
3G
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Messages
Calendar
Photos
Camera
YouTube
Stocks
Maps
280
Weather
73°
Notes
Utilities
iTunes
App Store
Settings
The App Economy
How start-ups create business value with mobile applications
Phone
Mail
Safari
iPod

THE APP ECONOMY

HOW START-UPS CREATE BUSINESS VALUE WITH MOBILE APPLICATIONS

MSc THESIS INNOVATION & ENTREPRENEURSHIP

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SUMMARY

Background – Mobile applications ('apps') are a relatively new phenomenon with rapidly growing popularity. There are indications that apps have the potential to create economic value. Much is unknown about the value that apps create, and the manner in which organizations can leverage the value creating potential of apps.

Objective & setting – The research goal of this study is to explain the business value of apps. The study will focus on explaining value creation by examining app-enabled economic opportunities initiated by start-up ventures. The research goal is met by focusing on two elements of the business value of apps: (1) an explanation of the business *process* of app-enabled value creation and (2) an explanation of the type of *outcomes* associated to the use of apps for business purposes.

Approach – A Dynamic Capabilities perspective is taken to explain the process and outcomes of app-enabled value creation by start-ups using interpretive case study research. The chosen theoretical framework is the Net-Enabled Business Innovation Cycle (NEBIC), which is used as basis for the collection, analysis, and reporting of data. Data on eight cases selected by method of intensity sampling are collected through interviews with the founding entrepreneurs and from additional sources such as websites and business plans.

Findings – The results include (1) the identification of twelve routines matched to four capabilities for creating business value using apps, (2) the explanation of the interactions between the four capabilities leading to a model representing the app-enabled value creation process, and (3) the identification of eleven types of app-enabled business value, categorized into four dimensions and matched to the capabilities making up the value creation process.

Conclusions – An understanding is created about how start-ups create business value by using apps for business purposes and what type of business value is created in this process. This understanding forms a basis for future studies on app-enabled value creation; directions for further research are formulated. The results also provide managers with insights regarding the creation of business value with apps, which can guide decision-making on the business adoption of apps.

Keywords – Mobile applications, apps, economic value, business value, app-enabled value creation, start-ups, app-entrepreneurs, Dynamic Capabilities, NEBIC, interpretive case study.

PREFACE

What is the economic impact of apps? Inspired by this question I started my graduate research at TNO, a research & technology organization. The recent proliferation of the app-phenomenon makes it a very interesting topic of study. Many people use them, but do they actually create value? I hope the reader will enjoy the insights on app-enabled value creation provided by this study.

I would like to express my gratitude to the whole team of advisors for their very valuable guidance during the investigation. The university team, including Fons Wijnhoven and Michel Ehrenhard, were of great help to place the study in an academic context, providing me with insights on how to frame the research. The TNO team, including Bas Kotterink and Tijs van den Broek, provided great inspiration and helped me to advance the investigation. I would like to thank my family and friends for their support and patience during this last phase of study. Special thanks go to my father for years of implicitly forming my analytical skills.

TABLE OF CONTENTS

LIST OF FIGURES AND TABLES

1 INTRODUCTION: THE BUSINESS VALUE OF APPS

1.1 APPS & THE ECONOMY

'App'[1] was voted word of the year in 2010 by the American Dialect Society. Apps have gained strong popularity in recent years, and currently over a third of the adult population in the U.S. has apps on mobile phones (Purcell, Entner, & Henderson, 2010). Since its launch less than four years ago, Apple's App Store has seen over 25 billion apps downloaded, and has an availability of over 500 thousand apps (Apple, 2012). Popular examples are gaming apps (e.g. Angry Birds), social networking apps (e.g. Facebook mobile), and GPS navigation apps (e.g. Google navigation).

Apps have the potential to impact the economic performance of organizations and countries. The sale of apps alone generated around € 5 billion in 2011, and is estimated to grow to over € 18 billion in 2016 (iDate, 2012). In the U.S., employment related to the 'app economy' is estimated at over 460 thousand jobs in 2011 (Mandel, 2012). Organizations are presented with new opportunities to create value using apps (Varnali & Toker, 2010). Firms are adopting apps in an attempt to meet new demands, increase efficiency, and improve competitiveness (Unhelkar & Murugesan, 2010). There are indications that apps can be used for different facets of business, for example as a new marketing medium, allowing more efficient inventory management, and providing a mobile office environment to employees (Varshney & Vetter, 2002). A recent report shows that small businesses are benefiting from using apps because they allow entrepreneurs to work more effectively and thus save time and money (Small Business & Entrepreneurship Council, 2011). However, given the high adoption numbers by the public, besides being leveraged to boost internal productivity apps can be deployed on the customer-side of an organization. Many large established organizations have attempted to create value with so-called 'branded apps' (Distimo, 2011a), but success stories are rare as many of the apps published by major brands have low download numbers (Deloitte, 2011). Because of the little research done in this field to date, much is unknown about the value that apps create, and the manner in which organizations can leverage the value creating potential of apps.

1.2 RESEARCH GOAL: THE BUSINESS VALUE OF APPS

Apps are part of the mobile information technology (IT^2) landscape, and research has shown that IT in general contributes to economic performance (for an overview see Dedrick, Gurbaxani, & Kraemer, 2003). It is important for researchers, managers, and policymakers to know *how* IT contributes to economic performance to guide effective decision-making (Melville, Kraemer, & Gurbaxani, 2004). In the field of Information Systems this stream is termed 'IT business value' research. In this field it is important to study the paths to economic value[3] that are influenced by IT (Kohli & Grover, 2008). Several calls have been made for investigating how businesses create value in the context of *mobile* IT (e.g. Basole, 2007; Ladd, Datta, Sarker, & Yu, 2010). Following these calls, the main research goal can be formulated as follows.

RG: *Explain the business value of apps*.

'Explaining' a phenomenon aims at developing an understanding of 'how things are' (Gregor, 2006). The resulting explanation provides insights to organizations on how to create value with apps.

[1] Throughout this paper the term *app* will be used to refer to a *mobile application*.
[2] Throughout this paper the abbreviation *IT* will be used for *information technology* and *information technologies*, depending on the grammatical context.
[3] In research dealing with IT business value, the term *economic value* is often used as synonym for *business value*. In fact, business value is a broader concept, including value that cannot directly be expressed in monetary terms, such as *increased competitive capability*.

1.3 FOCUS ON VALUE CREATION BY START-UPS

This study will focus on app-enabled value creation by start-ups. Start-ups are ventures in the process of defining a viable and scalable business model to exploit market opportunities; the start-up entrepreneur is the visionary driving this process (Gries & Naudé, 2010). Choosing start-ups and their founding entrepreneurs as focus for the investigation of value creation with apps has two main reasons.

(1) From a theoretical perspective, start-ups and their founding entrepreneurs are viewed as fundamental for economic transformation and growth (Gries & Naudé, 2010; Schumpeter & Backhaus, 2003). Especially when dealing with opportunities relating to novel technologies in new and dynamic markets, as is the case with apps, entrepreneurs are those who identify and explore these opportunities (M. A. Hitt, Ireland, Camp, & Sexton, 2001). Therefore, entrepreneurial start-ups provide fertile ground for strategic management research (Carland, Hoy, Boulton, & Carland, 1984) and examining these start-ups could yield novel and rich explanations of the business value of apps.

(2) From a practical perspective, the success stories relating to apps usually come from small start-ups. Many entrepreneurs have developed their app-enabled ideas and created 'million dollar' start-ups.[4] As mentioned in section (1.1), success stories coming from large established organizations creating value with apps are rare.

It should be noted that the validity of the results for large organizations might be limited by focusing this study on start-ups. However, also in large organizations new opportunities are identified and seized by entrepreneurial efforts connected to the organization, because industry incumbents are often blind to these opportunities (Wheeler, 2002). Therefore, explaining the value creation by start-up entrepreneurs can prove insightful to organizations of all sizes in their decision-making on the implementation of apps.

1.4 RESEARCH QUESTIONS AND APPROACH

Following Gregor (2006), an 'explanation' of the business value of apps should include a description of how business value is created (i.e. the process), and what the business value of apps is (i.e. the outcome). Following this reasoning, two research questions are formulated.

RQ1: ***How do start-ups create value by using apps for business purposes?***

This question should result in the identification of the key factors for creating business value using apps and an overview of the process of value creation.

RQ2: ***What type of value is created by start-ups that use apps for business purposes?***

This question should result in the identification and categorization of the business value of apps, providing insight into the type of outcome that is created using apps.

Most studies investigating the value of IT have their roots in the field of production economics. Basically, these studies investigate what part of the value at the output of a production system can be accounted for by IT related inputs. However, more recent studies on IT business value refute the 'black box' production models, and aim at investigating what goes on inside the production process.

[4] Many examples of small start-ups creating value through novel app-enabled business models are available by searching on Google for 'app success stories.' A recent and notable success-story is that of Instagram, a mobile photo-editing and sharing app. It was created by two entrepreneurs in 2010, and was purchased by Facebook for one billion dollars in 2012.

This perspective is grounded in the Resource-Based View (RBV) of IT, and poses that an IT related input on itself cannot create value, because the resource will probably be easy to copy by competing firms. To look inside the black-box production system it is argued that the focus should be on the *dynamic business capabilities* that shape the IT input and ultimately creates value (Kohli & Grover, 2008). Both approaches are further explored in sections (2.2) and (2.3). This study will take a Dynamic Capabilities perspective to answer the research questions, focusing on the business capabilities needed to create value with apps. By exploring the process and outcome of app-enabled value creation by entrepreneurial entities, this study attempts to explain the business value of apps.

Chapter (2) will first present some background on the topic of apps and IT business value, followed by a discussion of the NEBIC model in chapter (3), which is the theoretical framework that will be used for the empirical part of this study. Chapter (4) presents the interpretive case study methodology use for the empirical investigation. Based on the results presented in chapter (5), some theoretical propositions are discussed in chapter (6). Finally, chapter (7) will conclude with the study implications and limitations, and future research directions.

2 BACKGROUND: APPS & IT BUSINESS VALUE

This section presents a working definition of apps and gives an overview of the economic activity related to the app ecosystem. Subsequently, a review is presented of the two main streams in IT business value research: (1) the production economic-based approach and (2) the Dynamic Capabilities approach.

