be important in common, they also described non-monetary factors that have contribute to the business value of a feature. Their model consists of a total of six attributes:

- *Monetary Value*: Estimated financial value of the business case of a given feature, usually as a result of the initial business analysis of the feature.
- *Market Enabler*: The extent a given feature facilitates the introduction to a new market, or retaining the current market.
- *Technical Enabler*: Whether a given feature might work as a foundation for future features, or facilitates the improvement of existing features.
- *Competence Growth*: Whether developing a given feature acquires new competences or knowledge useful for future development.
- *Employee Satisfaction*: The extent a given feature facilitates to the creativity, satisfaction, and well-being of employees.
- *Customer Satisfaction*: Whether a given feature satisfies the customer.

They proposed that each attribute should be ranked per feature during the prioritization process. It's recommended to use a predefined ordinal scale from one to four, so to avoid a misuse of the middle value. Each option in the scale has its own clarification per feature, which are described in their article (p.54). The model can then be used to express and communicate the total business value and the relative impact of each attribute of a feature to the business stakeholders and the development team (p.54, p.57).

They propose a pie chart or other graphical representations for communicating the six attributes of the business value, helping the development team to understand the kind of value their work is adding to the software product (p.58).

In sum they see the following applications of their business value model: product backlog prioritization, sprint planning, and business information radiator. They rather see it as a prioritization and presentation tool as part of business value estimation, and they don't mention the purpose of evaluation. However, the six attributes can be used to determine what drives the business value per feature in an agile project, and can eventually be used for evaluation.

Rusnjak et al. (2010)

The authors propose a framework for determining the business value in e-commerce organizations. The framework seeks to fill the existing gap between business strategy and e-commerce development. It aims for "better prioritization regarding other domains, e.g. in agile software development- projects, an enhanced focus on strategic goals and developments, a better understanding of market needs (especially for technical employees), a strategic/value-control- and a strategic/value-feedback-system over all hierarchical levels". In this framework/model they define the drivers of business value intro three basic dimensions (CET-model): Company, Environment and Technology (p.465).

The authors argue that the business value in e-commerce organizations overlaps multiple hierarchical organizational level/domains. Their CET-dimensions are then applicable to three domains: Strategy, Tactics and Operation. The business value should as such be determined for each domain separately. The framework proposes that only one manager of each hierarchical domain should define what creates business value for them, by for example using some sort of point system. The overall business value can then be determined by adding up all the business values of the three domains.

The business value framework was proposed for general development use cases within e-commerce, and is not applied or tested in a agile software development environment. However, they do mention that the business value as determined by their framework can be related to a strategic program, a special product development, or a software project. Unknown is however whether this framework can also be used for evaluation purposes, however it is described very much as a concept and seems to be useful for all purposes that require business value determination in e-commerce organizations.

Racheva et al. (2010)

The paper is not proposing a method for determining business value. However, it tried to answer whether companies are using value-based criteria to perform value-driven decisions during feature prioritization, and how.

One of his conclusions were that priority seems to be based on subjective value-based criteria. Which was remarkable is that some of the companies were not only interested in the value delivery of a feature, but also the loss of value when a feature is not implemented, called "negative value" (p.5). Furthermore, "we observed that there is

a link between the perception of value and the price for the implementation.", which implies that both the size/effort and the business value of a feature should be measured (p.6).

This article can be used to design a method by taking into account the practices of organizations that are already using value-based criteria. However, it should be emphasized that it is only about prioritization and not about evaluation.

Highsmith (2009)

In the book a lot is being told about agile project management, and thus also the estimation of features and the performance evaluation of the development.

Concerning the delivery of value, the author proposes to use the agile triangle. It includes the following measures: "value (to the customer), quality (required to deliver continuous value to the customer), and constraints (scope, schedule, and cost)". They describe these three goals as follows:

- *Value goal*: Build a releasable product
- *Quality goal*: Build a reliable, adaptable product
- *Constraint goal*: Achieve value and quality goals within acceptable constraints

The value goal is the main goal of the triangle which should be focussed on, and realizes the base value for the project. The constraint and quality goals are just subject to the value goal, and are adjustable parameters to increase customer value.