2.1 APPS: DEFINITION & ECOSYSTEM

2.1.1 WORKING DEFINITION OF BUSINESS APPS

The most popular and most frequently downloaded apps are related to gaming or social networking functions (Distimo, 2011b). However, apps may take on a large variety of functions, and it is therefore necessary to formulate a working definition of apps before taking a closer look at their business value. Bellman, Potter, Treleaven-Hassard, Robinson, and Varan (2011, p. 191) narrowly define apps as "*software downloadable to a mobile device*," corresponding to the popular idea of what apps are. However, this definition may be too narrow. In the near future it is likely that it will not matter whether the software is installed on the mobile device or (part of) the code is stored on a central location and accessed using very limited software on the mobile device. This is the basic premise of recent developments termed 'cloud computing' (Armbrust et al., 2010). Additionally, it is expected that through the proliferation of HTML5[5], mobile websites will be able to behave as 'native' apps (i.e. installed on the device) behave today. HTML5 allows websites to be more interactive, further blurring the line between native mobile apps and web-based applications accessed through a mobile device's web-browser.

Nickerson, Varshney, Muntermann, & Isaac (2007, p. 2) define apps in a broader sense as "*a use of a mobile technology by an end-user for a particular purpose*." This definition is more complete than the previously mentioned one. Next to defining the *form* of an app as 'a mobile technology', the definition reflects the importance of the *function* and *fit* of the apps; namely, it includes a 'purposeful use' and a 'user'. The latter two are especially important in the context of this study. Value is not created by just a technology, but it is rather created through the interplay of the technology, the user, and the purpose of use. However, the focus of the above definition is on mobile computing in general, as it would include all uses of a mobile technology. This includes mobile phones and tablet pc's, but, for example, also WiFi-enabled laptops. A narrower definition may be more useful for the purpose of the current study. The definition by Nickerson, et al. (2007) is narrowed down through the following reasoning.

- This study is interested in the activities that can be carried out on *mobile phones* and *tablet pc's*. Laptops are excluded as they are more closely related to the desktop pc than to mobile phones and tablet pc's, based on for example function, input/output mechanisms, and operating software. However, due to the technological convergence in the field of mobile computing, the line dividing desktop and laptop pc's on the one hand, and mobile phones and tablet pc's on the other, is becoming increasingly blurry. An important manifestation of this convergence is captured by the soon-to-be released operating system Microsoft Windows 8, that aims at running on many different forms of (mobile) devices, and providing a consistent delivery of functionality and user-experience on the different devices.

[5] HTML5 is the fifth revision of the standard language used for websites.

- The current study focusses on apps that potentially have a *business value*. From a business-user perspective, this includes, for example, the use of apps for providing information to employees and facilitating collaboration between employees. However, the end-user does not need to be within the boundaries of the organization for the app to hold business value. For example, an app could be used by organizations to communicate with suppliers, or reach and attract customers. Table 1 presents a functional taxonomy of business apps based on the level of interactivity adapted from Unhelkar and Murugesan (2010). This taxonomy gives an overview of the uses of apps that might hold the business value this study is aiming to assess. Five app types are distinguished with increasing level of interactivity between the user and the app, namely broadcast, information, transaction, operation, and collaboration apps. Table 1 gives a short description of each of the app types, providing an indication of the kind of business value that is associated with them. It should be noted that the different types are not mutually exclusive; one app could perform different functionalities and, therefore, fall under multiple categories.

TABLE 1. *Functional taxonomy of business apps based on their level of interactivity (adapted from Unhelkar & Murugesan, 2010).*

	App type	Description of delivered value
Interactivity ↑	Collaboration	Supports collaboration within and outside the enterprise
	Operation	Facilitates operational aspects of the business (e.g. inventory management, HR management)
	Transaction	Facilitates e-transactions, customer relationship management, and sales and marketing
	Information	Provides information sought by the mobile user (e.g. timetables, weather conditions)
	Broadcast	Facilitates large-scale information broadcast to mobile devices (e.g. advertisements, promotions)

- The activity performed on the mobile device takes place through an *interface* governed by software. To get a better feel of the IT under investigation, the interfacing characteristic of apps is included in the definition. An app interfaces between front-end (i.e. end-user) and backend (e.g. phone software, servers) to exchange information. This shows that an app is embedded in a larger information system. The software governing the interface is either installed on the mobile device, or accessed through the device's wireless connection. Through this understanding web-applications accessed through a mobile device's internet browser are mobile applications as well.

On the basis of the former, the working definition of a business app for this study is given by:

a use of an interface on a mobile phone or tablet pc by an end-user for a purpose that potentially holds business value

2.1.2 THE APP ECOSYSTEM

The economic activity surrounding apps involves many actors. The app ecosystem shown in figure 1 shows the actors involved in creating value with apps and, as such, provides an overview of the economic activity related to apps.

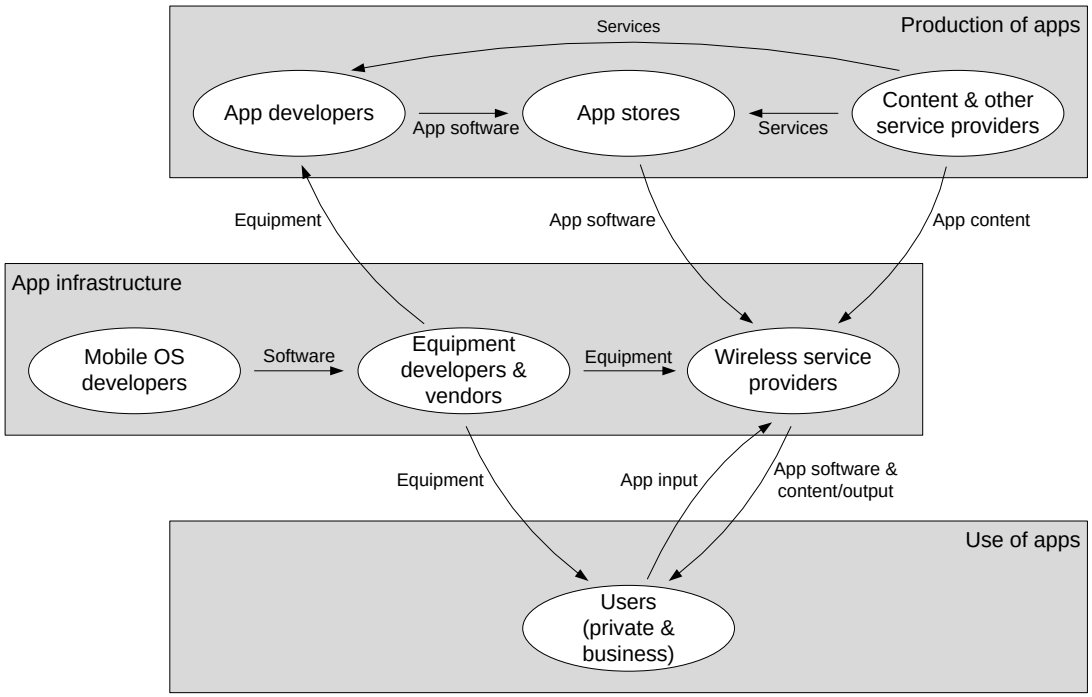

FIGURE 1. *Actors and interactions of the app ecosystem (adapted from the mobile commerce lifecycle by Varshney & Vetter, 2002)*

Three separate levels of economic impact can be identified from the three groups of actors showed in figure 1. The following list elaborates on some of the properties of the three levels of impact.

(1) The first level of economic impact related to the **production** of apps can be divided into two tiers. The first tier of impact lies with the creation of new business activity for app developers. Here, app developers are those that make an app, i.e., related to the software coding process. The second tier of impact is the economic activity created in the form of services provided in support of the production and use of apps. The app stores, such as the Apple App-store and Google Play, provide a distribution platform for the apps. Also, there are organizations that provide content and other services supporting the production and use of apps. Supporting services could be, for example, analytics on app use for app developers, mobile payment platforms mediating between users, or app related content services like weather forecasts or train schedules delivered through the wireless service providers.

(2) The second level of economic impact is related to the provision of the **infrastructure** allowing for apps to be produced and used. The proliferation of apps might affect the demand for equipment and services that enable apps to be produced and used. This level of impact is mostly characterized by building and maintaining the hardware and software infrastructure, and the services related to these activities.

(3) The third level of economic impact is related to the **use of apps**. This is the level of impact the current investigation is going to focus on, since this study aims at explaining the business value gained by start-ups employing apps for business purposes. Business users employ an app for work-related tasks, while private users employ an app for personal purposes. Both uses might hold business value for start-ups. For example, private use of an app by consumers might be valuable for businesses to reach and attract them.

Mobile technologies in general are viewed as a disruptive innovation (Latzer, 2009). Therefore, in addition to these three levels of impact in the app ecosystem, apps might have a destructive effect on other industries. For example, gaming apps might negatively affect the traditional PC and console gaming industries. Studies that aim to assess the value created at a higher level of aggregation (e.g. country-level) should also account for the destructive economic effect of apps. This study will not focus on these effects.

2.2 A PRODUCTION ECONOMICS APPROACH TO IT VALUE RESEARCH

2.2.1 IT BUSINESS VALUE & PRODUCTION ECONOMICS

Most studies investigating the value of IT have their roots in the field of production economics. Productivity is a fundamental measure in this field, and is used to measure the contribution of a technology to economic performance (Brynjolfsson & Yang, 1996). Productivity reflects the efficiency of value creation. Higher productivity at the firm level results in more added value, which can lead to competitive advantage and better organizational performance. Higher productivity at the aggregate level (i.e. industry or macro-economic domain) can result in more employment and/or higher wages, which ultimately lead to better economic performance and more wealth. In the 1980s, the first studies investigating the impact of IT showed no relation between IT and productivity (Dedrick, et al., 2003). This so-called 'productivity paradox' was famously described by Robert Solow: "we see computers everywhere except in the productivity statistics" (quoted from Brynjolfsson, 1993).

According to Brynjolfsson (1993), the productivity paradox was partly caused by deficiencies in research methodologies. Improved scientific analyses provided evidence of IT related productivity, refuting the paradox. Using the framework depicted in figure 2, Dedrick, et al. (2003) reviewed more than 50 empirical articles that successfully related IT to economic performance. The framework provides insight in some of the variables and relationships that are commonly investigated in empirical IT value research. Most of the empirical assessments used production economic-based models. In this type of research, the train of thought is to investigate what part of the *outputs* can be explained by *input* in the form of IT capital through regression analysis. If a significant effect is established, the impact of IT can be estimated as an outcome usually measured by increased productivity (i.e. the efficiency of converting input into output). Other frequently used outcome measures are growth and profitability. 'Softer' outcome measures, such as a firm's competitive capability and consumer welfare, are less popular measures in production economic-based studies on IT value. The main reason for this is that they are harder to express quantitatively and as such harder to use in a regression analysis. The analysis can be done at different levels within a production system, i.e. firms or aggregate levels of firms. Studies have found a positive economic impact of IT on firms (for an overview see Kohli & Devaraj, 2003), industries (e.g. Stiroh, 2002), and the macro-economy (for an overview see Van Ark, 2002).

The impact IT has is governed by complementary factors, such as management practices within firms, industry organization, and government policy. Some studies account for these factors by including them as moderators when investigating the relationship between IT capital and output-value (e.g. Chen & Zhu, 2004; Mittal & Nault, 2009). However, production economic-based models are primarily concerned with relating input to output. As such, they do not zoom into the 'black-box' of the business process to look at how IT and the complementary factors actually create value. The production process is related to the third level of impact from figure 1, namely the use of apps. The first two levels of impact discussed in the previous section (i.e. production and infrastructure of apps) are actually all inputs to creating value by employing apps in business processes. Because this study aims at explaining *how* value is created using apps (i.e. RQ1), it is needed to zoom in to the

process. Using a black-box production economic-based model will not serve this study to meet its research goal. Nevertheless, the following section will derive such a model to show why it is unfeasible to use this approach to answer the research questions.

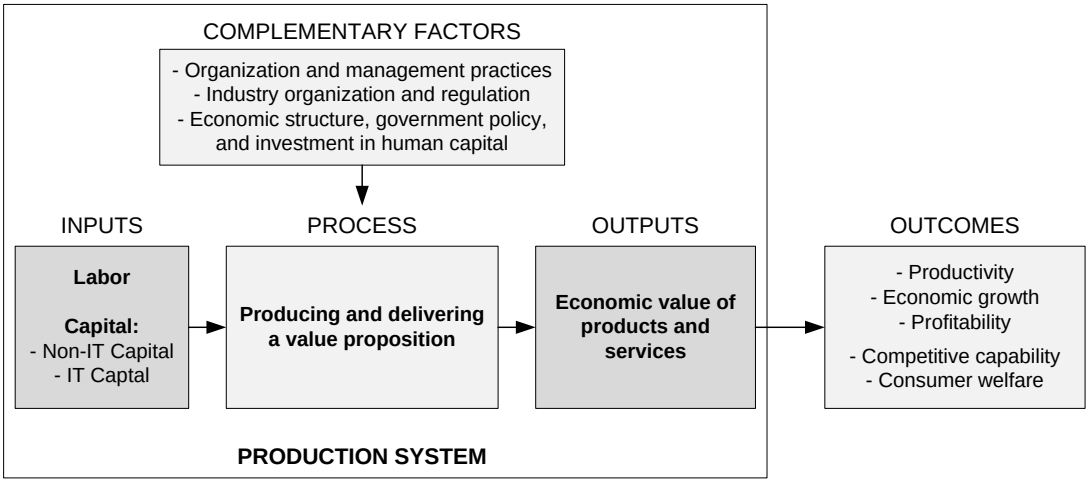

FIGURE 2. *IT and economic performance (adapted from Dedrick, et al., 2003).*

2.2.2 A PRODUCTION ECONOMIC-BASED MODEL FOR THE BUSINESS VALUE OF APPS

A production function can be used to assess the business value of apps by estimating the impact apps have on the productivity of a production system. Production functions have their root in economic theory and are mathematical representations of a production system in which the outputs are explained by an algebraic combination of inputs. The productivity of a system reflects the efficiency with which the inputs are used to create the output. It has been demonstrated that the Cobb-Douglas production function best characterizes firm-level production in the context of IT (Gurbaxani, Melville, & Kraemer, 2000), and is commonly used in similar research (Brynjolfsson & Hitt, 2003). A basic Cobb-Douglas production function is given by equation (1).

$$V = A\, L^{\beta_L}\, K^{\beta_K}\, IT^{\beta_{IT}} \qquad (1)$$

where:

- V = production value (i.e. output measure)
- A = an efficiency parameter explaining variations in output not accounted for by the inputs, often captured by Total Factor Productivity,
- L = labor input,
- K = non-IT capital input,
- IT = IT capital input, and
- β = output elasticity of the respective factor (i.e. a measure explaining how much the output changes for every unit change of the respective input).

Research explaining the business value of IT aims at estimating the output elasticity of IT (β_{IT}) to explain what part of the production value can be accounted to the use of IT. By taking the natural logarithm of equation (1), the Cobb-Douglas production function can be rewritten into equation (2). The resulting equation (2) allows the estimation of the output elasticity measures (β) of the production function through regression analysis for a given set of in/output measures and efficiency parameter.

$$\ln V = \ln A + \beta_L \ln L + \beta_K \ln K + \beta_{IT} \ln IT + \varepsilon \quad (2)$$

where:
ε = estimation error term.

In line with previous studies, it is possible to model a parameter capturing a specific IT in the production function (e.g. Aral, Brynjolfsson, & Wu, 2006; L. M. Hitt, Wu, & Zhou, 2002). For the purpose of this study, equation (3) includes a term for 'app adoption' in the model. IT capital and non-IT capital are summed as it is not necessary to estimate separate output elasticity measures for them (β). Equation (3) also models year dummies to account for economy wide shocks, and industry dummies for controlling variations in performance due to industry differences.

$$\ln V = \ln A + \beta_{AA} AA + \beta_L \ln L + \beta_{K+IT} \ln(K + IT) + Year + Industry + \varepsilon \quad (3)$$

where:
AA = app adoption,
Year = time control variable, and
Industry = industry control variable.

App adoption should be represented by one or more variables capturing the level of a firm's implementation and use of apps for a business purpose. Although 'investment' in the IT is traditionally used as adoption variable (L. M. Hitt, et al., 2002), research has indicated that for the purpose of linking IT to the value it creates, it is necessary to dig deeper into the adoption of the IT by looking at its actual use (Aral, et al., 2006; Devaraj & Kohli, 2003). Before being able to quantify the value apps create by estimating β_{AA} in equation (3), it is needed to conceptualize an app adoption variable. 'Investment in apps' as an adoption variable fails to include the way in which the apps are used. Logically, an organization can invest in apps, but if they are poorly developed or implemented, value creation could hold off. Looking inside the black-box of the production system and exploring how apps actually impact the production process is a first step in the direction of conceptualizing an app adoption variable. Furthermore, such an investigation is valuable in itself to provide guidance for businesses wanting to adopt apps.

An additional weakness of the model in equation (3) is the limited data available for estimation. This study would rely on the availability of secondary data to estimate equation (3) because of the cost and time involved in collecting the necessary firsthand data. The needed production data can be accessed through, for example, Statistics Netherlands or Eurostat, and are available until 2008. Although there are datasets available on the business adoption of apps from analytics companies, these data do not go further back than 2010. This limitation means that at present the datasets cannot be linked to each other, leaving an estimation of equation (3) unfeasible.

2.3 A DYNAMIC CAPABILITIES APPROACH TO IT VALUE RESEARCH

2.3.1 CONSIDERATIONS FOR IT BUSINESS VALUE RESEARCH

Previous studies in the field of IT business value reveal several considerations to be made for researchers to advance investigation in this field. This section discusses some of these considerations to be made when investigating the business value of IT.

- **Use of firm-level data**
  One of the issues in IT value measurement is caused by inaccurate or unavailable data (Dedrick, et al., 2003). Availability of firm-level data in the 1990s allowed for improvements in impact assessment, in contrast of using industry or macro-level aggregates (Brynjolfsson,

1993). Studies revealed differences in IT productivity among firms, indicating that some firms used IT more productively than others (Dedrick, et al., 2003). A study by Brynjolfsson & Hitt (1995) showed that about half of the productivity benefits generated by IT-investments depended on what they called 'firm-effects'. This means that there are many complementary factors that influence the conversion of IT-investment into output. The approach to this study should account for the firm-effects to understand the impact of apps. Therefore, the individual organization will be the focus of the investigation, as firm-effects cannot be analyzed using aggregate data.

- **Account for complementary factors**

  Production economic-based impact models often relate IT measures to productivity through a black-box value production process. To explain the previously mentioned firm-effects and their relation to IT, the analysis should take a look at "what goes on inside the black-box of the firm" (Brynjolfsson & Hitt, 1998, p. 52). Firm-effects are shaped by organizational factors, such as management practices, complementary investments, and IT training (Brynjolfsson & Hitt, 1998; Dedrick, et al., 2003). Also environmental factors should be taken into account, such as the characteristics of trading partners, industry, and country (Melville, Gurbaxani, & Kraemer, 2007; Melville, et al., 2004). According to Brynjolfsson and Hitt (2000, p. 45), "both case studies and econometric work point to organizational complements such as new business processes, new skills and new organizational and industry structures as a major driver of the contribution of information technology." To account for complementary factors in this study, the apps need to be analyzed in relation to their context. Section (2.3.2) explains the Dynamic Capabilities perspective in relation to app-enabled value creation, which focusses on looking at how complementary factors shape the process of value creation.

- **Look beyond productivity**

  The value that IT creates can manifest itself in many forms (Kohli & Grover, 2008). One of the shortcomings in the production economic-based models is that it fails to see the non-productivity impacts. For example, the use of IT can create business value which is passed on to customers in the form of price-reductions (Mithas, Tafti, Bardhan, & Goh, 2007). In addition, there might be manifestations that are hard to measure quantitatively, such as securing an organization's competitive position (Avgerou, 2001). Schryen (2011, p. 4) calls this the "ambiguity and fuzziness" of the IT business value construct and calls for looking at different types of value, such as improved market-oriented capabilities. Section (2.3.3) explains what types of value are associated to the use of IT, and conceptualizes an 'IT business value' construct to capture many different manifestations of IT value.

- **Look at the long-run impact**

  Productivity surges caused by IT can develop over time, with increased impact in the long-run. Brynjolfsson & Hitt (2003) found that, over a longer time horizon, IT is associated with a contribution to productivity that is between two and five times larger than in the short-run. This is partly related to the complementary factors previously discussed; organizational complements such as additional investments in training take time to implement and exploit. Studying the implementation of IT and the creation of value over a longer horizon is not always feasible, and requires considerable commitment of time and money (Paré, Bourdeau, Marsan, Nach, & Shuraida, 2008).