The author also mentioned that, at the moment of writing, specific practices for capturing or even evaluating business value are sparse. He argues to use value points at story (feature) level to represent relative or monetary business value, the same way as needed effort is being represented as story points. He recommends estimating and evaluating the business value by means of "value point analysis". Therein, the product manager (product owner), or customer representatives, should do the estimation of the value points. Furthermore, the entire development team including developers may be involved in the discussion.

According to the author, the estimation or calculation of the value points is not as straight forward as estimating effort or story points. For instance, there is the potential difficulty that there is not "a feedback mechanism that corrects bad estimates as there is with story points", as the actual effort can be easily calculated afterwards to adaptive action is indicated. For value points the assigners can for instance assign high value points to all features without being corrected later, losing relevance and usefulness. The author proposed two methods to cope with this issue:

- "value points for individual stories should be limited to a short series of possible numbers (1, 2, 3, 5, 8, 13)", restricting the assigner in the number of points he or she may assign.
- "total value points should be allocated on a percentage basis to capabilities, thereby capping the total number of value points in a set of stories". According to the author, capabilities (also known as epics) are high-level business product functions delivering a complete and valuable set of features.

The value point analysis works great for customer related features. However, features that are not directly related to the customer, such as technical debt reduction features, technical features, or refactoring features, must be handled differently. For such features, the author recommends to assign relatively smaller values than the original set of possible values (e.g. 0; 1; 2; 3). He thus considers technical stories as less important and less value adding. This may not always be fair however, for example when a feature is really to prevent a system from a disastrous collapse in the future. This may be very valuable as well, which can be seen as the negative value (loss of value) as more often discussed (Z. Racheva, Daneva, Sikkel, Herrmann, et al., 2010; Sobiech et al., 2015).

The author concretely describes a method that uses point assignment per feature to determine business value in an agile project, and foster prioritization. This is very useful for proposing an elaborated estimation method, and eventually a method for evaluation. They describe estimation as the main purpose of the method, however they were also proposing the purpose of an evaluation method whereby this method can be considered as an advance.

Logue & McDaid (2008)
The authors propose a method for planning and selecting features as part of release planning in agile projects.

Their method consists of practices for "gathering all features, estimating both the size of each feature, expected value and also project velocity" (p.439). It recognizes that estimating business value is subject to uncertainty. The methodology allows for uncertainty in these three measures by assigning optimistic, pessimistic and most likely values for story sizes, business value and the project velocity (p.439). The story sizes and project velocity are expected to be estimated by the development teams, the business value by the product owners.

While the method increases the data required in planning agile projects, it remains relatively lightweight and fits well within the existing planning models (p.442). The method is only applied to the Extreme programming (XP) agile methodology, but has not been tested on others.

Racheva, Daneva, & Buglione (2008)
In the study, the authors tried to find a method in determining business value of a feature to support decision in agile projects. This method was an attempt to deliver business value in a more systematic way, as there was none at the moment of their writing. They used the knowledge available in the information technology domain about quantifying business value, accounting for "multiple aspects of the IT adoption, as operational, strategic managerial benefits from financial, customers' or process perspectives" (p.460).

They developed the business value measurement technique for the purpose of the paper. The technique is based on the Earned Business Value (EBV) technique that was introduced earlier in agile methods to provide more information about project progress from a business perspective, showing the known business value that is actually delivered. They adopt the calculation part of the technique, which measures the business value of each feature. They explain the following calculation steps (p.461):

"The client assigns additive weights to the buckets of the WBS, which represent features and other organizations of stories. Given this assignment, we can now calculate the Business Value (BV) of any WBS bucket, including Stories. The idea is simple and has two parts. First, the value of the whole tree is set 100% (or 1), which means that doing all the work gives all the value. This value (of 1) is assigned to the top of the tree."

"As we move down the tree, each bucket's value is the appropriate percentage of its parent's value, as compared to its 'siblings' - the other children of its parent. The calculation is recursive." They mention a specific formula for the calculation, which is further elaborated in their article

Using these steps, one can thus calculate the business value per story, and also the total business value for sets of stories combined.