- **Account for spillovers**
  Research has also indicated the presence of IT-related spillovers (Chang & Gurbaxani, 2011). IT-related investment and knowledge can spill over from a firm's trading partners and create value at the focal firm. Complementary factors like, for example, industry characteristics, have been shown to shape the spillover effects (Han, Chang, & Hahn, 2011). Investigating spillovers requires the analysis of a value producing *network* of businesses. This study is concerned with the value creation by start-ups, not the whole value-network of the start-up. Therefore, investigating spillovers will not be a focus in this study.

2.3.2 DYNAMIC CAPABILITIES TO EXPLAIN APP-ENABLED VALUE CREATION

The body of research in the field of 'IT business value' has been in decline since it peaked around the turn of the century (Schryen, 2011), despite its fundamental contribution to the Information Systems discipline (Kohli & Grover, 2008). One of the reasons for this fact may be that much of the more recent work is not coined IT business value research, because it focusses more on what goes on inside the black-box of the production system (Melville, et al., 2004). This is in contrast to the earlier work attempting to pin a value to IT in the form of a percentage increase in productivity, as described in section (2.2). Recent literature suggests that it is also valuable to know *how* an IT can create value. For this purpose, most business value research has shifted from using production economics as theoretical basis, to employing a Resource-Based View (RBV) on IT (Santhanam & Hartono, 2003; Wade & Hulland, 2004).

Adopting an IT resource alone cannot provide a competitive advantage, because the resource will probably be easy to copy by competing firms. The RBV poses that the creation of *valuable*, *rare*, and *inimitable* (VRIN) IT resources provides a competitive advantage (Aral & Weill, 2006). However, the RBV does not seem to apply in dynamic markets (Eisenhardt & Martin, 2000), like the one concerning apps. The main reason for this is that competitive advantage from VRIN resources in fast-moving markets erodes because of the speed with which new technologies disrupt the market (Wheeler, 2002). To compete in dynamic markets, organizations need to continually build new, and reconfigure their existing VRIN resources to create novel forms of competitive advantage. This view is captured by the Dynamic Capabilities perspective, which is an extension of the RBV (Teece, Pisano, & Shuen, 1997).

The essence of the Dynamic Capabilities perspective is that competitive advantage comes from having strong capabilities in the form of routines that continually create and reconfigure VRIN resources (Teece, et al., 1997). Dynamic capabilities are "organizational routines through which firms achieve new resource configurations" (Eisenhardt & Martin, 2000, p. 1107). Examples of such capabilities are product development routines and strategic decision making. The capabilities themselves are not a source of competitive advantage; it is the effective *evolution* of the capabilities that provides long-term advantage (Wheeler, 2002). Learning mechanisms guide the evolution of the capabilities (Zollo & Winter, 2002). Because of market dynamism the effective evolution of the capabilities depends on a manager's ability to assess and understand changes in the market and respond to them in a timely manner by reconfiguring organizational resources. Therefore, dynamic capabilities can be viewed as a combination of 'simpler capabilities' and their related routines for resource configuration (Wheeler, 2002).

App-enabled value creation can be seen as a dynamic capability (cf. Wheeler, 2002). App-enabled initiatives need to continually innovate because apps are imitable, and often not valuable or rare. Therefore, app-enabled start-ups need to continually reconfigure resources to create sustainable value. Taking a Dynamic Capabilities perspective is useful to explain how start-ups create value with apps (i.e. RQ1), by focusing on the routines that the start-up entrepreneurs use to achieve new

resource configurations and create value. For the purpose of answering RQ1, and providing a basis to answer RQ2, this study will use the Net-Enabled Business Innovation Cycle (NEBIC) formulated by Wheeler (2002). The NEBIC is a Dynamic Capabilities framework describing the creation of value through the business use of digital networks through four 'simpler capabilities' and related routines. The framework is explained in more detail and adapted to fit the context of app-enabled value creation in chapter 3.

2.3.3 THE DEPENDENT VARIABLE: APP BUSINESS VALUE

The previous section argued that a Dynamic Capabilities approach is suitable to explain the process of app-enabled value creation by start-ups (i.e. RQ1). The outcome of this process, i.e. the dependent variable, is 'app business value'. Section (2.3.1) explained that to capture different manifestations of business value, it is necessary to 'look beyond productivity'. One of the aims of this study is to explain what type of value is created by apps (i.e. RQ2). Therefore, it is needed to formulate a categorization of the different manifestations of business value. Different conceptualizations of IT business value are present in the literature. For this investigation, app business value is conceptualized as a ten-dimensional construct obtained by combining four dimensions of the functional value IT can create, and three dimensions of the locus of the value creation within the value chain (figure 3). Below is an explanation of these dimensions.

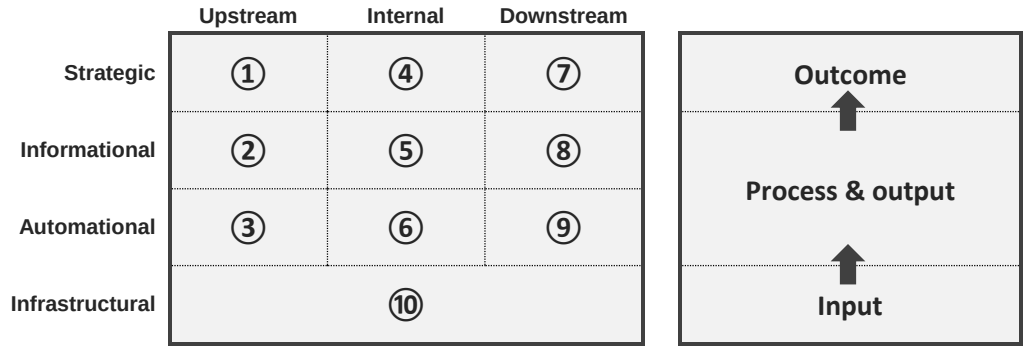

FIGURE 3. *Ten-dimensional construct of 'app business value'*

Four different functional dimensions of IT business value are used as basis for conceptualizing the business value of apps (Aral & Weill, 2006; Mooney, Gurbaxani, & Kraemer, 1995; Weill, 1992).

- ***Strategic*** value is related to transformational processes and refers to the capability of IT to gain competitive advantage through innovation and business transformation. Strategic value is created through, for example, increasing market share, meeting new demands, reducing cycle times, and improving products and services.
- ***Informational*** value is related to decision and control processes and refers to the ability of IT to collect, store, process, and distribute information. Informational value is created through, for example, improving planning, control, information quality, and decision-making.
- ***Automational*** value is related to operational processes and refers to the ability of IT to substitute labor for IT. Automational value is created through efficiency improvements and/or savings on labor costs.
- ***Infrastructural*** value is related to the supporting processes enabled by IT and refers to the basis of shared IT services (i.e. hardware, software, and IT staff) that can be used for current and future business initiatives. For example, IT infrastructure can hold business value when there are investments made in computers that help advance project A. The same computers can be used for a (future) project B. For the computer to hold business value it does not matter where in the value chain projects A and B are; one can be

upstream while the other is downstream. Therefore, the infrastructural dimension forms the tenth business value dimension, which is independent of the locus of value described hereafter (i.e. upstream, internal, or downstream).

In addition to the above dimensions, three dimensions of electronic-business and mobile-business value can be found in the literature according to the locus of the value creation within the value chain (Kuo & Chen, 2008; Picoto, Palma-dos-Reis, & Bélanger, 2010; Zhu & Kraemer, 2005).

- ***Upstream*** value lies on the supplier-side of the organization (business to business) and includes cost savings and/or efficiency improvements relating to procurement and supplier collaboration processes.
- ***Internal*** value lies within the organization (business to employee and employee to employee) and refers to value created through the increase in efficiency and flexibility of employees and management.
- ***Downstream*** value lies at the output-side of the organization (business to consumer, consumer to business, and business to business in the case of industrial customers) through, for example, facilitation of sales, customer driven innovation, and better customer service.

Combining the above dimensions conceptualizes app business value as a ten-dimensional construct as shown in figure 3. It should be noted that the four functional dimensions of the app business value construct can be related to each other. For example, purchasing a certain IT (i.e. infrastructural value) and using it to communicate with customers (i.e. automational value) can lead to the generation of useful customer-data. The gathered data can be used to improve decision making (i.e. informational value). The data combined with improved decision making could lead to better product and/or service innovation and more customer satisfaction (i.e. strategic value). In addition, the hardware and software used to communicate with the customers might also be used to communicate with suppliers in the future (i.e. infrastructural value).

The right half of figure 3 shows links between the four functional dimensions and some of the elements of the production system shown in figure 2. It is interesting to see that the app business value construct attempts to capture value associated to different elements of the production system. For obvious reasons, infrastructural value can result from the IT *input* to the production system. Automational and informational value are associated to the use of IT in business *processes*. The business processes can be split into operational and managerial processes (Mooney, et al., 1995). The operational processes are directly related to the 'production' of an organization's value adding output (i.e. the product or service delivered). IT can produce automational value when production processes are automated. Managerial processes are related to the administration and control of an organization. Using IT for managerial processes can lead to informational value. Additionally, automational and informational value can also be associated to the product or service at the *output* of a production system. A product can be automated to perform certain tasks for customers, leading to repeat transactions without human interference. This leads to automational business value in the form of reduced delivery costs. Also, a product might allow customers to feedback useful ideas or recommendations, leading to the creation of informational business value. The *strategic* value is associated to the outcomes of a production system, as it captures measures such as growth, competitive capability, and customer satisfaction.

The above shows that the app business value construct captures a wide array of manifestations of value, associated to different elements of a productions system. Such a construct is useful for this study as it does not limit the search for value to, for example, only increased productivity. Appendix 1 formulates the manifestations of value as indicators for each dimension to provide guidance to

the empirical investigation of the kind of business value that is created with apps. The indicators were extracted from the literature mentioned in this section. Overlapping indicators were combined to improve parsimony.

2.4 SUMMARY

Section (2) reviewed literature on apps and IT business value. The main points resulting from this review are described hereafter.

- A working definition of apps for this study is formulated as follows: *a use of an interface on a mobile phone or tablet pc by an end-user for a purpose that potentially holds business value*.
- An 'app ecosystem' with different actors is given to provide an overview of the economic activity related to apps. This study focusses on the value related to the use of apps.
- Studies on the business value of IT were reviewed and showed two main streams of research based on (1) production economics and (2) Dynamic Capabilities as an extension of the RBV.
- A production economic-based model for the business value of apps is derived, but considered unfeasible to estimate because of data restrictions and limited knowledge on how to conceptualize an 'app adoption' variable.
- More recent studies have revealed shortcomings in the production economic-based models, and several considerations resulting from these studies are formulated for guidance in designing the approach of this study. The main shortcoming is that production economic-based models are 'black-box' models, i.e. focusing on the relationship between in and output, hereby ignoring the process in-between.
- The Dynamic Capabilities perspective on the creation of IT business value is useful to explain the process of how start-ups create value with apps. The NEBIC theory, a Dynamic Capabilities framework for net-enabled value creation guides the approach to answer RQ1.
- The dependent variable 'app business value' is conceptualized as a ten-dimensional construct along four functional dimensions, i.e. infrastructural, automational, informational, and strategic value, and three situational dimensions, i.e. upstream, internal, and downstream value. This construct forms the basis to answering RQ2.

3 FRAMEWORK FOR THE VALUE CREATION PROCESS: NEBIC

This section presents the Net-Enabled Business Innovation Cycle (NEBIC). The NEBIC is a framework taking a Dynamic Capabilities perspective on internet-enabled value creation. The NEBIC will be used as an a priori framework to guide the data collection and analysis, and ultimately to support answering the research questions. The following section explains the premises of the NEBIC theory, followed by the adaptation of the NEBIC into an app-enabled business innovation cycle in section (3.2). Section (3.3) describes the role the 'app' plays in this model as the artifact under study.

3.1 THE NET-ENABLED BUSINESS INNOVATION CYCLE

Section (2) has shown that this investigation should focus on the *dynamic capabilities* needed during the *process* of value creation for the purpose of explaining *how* apps contribute to this value creation (i.e. RQ1). There are multiple frameworks available that take a process perspective on IT business value creation (e.g. Melville, et al., 2004; Soh & Markus, 1995). Although most of these frameworks put emphasis on the interaction between IT resources and complementary factors, they fail to focus on the dynamic capabilities needed during the process of value creation. In other words, the routines with which IT resources are identified and used to generate value are ignored. The NEBIC is a framework made in the context of electronic-business that focusses on these value-creating routines during the IT adoption process (Wheeler, 2002). The NEBIC is an "applied dynamic capabilities theory for measuring, predicting, and understanding a firm's ability to create customer value through the business use of digital networks" (Wheeler, 2002, p. 125). The theory describes four dynamic capabilities forming the cycle of value creation in net-enabled organizations (figure 4). Because of the focus on these dynamic capabilities as routines for value creation, and the closeness of net-enablement to app-enablement, the NEBIC model can prove useful as basis for the further investigation.

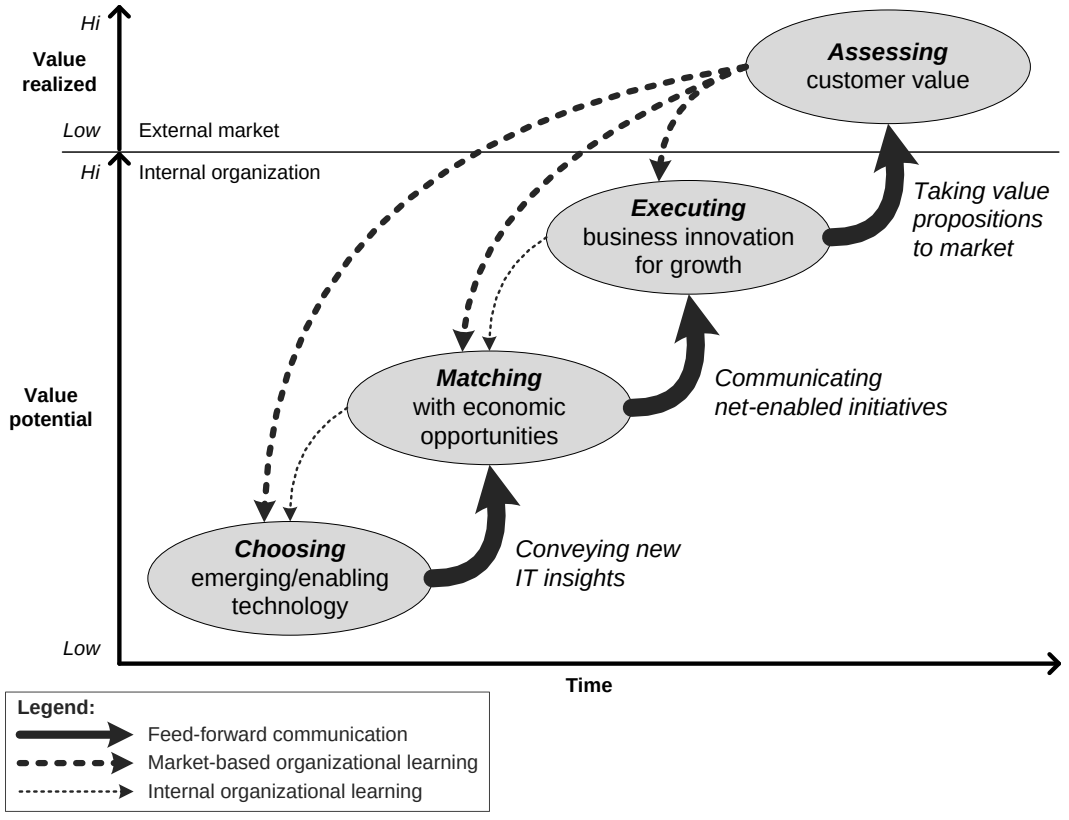

FIGURE 4. *Net-enabled business innovation cycle (adapted from Wheeler, 2002)*

The NEBIC describes four sequenced capabilities that lead to the creation of customer value, and the processes that link them. The four capabilities reflect four activities described as follows (i.e. ovals in figure 4; for a more thorough discussion on the derivation of the capabilities see Wheeler, 2002).

- ***Choosing* emerging/enabling technologies**: routines to identify, evaluate, and select promising technologies from the IT landscape. An IT is 'emerging' when it still needs development, and 'enabling' when it is commercially available and becoming pervasive.
- ***Matching* with economic opportunities**: routines to combine the inputs from the *choosing* capability, the business strategy, and the business context (e.g. customer trends). The result should be a revelation of new IT-induced economic opportunities.
- ***Executing* business innovation for growth**: routines to (re)configure resources of the business to support business growth (e.g. set-up or adapt the organization, develop the product and/or service, set-up the supply chain and sales channels).
- ***Assessing* customer value**: routines to measure and understand customers' preferences and evaluations of the delivered value.

The processes (i.e. arrows in figure 4) describe learning from each of the four capabilities, communicating the results to the following capability, and feeding back market-based metrics. The dependent variable in the NEBIC theory is the outcome of the NEBIC in terms of 'customer value'. This presents an incongruity with the dependent variable in this study, i.e. business value. Although customer value is not the same as business value, the two concepts are related (L. M. Hitt & Brynjolfsson, 1996). This also becomes clear by looking at the guiding business value indicators in appendix 1. The downstream business value dimensions include several indicators of customer value (e.g. improved customer communication and input possibilities, improved customer service and satisfaction). Additionally, Zahra and George (2002) suggest that researchers using the NEBIC theory incorporate outcome measures that are broader than customer value, for instance cost reductions attributed to net-enablement. Many of the downstream business value indicators are actually cost reductions associated to the use of IT for different purposes. This does not imply that apps do not hold upstream or internal value potential. However, it is arguably interesting to focus on the downstream dimension because of the recent proliferation of mobile devices among consumers. This is also the dimension where 'branded-apps', mentioned in the introduction, are struggling to create value. Following this reasoning, the NEBIC model is also applicable with 'downstream business value' as dependent variable, which is how the model is used in this study.

The NEBIC model can be approached from both a variance and a process-based perspective. From a variance-based perspective, the model suggests that the four sequenced capabilities are discrete variables (i.e. can be high or low). The configuration of these variables will be related to the outcome in terms of created customer value.[6] From a process-based perspective, the model suggests that effective feed-forward and feedback communication processes between the variables are necessary conditions to create value.[7] In line with the discussion in the previous sections, this study takes a process perspective to explain how value is created and answer RQ1. By investigating what kind of value is created through this process, also RQ2 can be answered through this perspective. The theory will be used as an a priori framework to guide the collection and analysis of data. The data collected in this study will be used to confirm, refine, extend, or reject the proposed NEBIC process. This should result in a model explaining the entrepreneurial process of app-enabled value creation by start-ups.

[6] For example, organizations with strong *choosing*, *matching*, and *executing* capabilities, but weak *assessing* capability, will create high levels of customer value unsustainable for longer periods of time.

[7] For example, effective communication processes are necessary between the *choosing* and *matching* capabilities to create customer value.

3.2 THE APP-ENABLED VALUE CREATION CYCLE: PROCESS PROPOSITIONS

A series of theoretical propositions that explain the process of value creation follows from the NEBIC framework. However, the NEBIC framework describes processes that are valid for "particularly large firms" (Wheeler, 2002, p. 139). Therefore, the NEBIC propositions are adapted to fit the context of app-enabled start-ups before empirically validating them (see Wheeler, 2002, pp. 137-139 for the original propositions). The propositions are derived from the arrows of the NEBIC as shown in figure 4. The arrows represent the processes between the capabilities and explain the sequencing, as well as the mechanisms of interaction of the factors in the model.[8] The propositions below will serve as basis for the empirical refinement and extension of the NEBIC.