Hoff, Fruhling, & Ward (2008)
In this article they didn't discuss a method for determining business value. However, they discussed the decision making aspect of stakeholders in deciding which features should be implemented in agile projects, which might be of use and should be taken into consideration.

What the authors found was that there are several different core decision factors that stakeholders see as more relevant and important than others. According to the authors, by knowing these factors project planners have more insight in how features should be prioritized according to their business value. The data suggests that the following decision factors are most important decision factors when prioritizing features (p.10):

- Impact to the Organization,
- Fixes Errors,
- Cost-benefit to the Organization.

Hartmann & Dymond (2006)
The authors of this article explain a concept for measuring the delivery of business value in agile projects. They argue that business stakeholders, such as research, marketing, sales, etc., should be involved in the business value realization of agile projects. Furthermore, business value is best determined by developers and business stakeholder together. Features then should be assigned a specific cost and business value (p.2).

They recommend several ways to measure the delivered business value in agile projects, of which all of them are of financial nature. The measures include Net Present Value (NPV), Internal Rate of Return (IRR), and Return on Investment (ROI) (p.4). In the end the recommend you to use one key metric for business value to focus on, that is closely related to the economics of investment (p.5).

However, the authors do discuss the measurement of business value, they don't mention how this should be carried out in practice.

Favaro (2003)
Although the article is somewhat outdated, the authors discuss mention some interesting aspects of business value measurement in their value based management for agile methods article.

First of all, they mention that there are only two primary determinants of business value creation, namely market economics and competitive position (p.18). Second, they argue that the strategic/financial framework in an organization should provide in what should be considered as valuable in an agile project, ideally forming the basis for evaluation in agile project management. For instance, the defined goals and objectives in the organization's strategy could be used, in the form of a mission statement providing a decision-making and conflict resolution principle, to decide which features are more valuable than others (p.19).

Considering measuring business value, the authors argue that business value should be measured using financial metrics, showing profitability and costs. They propose some example metrics in their article.

B.5 COMPARISON OF BUSINESS VALUE DIMENSIONS

In the literature mentioned in this review, different business value dimensions can be distinguished. To design a business value determination method, these dimensions might be of use. As the dimensions in the literature lack consensus and have. For the purpose of the determination method, the dimensions as found in the literature have been merged by similarity into Table 4.

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Table 4: Merged literature dimensions

DIMENSIONS	SOBIECH, EILERMANN, RAUCH (2015)	KAUTZ ET AL., (2014)	HEIDENBERG ET AL. (2012)	RUSNJAK ET AL. (2010)	RUSNJAK ET AL. (2010)	RACHEVA ET AL. (2010)	HOFF, FRUHLING, & WARD (2008)	QUMER & HENDERSON-SELLERS (2007)	MELVILLE ET AL. (2004)	FAVARO (2003)	AMIT & ZOTT (2002)	LEE (2001)
PROFIT CREATION	Financial value		Monetary value	Company	tangible value internal value		Cost-benefit to the organization	Value to Customer	Profitability improvement		Lock-in	Profit creation
COST REDUCTION	Financial value		Monetary value	Company	tangible value internal value		Cost-benefit to the organization	Value to Customer	Cost reduction		Efficiency	Cost reduction
INVENTORY REDUCTION	Strategic value (IT)			Company	tangible value internal value		Impact to the organization	Value to Process	Inventory reduction		Efficiency	
MARKET ENABLER	Strategic value (Customer)		Market enabler	Environment	intangible value external value		Impact to the organization	Value to Customer	Competitive advantage	Market economics	Novelty	
COMPETITIVE POSITION	Strategic value (Customer)			Environment	intangible value external value		Impact to the organization	Value to Customer	Competitive advantage	Competitive position	Novelty	
COMPETENCE GROWTH	Strategic value (Customer)		Competence growth	Company	intangible value external value		Impact to the organization	Value to Team				
PRODUCTIVITY ENHANCEMENT	Work organizational value	productivity		Environment	tangible value internal value		Impact to the organization	Value to Process	Productivity enhancement		Efficiency	
STRATEGIC VALUE (IT)	Strategic value (IT)			Company	intangible value internal value		Impact to the organization	Value to Process			Efficiency	
NEGATIVE VALUE	Negative value			Company	intangible value internal value	Negative value	Impact to the organization	Value to Customer			Efficiency	
FIXES ERRORS	Software qualitative value	quality		Technology	intangible value external value		Fixes Errors	Value to Product			Efficiency	
TECHNICAL ENABLER	Strategic value (IT)	quality	Technical enabler	Technology	intangible value external value			Value to Product			Novelty	
EMPLOYEE SATISFACTION	Strategic value (IT)	employee satisfaction	Employee satisfaction	Environment	intangible value internal value		Impact to the organization	Value to Team			Efficiency	
CUSTOMER SATISFACTION	Strategic value (Customer)		Customer satisfaction	Company	intangible value external value			Value to Customer			Lock-in	
SOFTWARE QUALITY	Software qualitative value	quality		Company	intangible value external value			Value to Product				
COMPLEMENTARITIES	Software qualitative value	quality		Company	intangible value external value			Value to Product			Complementarities	
TERTIARY VALUE	Tertiary value			Company	intangible value external value		Impact to the organization	Value to Customer			Lock-in	
VALUE TO WORKSPACE				Environment	intangible value internal value		Impact to the organization	Value to Workspace			Efficiency	