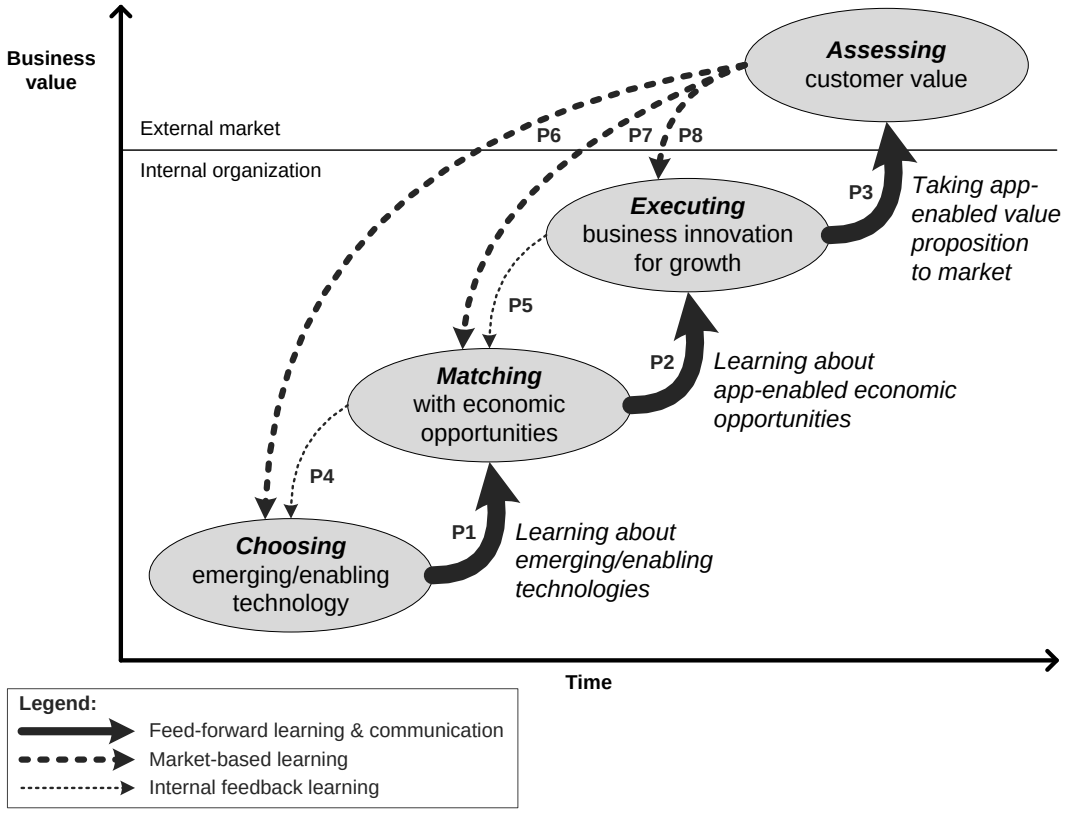

FIGURE 5. *Proposed app-enabled business innovation cycle (adapted from Wheeler, 2002; P-numbers are references to the theoretical propositions discussed hereafter explaining the processes between the capabilities)*

Almost all the original NEBIC propositions describe the processes between capabilities as organizational learning processes. There are different types of organizational learning processes[9]; the NEBIC theory focusses on intra-organizational learning through the distribution of knowledge and assumes that each of the four capabilities resides with different departments in an organization. The NEBIC processes are focused on communication routines involved in transferring knowledge from one department to the other, for example through memos, briefings, and business plans. In the case of the small start-ups, learning does not primarily focus on communication, because of the absence of a departmental organization. Usually, the entrepreneur alone, or with a small group, is involved in the initiative from beginning to end. As such, there is no direct need to

[8] For example, *choosing* precedes *matching*, and they are connected to each other through learning processes.
[9] Although there are different conceptualizations of organizational learning, an often cited example distinguishes between knowledge acquisition, distribution, interpretation, and memory (Huber, 1991).

transfer the knowledge to a different group of people. Rather, entrepreneurs engage in 'entrepreneurial learning'. This type of learning might include communication processes, but is primarily focused on cognitive learning processes. Entrepreneurs enhance their cognitive framework through this type of learning, which allows them to better identify, develop, and exploit opportunities (Baron, 2006). Therefore, the propositions below do not focus on communication as the learning process, but describe the processes as 'entrepreneurial learning'. It is argued that entrepreneurial learning allows for 'adaptive sense-making' through the enhancement of cognitive frameworks, which is key for managers to cope in dynamic environments (Bogner & Barr, 2000).

The *choosing* capability includes routines to create insights on emerging and enabling technologies that could support app-enabled value creation. These insights could relate to, for example, mobile technologies, internet technologies, or other technologies relevant to the app-enabled initiative. The resulting insights are input to the *matching* capability, which includes routines to combine technological insights, business strategy, and business context. The *matching* capability aims at revealing new app-enabled economic opportunities. To create business value through these economic opportunities, it is necessary to be able to effectively convey and use the technological insights from the *choosing* capability. For this purpose, the entrepreneurs need to engage in learning processes to create or change their understanding of the emerging and enabling technologies.

PROPOSITION 1. Effective entrepreneurial learning processes that create or change understanding are necessary between the *choosing* and *matching* capabilities to create business value.

A similar feed-forward process as described above is needed between the *matching* and the e*xecuting* capability. Executing the business innovation needed for growth (e.g. building organization, developing product) builds on the economic opportunities revealed by the *matching* capability. To create business value, it is therefore necessary for the entrepreneur to engage in learning processes that clarify priorities and objectives of the app-enabled opportunities resulting from the *matching* capability. Only then will *executing* capabilities be able to effectively achieve business innovation.

PROPOSITION 2. Effective entrepreneurial learning processes that clarify priorities and objectives are necessary between the *matching* and *executing* capabilities to create business value.

The third feed-forward process represents taking a value proposition to the market. It is necessary to *communicate* and *deliver* the value proposition that results from the (re)configuration of resources to the marketplace. Failing to effectively *communicate* a value proposition to the market inhibits the realization of business value. Effective communication, for example, in the form of advertising, is a necessary condition to reach and attract the right customers. Failing to effectively *deliver* a value proposition to the market also inhibits the realization of business value. For example, failing to have reliable distribution channels and fulfill orders on time will lead to the loss of potential customers, even if the value proposition was effectively communicated to the market.

PROPOSITION 3. Effective communication and delivery processes are necessary from the *executing* capability to the marketplace to create business value.[10]

[10] The original propositions by Wheeler (2002) included two separate propositions, one for the *communication* and another for the *delivery* process. Here, they are combined for two reasons. First, communication and delivery are highly related to each other in the context of apps, because the delivery can be seen as a

The two light dotted arrows in figure 4 are feedback processes in the form of *internal* learning. These learning processes help in understanding and conveying insights back to antecedent capabilities. These insights may come from, for instance, mistakes due to wrong choices that manifest themselves later on in the process, or the need for additional information from antecedent capabilities. Antecedent capabilities are strengthened by these insights, as it allows the capabilities to be carried out with a stronger frame of reference. Following are two propositions describing these processes.

PROPOSITION 4. The *choosing* capability is strengthened when entrepreneurial learning conveys insights from the *matching* capability.

PROPOSITION 5. The *matching* capability is strengthened when entrepreneurial learning conveys insights from the *executing* capability.

The four *market-based* organizational learning processes shown in figure 4 play an important role in the innovation cycle. Marketplace data gathered by the *assessing* capability can strengthen all the capabilities by providing guidance to the routines associated with the respective capability. Learning from, for example, customer preferences or behavior can help in adjusting the innovation cycle to a more favorable path. The marketplace data is conveyed to the four capabilities through learning processes. These processes include the selection and contextualization of the data resulting from the *assessing* capability.

PROPOSITION 6. The c*hoosing* capability is strengthened when entrepreneurial learning is based on marketplace data.

PROPOSITION 7. The *matching* capability is strengthened when entrepreneurial learning is based on marketplace data.

PROPOSITION 8. The *executing* capability is strengthened when entrepreneurial learning is based on marketplace data.

The eight propositions presented above explain the mechanisms of interaction between the NEBIC capabilities. The propositions describe the processes depicted by the eight arrows in figure 4. They are essential to explain how entrepreneurs create or fail to create business value from net-enabled initiatives. This study will use the framework to guide the explanation of business value creation from app-enabled start-ups.

3.3 THE APP ARTIFACT

Although a working definition of apps is given in an earlier section of this work, the role that the app plays in the explanation of its business value is yet unexplored. It is important to conceptualize the IT artifact under study, because it shapes the understanding of the object of value (Orlikowski & Iacono, 2001). Especially in today's world with ubiquitous and interdependent IT, Orlikowski and Iacono argue that it is necessary to explain how IT is viewed and used in Information Systems research. The NEBIC model in figure 4 shows an absence of the IT artifact explicitly conceptualized as dependent or independent variable. As such, the model views technology as an embedded system "enmeshed with the conditions of its use" (Orlikowski & Iacono, 2001, p. 126). This fits the Dynamic Capabilities view on IT business value creation, where assessing causality from IT investments to value creation is problematic, and IT should be viewed as embedded in the business capabilities that drive value (Kohli & Grover, 2008). This also fits the perspective on app-enabled

communication process through a network. Second, it improves model parsimony, as both *communication* and *delivery* are represented by one arrow in the model.

value creation that this study takes, i.e. apps are seen as an embedded system of value creation. To make it more concrete, consider the following. Apps could be seen as a commodity with monetary value because it has a sales price. For example, app developers can sell their app-software to individuals through the app stores, or to businesses, resulting in a financial transaction. Therefore, apps could be conceptualized through a financial proxy. However, this study aims at investigating the business value at the usage level, where it is embedded in an organizational context and leveraged in conjunction to the context to create some form of business value.

3.4 SUMMARY

- The NEBIC theory, based on the dynamic capabilities perspective, will be used as an a priori framework to guide the collection and analysis of data. The aim is to answer RQ1 and meet the research goal by adapting the NEBIC model to result in a theory explaining the entrepreneurial process of value creation with apps.
- The dependent variable of the NEBIC theory, i.e. customer value, can be justifiably adapted to fit the dependent variable in this study, i.e. downstream business value.
- A series of theoretical propositions that explain the process of value creation are derived from the NEBIC model and adapted to fit the context of the app-enabled start-ups under study. These propositions will serve as basis for the empirical confirmation, refinement, and extension of the NEBIC.
- The artifact under study is discussed in relation to the role it plays in the creation of value. In line with how the IT artifact is conceptualized in the NEBIC theory, this study sees the 'app artifact' as an embedded system where it is leveraged in an organizational context to create business value.

4 METHODOLOGY

4.1 RESEARCH STRATEGY

The previous chapter formulated eight propositions for the process of app-enabled value creation by start-ups based on the NEBIC theory. The propositions were used as a priori guidance for the collection and analysis of data. The focus lies on confirming, refining, or rejecting these propositions, or extending the theory with new propositions, for the purpose of providing a valid explanation of how start-ups create value with apps (i.e. RQ1). Combined with an assessment of the type of business value that results from the value creation process (i.e. RQ2), this study meets its main research goal, namely providing an explanation of the business value of apps.