Appendix C:
INTERNAL INTERVIEW FRAMEWORK

The interviews are set up to come to a business value determination method that results from the input of all stakeholders and users. A semi-structured interview approach will be used, as it is best used when there is only one or a few chances to interview an individual (Bernard, 1988). It consists of using an interview framework of predefined questions to guide the interview.

From all the conclusions of the literature review, there are some indistinctness's that need to be tackled and assumptions that need confirmation (see literature review).

The following roles in the organizations are being interviewed:

- Business owners / Business stakeholders (BO)
- Product owners (PO)
- Business analysts (BA)
- Scrum masters / Team leaders / Developers (DE)

The roles will be couples to each other, and as such selected for the interviews. A couple consists of one of each role.

The questions that need to be asked per respondent are to tackle some of the main issues. The questions per main issue are displayed in Table 5. The questions don't have to be asked literally, however function as a guidance to give the interview process structure and to be sure that nothing will be overlooked.

Table 5: Interview questions and sub-questions

Context and control information	BO	PO	BA	DE
What topics within the organization are you concerned with?	X	X	X	X
To what extent are you concerned with the business value topic?	X	X	X	X
Business value	BO	PO	BA	DE
What is your definition of business value?	X	X	X	X
What creates business value from your perspective?	X	X	X	X
Which of the dimensions have influence on value creation within the organization?	X	X	X	X
How does the relation between business and development withhold?	X	X	X	X

Current situation	**BO**	**PO**	**BA**	**DE**
How does a product/feature request originate? Are you driven by business plans, goals and objectives to determine what should be developed?	X	X		
How does a product/feature request originate?	X	X		
What is your workflow within the agile organization?	X	X	X	X
How do you prioritize the features that were developed?	X	X		
How do you evaluate the features that were developed?	X	X	X	X
How do you perform feature effort estimation?		X	X	X
Desired situation	**BO**	**PO**	**BA**	**SM**
Would you encourage the use of a business value determination method?	X	X	X	X
How would you estimate business value? (using the guidelines for estimation)	X	X	X	X
Who should be involved in estimating business value?	X	X	X	X
How would you measure business value?	X	X	X	X

Appendix D:
EXTERNAL INTERVIEW FRAMEWORK

The interviews are set up to test whether the business value determination method can actually be used outside the organization. A semi-structured interview approach will be used, as it is best used when there is only one or a few chances to interview an individual (Bernard, 1988). It consists of using an interview framework of predefined questions to guide the interview.