The propositions provide a subjective understanding of reality as a basis to develop further understanding through empirical validation (Lee, 1991). To empirically validate this subjective understanding within the research setting, Wheeler states that a researcher could follow two distinct approaches via (1) positivist and (2) interpretivist research. A positivist approach would aim at describing cause and effect relationships among the NEBIC capabilities by using variance-based techniques such as regression analysis. An interpretivist approach focuses on explaining the relationships between the NEBIC capabilities and is concerned with interactions between capabilities and their sequencing. Using the insights from Markus and Robey (1988), Wheeler argues that the NEBIC *process* explanations as given by the propositions should be investigated using *interpretivist case studies*, which is the research strategy this study follows. Interpretivist research "attempts to understand phenomena through the meanings that people assign to them" (Klein & Myers, 1999, p. 69), and is "aimed at producing an understanding of the *context* of the information system, and the *process* whereby the information system influences and is influenced by the context" (Walsham, 1993, pp. 4-5). As such, the aim of interpretivist research is in line with what this study attempts to accomplish.

There is an additional reason for not applying the model in a positivist fashion. It is likely that the four NEBIC capabilities play a role in the value creation process with apps. Nevertheless, the conceptualization of the NEBIC theory and the operationalization of the capabilities into empirical indicators are done in the context of net-enablement at large organizations. This study is set in the context of the smaller start-ups and a more specific form of net-enablement, namely app-enablement. It is yet unclear what the important factors are for value creation in this setting.[11] As such, it remains also unclear how to operationalize the capabilities to appropriately measure them in the study setting. However, the results of this study include an identification of sample empirical indicators for the capabilities in the context of app-enablement. This helps future studies to create reliable measurement instruments that can be used in positivist studies.

An important issue to discuss is the use of theory in interpretive studies. There is a common notion in interpretivist research that the use of prior theory might blind the researcher and stifle the revelation of new and interesting understanding of a phenomenon (Walsham, 1995; Wheeler, 2002). However, if a researcher preserves the flexibility to modify a theory based on the interpretations of the data, theory can be an important guide during three phases of the study: theory provides (1) guidance to formulating a data-collection instrument, (2) a starting ground for data analysis, and (3) a framework for reporting the results (Walsham, 1995). The NEBIC theory was

[11] For example, consider one of NEBIC's empirical indicators for the *choosing* capability: *consistent set of IT standards for enabling technologies within and across operational units*. According to Wheeler (2002), this is an important factor in the ability to choose the right technologies regarding net-enablement. It is yet unknown if this is also important in the context of apps. Moreover, the indicator is not applicable for start-ups, because they usually do not have multiple operational units and, therefore, 'consistency' cannot be assessed.

used in this study accordingly. The guidelines by Walsham (1995, 2006) for interpretive case studies were followed to prepare and conduct this study; the steps taken are described in the following three sections explaining the sampling, data collection, and data analysis procedures.

4.2 POPULATION & SAMPLE

The population under study is defined as Dutch 'app-enabled start-ups' referring to start-ups that employ at least one app in their business activities. Start-ups are ventures in the process of defining a business model to exploit market opportunities. The start-up entrepreneur plays a central role in this process, as he/she is the visionary driving this process. Entrepreneurs are "individuals or groups of individuals, acting independently or as part of a corporate system, who create new organizations, or instigate renewal or innovation within an existing organization" (Sharma & Chrisman, 2007, p. 91). As such, entrepreneurs can also be found at established enterprises. However, this study focusses on entrepreneurial initiatives at start-ups. Although previously discussed, it should be noted again that pure 'app-developers' are not the aimed population. Nevertheless, app-developers might also 'use' apps to create business value (as opposed to only developing and selling apps), and then the entrepreneur would fall within the aimed population.

To explain how start-ups create value with apps through an interpretivist approach, value-creating initiatives *in process* must be studied. Because at the later stages of the process people forget details of the early stages, this study sampled start-ups in two different phases of the initiative (cf. Markus, Axline, Petrie, & Tanis, 2000). Start-ups in the first phase are developing their value proposition, but have not yet introduced it to the market, i.e. the pre-market phase. Start-ups in the second phase have brought the initiative to the market, i.e. the market phase. The pre-market phase entrepreneurs provide valuable information on the earlier capabilities, and they might not have reached yet a point in the initiative to engage in the routines related to the later capabilities, like *executing* the initiative. The market phase entrepreneurs could provide information about all capabilities, but emphasis will be put on the later ones in which they are currently engaged. Within both phases, multiple cases will be analyzed to allow for replication logic (Eisenhardt, 1989; Yin, 2003).[12] That is, subsequent cases are used to confirm, refine, extend, or reject the emerging insights from the previous cases, thereby reducing researcher bias and improving reliability.

Cases in the pre-market phase are identified through current or recent participation in a 'bootcamp' or 'accelerator',[13] which allows finding start-ups that are developing their ideas into a product or service but have not yet introduced it to the market. Cases in the market phase are identified through app-store and internet presence. This form of sampling is combined with intensity sampling, ensuring that the cases produce rich enough data to reveal interesting information about the capabilities and processes under study. Intensity sampling is done by selecting cases that have received considerable (public) attention and are therefore potentially valuable (e.g. prize winner, raised venture-capital, downloaded a considerable number of times). This form of sampling does introduce a bias as the sample might not be representative for all app-enabled start-ups. However, it provides a higher likelihood for theoretical insights (Eisenhardt & Graebner, 2007). One of the research questions aims at categorizing the business value of apps. Intensity sampling is employed to include some form of business value in each of the cases; for that, a common practice in comparable research (e.g. Amit & Zott, 2001; Markus, et al., 2000). Four cases were sampled for each phase, giving a total of eight cases. Table 2 gives an overview of the sample, and provides some background information for each of the cases.

[12] Although Eisenhardt (1989) and Yin (2003) have their roots in the positivist school of thought, here they provide insight into an important element of conducting case research in general.

[13] *Bootcamps* and *accelerators* are programs that support the development of startup businesses by offering services that might be hard to obtain for startup businesses on their own (formerly known as *incubators*).

TABLE 2. *Sample overview and background*

#	Organization	Size*	Founded	Main value proposition
Pre-market phase				
1	**Peerby**	5	2011	*Collaborative consumption of goods; social consumption*
	Description: Peerby aims at bringing together supply and demand of rental goods for individuals. An individual in need of a certain good can notify Peerby users in the neighborhood. When the good is found, the persons involved can communicate to arrange the collection through the Peerby app. Goods can be freely borrowed or rented. In the latter case, the payment is done through the app and Peerby gives some security to the individual renting out.			
2	**Truienradar**	7	2012	*Social and contextual clothing assistant; social shopping*
	Description: Truienradar aims at giving advice on what clothes to wear based on weather conditions and social recommendations. Users can digitalize their collection of clothes, and selected friends can communicate what they feel about the user's collection. Also, it allows for the selling and trading of used clothing, and it connects to e-commerce platforms to create a social online shopping experience when buying clothes.			
3	**Rushkick**	1	2011	*Social betting and gaming*
	Description: Rushkick is a social betting game that enables football fans to monetize their knowledge of the game. It combines gaming and betting in a social environment. It is a fantasy-football application where users can make bets on the performance of their fantasy team. Results are based on the real-world performance of these teams. Rushkick is free to be used as a game, but the entrepreneur collects a fee when bets are made.			
4	**Sugarhabits**	8	2011	*Socially develop new habits*
	Description: Sugarhabits helps users develop new habits so they can live a more productive life. It is a web-based habit-tracker to develop habits and share the results with friends, coaches or peers. Depending on the user and the habit, the app gives tips, facts and stats that help to keep focus and motivation. Others can support the process to create social pressure and improve the chances of success.			
Market phase				
5	**Couverts**	10	2009	*Restaurant choosing and table reservation system*
	Description: Couverts is a platform connecting restaurants with potential customers. Couverts provides a table-management system to restaurants, with which they can control the availability of seats in their establishment. For consumers, Couverts supplies an app with which they can check real-time table availability and reserve instantly. Couverts charges a fee to the restaurants for the use of the service, and a percentage fee on each completed transaction by customers that reserved through the app.			
6	**Moneybird**	5	2009	*Online accounting*
	Description: Moneybird is an online accounting app for small businesses and freelancers. The app is made to simplify the accounting processes, as most of the available accounting software is built for larger and more complex organizations. Users can use the app for free for up to three invoices per month. After, they pay a monthly fee. Moneybird allows connecting to e-commerce software to import products and prices, to banks to import transactions, and to postal services to automatically send invoices.			
7	**Toogethr**	4	2011	*Collaborative consumption of transit; carpool assistant*
	Description: Toogethr is a carpooling app that connects suppliers of a ride to people that would like to join that ride. The app uses connections to social networking sites to allow people sharing a ride to 'get to know each other' digitally. Riding along can be free when the person offering a ride chooses so. When this person asks for a financial compensation, the monetary transaction can be done through the app. This allows Toogethr to collect a percentage fee, and cash transactions are not needed among users.			
8	**Roots2share**	4	2011	*Cultural heritage storytelling*
	Description: Roots2share is an app made for the Museon museum of ethnology. It allows Greenlanders to add stories to a large collection of photographs taken in East Greenland. Visitors of the online photo-exhibition can benefit from local knowledge on the events portrayed in the photographs. The initiative is financially supported by third-party funding.			

** Number of people working on the app-enabled initiative; numbers are indicative only, because the initiatives often employ people on a flexible basis, and the same people might also be active in other initiatives.*

4.3 DATA COLLECTION

Data were collected in spring 2012. Information richness and within-case triangulation of the data were improved by using multiple data sources (Yin, 2003).[14] Two data collection procedures were followed as explained below. The first refers to the collection of general information about the app-enabled initiative. The second procedure, i.e. interviews, is the primary data source, since it gives access to the interpretations the interviewees have of real-life processes, and this plays a central role in interpretive case studies (Walsham, 1995). As such, the entrepreneurs' interpretations provide access the processes at the start-ups under study. Table 3 shows the available data sources specified by case.