- *Main Artefact questions*
    - *What do they think about it?*
    - *Recognition?*
    - *Something missing or incomplete? Would they do it differently?*
    - *Can it be applied to their situation?*

1. Current situation on agile development
    a. Team structure?
    b. Work process?
    c. Currently using business value?
2. Business value model
    a. What is business value to him?
    b. Explain business value model
    c. *Main questions*
    d. Value to internal? To product? To customer?
    e. Financial value as a result?
3. Estimation method
    a. Explain artefact
    b. *Main artefact questions*
4. Measurement method
    a. Explain artefact
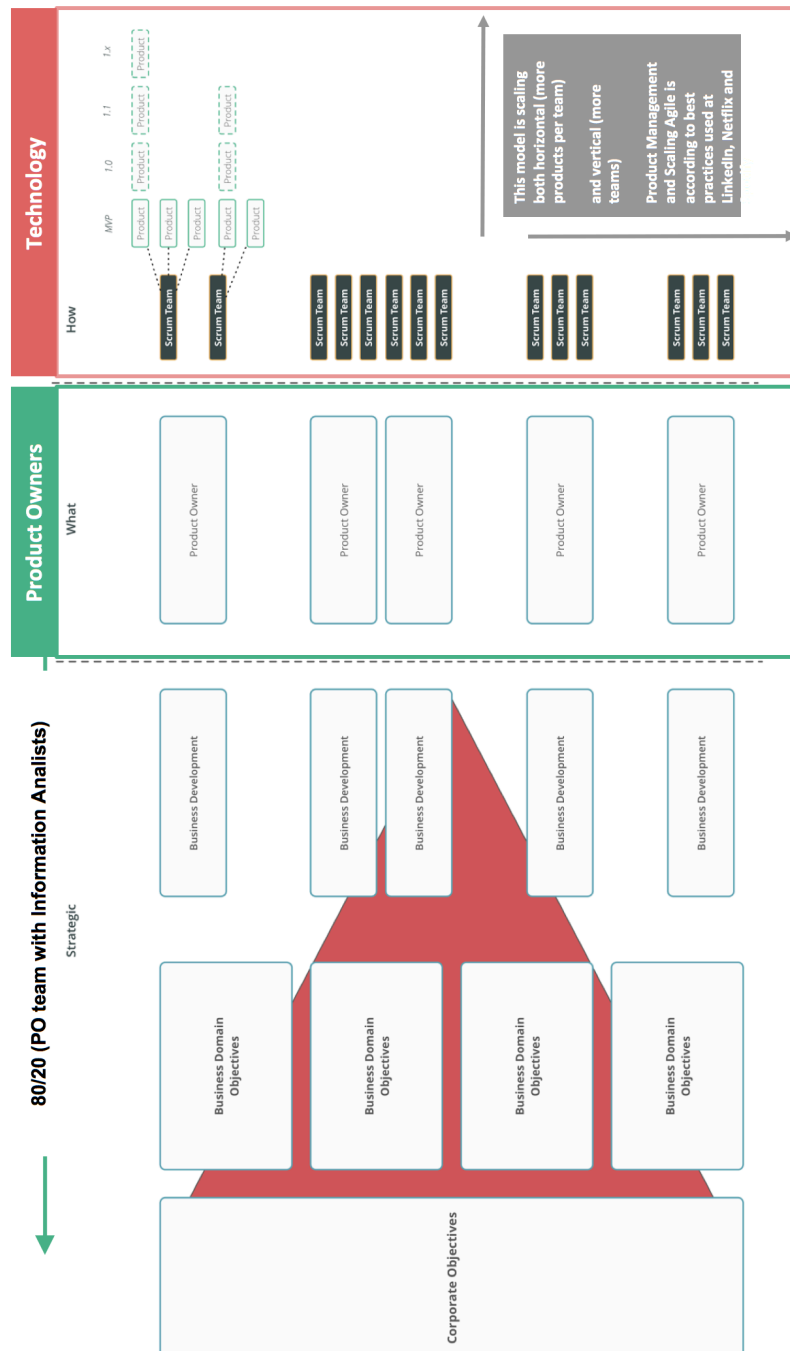   b. *Main artefact questions*

Appendix E:

AGILE TEAM STRUCTURE

Figure 6: Unit of analysis' agile team structure as per December 15, 2015