TABLE 3. *Data sources specified by case*

#	***Start-up name*** **Entrepreneur***	Interview date	Interview duration	Additional data sources
Pre-market phase				
1	*Peerby* Daan Weddepohl	21-02-2012	60 min	▪ Website (*peerby.com*) ▪ Television interview (*omroep.vara.nl/media/85166*) ▪ Interview with the Founder Institute (*youtube.com/watch?v=8UrQH7pzk04*)
2	*Truienradar* Lars Rengersen	05-03-2012	60 min	▪ Website (*truienradar.nl*) ▪ Television interview (*omroep.vara.nl/media/87317*)
3	*Rushkick* Vincent van Leeuwen	14-04-2012	30 min	▪ Website (*rushkick.com*) ▪ Interview with the Founder Institute (*youtube.com/watch?v=RK04-Hbpfx4*) ▪ Slides with company plans
4	*Sugarhabits* Leedo Daniel	18-05-2012	30 min	▪ Website (*sugarhabits.com*) ▪ Interview with the Founder Institute (*youtube.com/watch?v=nmA3FzFeEjU*), ▪ Slides with company plans
Market phase				
5	*Couverts* Paul Wiertz	07-03-2012	60 min	▪ Website (*couverts.nl*) ▪ YouTube interview (*youtube.com/watch?v=rzeZa2LLH4Y*)
6	*Moneybird* Joost Diepenmaat	19-04-2012	50 min	▪ Website (*moneybird.nl*)
7	*Toogethr* Martin Voorzanger	23-04-2012	40 min	▪ Website (*toogethr.nl*) ▪ Company presentation slides
8	*Roots2share* Erik Hekman	08-05-2012	40 min	▪ Website (*roots2share.org*) ▪ Website (*museon.nl/roots2share*)

** All are founders or founding partners, and managing the initiatives at the time of interview*

(1) General data about the app-initiative (e.g. value-proposition, supporting organization) were gathered through publicly available information. First, the websites of the respective initiatives were consulted. Second, interviews from public television and YouTube with the entrepreneurs were used to provide additional data. Moreover, some of the entrepreneurs that participated in the study made digital material available in the form of short business plans, roadmaps, or overviews of the initiative.

[14] Idem to footnote #12.

(2) Semi-structured interviews were held with the start-up entrepreneurs following the interview instrument from appendix 2. The formulation of an interview instrument provides guidance to the researcher, and achieves a higher level of reliability by allowing replication by other researchers. The interview instrument was roughly divided into three sections. First, some general questions were formulated about the app-enabled initiative. Second, questions about the process of value creation were formulated using the capabilities as guidelines. To allow for the respondents to give their interpretations of reality, the questions asked about the process of value creation were open in nature, and the respondent was not guided towards certain answers by the interviewer. Third, questions about the app-enabled business value were included. The interviewees were all founders of the app-enabled initiatives, and were currently managing the value creation process. The interview schema was applied loosely, as semi-structured interviews allow for developing the interview depending on the course of the conversation (Runeson & Höst, 2009). More specifically, this means that the ordering of the questions differed from one interview to the other. However, the list of questions was used to be certain that all the themes were touched during the interview. The duration of the interviews was 30 and 60 minutes each. The later interviews were shorter because the acquired experience allowed the researcher to ask more targeted questions. Also some interviews were shorter because of previous data availability, allowing to save time on the general questions. Notes were taken during the interviews and the interviews were recorded for later reference. Immediately after the interviews the notes were digitized using word-processing software and worked out to make documents that are in fact summaries of the interviews. The interviews were not fully transcribed, as this is very time-consuming and does not always lead to better data analysis (Walsham, 2006). Rather, the interview summaries were extended with insights from the data sources described in table 3. These insights help confirm or strengthen certain points made during the interviews and contribute to the within-case triangulation of the data. Finally, the recordings of the interviews were replayed with the interview summaries at hand to confirm the summary is a good reflection of the interview and make final adjustments if necessary.

4.4 DATA ANALYSIS

To answer the research questions and meet the main research goal, the data were analyzed following the five steps described below. The analysis resulted in: (1) the description of the capabilities for app-enabled value creation, (2) the identification of the type of business value created by the respective capabilities, and (3) the explanation of the mechanisms of interaction among the capabilities using propositions. It should be noted that data collection and data analysis happen concurrently in interpretive case studies (Wheeler, 2002), and therefore the five steps were iterated after the data collection of every case. Figure 6 visualizes the steps taken for data analysis, which loosely follow the content analysis guidelines by Runeson and Höst (2009).

(1) **Finding concepts**

The first step uses a content analysis technique known as *open coding*. Open coding is the process of identifying emerging concepts suggested by the data rather than imposed by theory (Strauss & Corbin, 1990). This technique is commonly used in similar interpretive research (e.g. Orlikowski, 1993), and ensures that the identification of concepts is not stifled by the a priori use of theory. The concepts derived from the data (table 4) provide insight into the factors considered important by each respondent to create value. However, these data are not suitable to use for analyzing cross-case *differences*. The reason for this is that respondents were asked open questions as to the important factors for value creation pertaining to a certain capability. When a respondent fails to note a certain factor as

important, it does not mean that this factor is *un*important (i.e. he/she did in fact not reflect to this factor as 'unimportant'). However, this does not present a problem for data analysis. The *similarities* between the factors are analyzed to create data categories that are supported across the cases, as is explained in the following point.

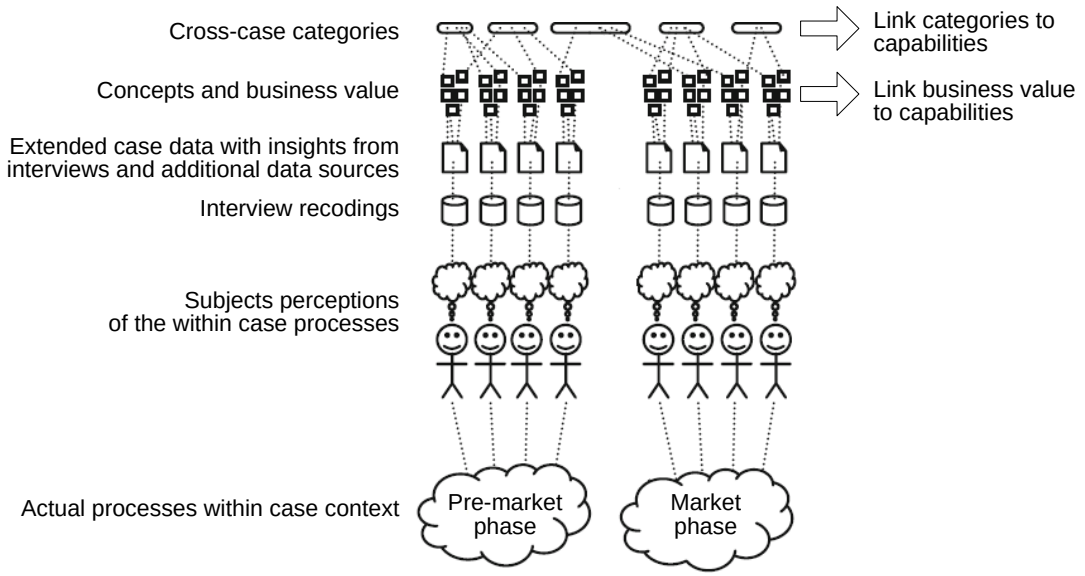

FIGURE 6. *Visualization of the data analysis procedure (adapted from Runeson & Höst, 2009)*

(2) **Forming categories**

Following the identification of the concepts at case level, all the concepts are grouped by defining unifying categories that reflect multiple concepts (table 4). This process of linking associated concepts is known as *axial coding*, a common follow-up to open coding (Strauss & Corbin, 1990). Axial coding reduces the data into a more manageable number of grouped concepts, i.e. categories, through the identification of patterns and similarities among the codes. This step is also concerned with cross-case triangulation of the data, as the step is made from within-case concepts to cross-case categories. Categories are considered when they are supported by at least three cases.

(3) **Linking categories to capability**

The emerging categories are aligned to the four NEBIC capabilities (table 4). This is the first step to answering RQ1 because it gives a basis to describe the capabilities in the context of app-enabled value creation by entrepreneurs. The linking of the categories to capabilities is done by tracing back the codes forming a category to the question that produced the code. For example, the interview question 'What is important in the creation of the organization and the product or service?' produced several codes that are related to the *executing* capability, as this question was formulated following the description of the *executing* capability. However, own judgment in aligning the categories was also used for categories that emerged from codes unrelated to a specific question, for example because the interview drifted away from the planned sequence.

(4) **Linking capability to business value**

The type of business value enabled by apps is identified using the four downstream dimensions of the app business value construct from appendix 1. The resulting business value data is shown in table 5. Associations are made between a capability and the resulting business value by linking elements of these two factors to each other, answering RQ2. The procedure is based on interpretations by the researcher. For instance, following

the previous step of data analysis, the *choosing* capability consists of routines for selecting several *platforms* as enabling technologies for the initiative. The data shows that the use of *platforms* allows entrepreneurs to reduce software development costs, i.e. create *infrastructural value*. Therefore, the *choosing* capability is linked to *infrastructural value*.

(5) **Identifying mechanisms of interaction among capabilities**
The relationships between the capabilities are identified through an analysis similar to the one described in the previous step. Again, the procedure is based on interpretations by the researcher. For instance, part of the *matching* capability consists of routines to find and create solutions through combining several *platform* functionalities. As mentioned in the previous step, routines for selecting these *platforms* are part of the *choosing* capability. Therefore, the output of the *choosing* capability provides an input for the *matching* capability. This procedure is guided by the propositions of section (3.2) that provide a priori indication of the possible interactions. By confirming, refining, rejecting, or extending these propositions, the entrepreneurial app-enabled value creation process is described, answering RQ1.

Steps (1) and (2) of data analysis relate to the process of coding and categorizing the data, meant to reduce the data by extracting concepts and classifying the concepts into categories. Step (3) links the categories to the theoretical constructs under study, i.e. the four NEBIC capabilities. Table 4 shows the elaboration of these first three steps of data analysis. The discussion of the categories in this table, the related business value, and the identification of the mechanisms of interaction between the capabilities as explained by steps (4) and (5) are presented in the following two chapters.

It should be noted that the data analysis is to some extent subjective, because it requires significant input from the researcher (Walsham, 2006). In fact, the researcher constructs processes by interpreting data that represent the respondents' interpretations of these processes. For instance, the identification of the mechanisms of interaction between the capabilities (as explained by step 5 above) is a construction by the researcher of these mechanisms based on the entrepreneurs' interpretations of the capabilities. Forming such second-order constructions of first-order interpretations is a common procedure in interpretivist research (Walsham, 1995).

TABLE 4. *Concepts derived from data and emerging categories linked to capabilities*

Capability / **Category** / ▪ Concept	**Case #** 1	2	3	4	5	6	7	8
Choosing enabling technologies								
Platform functionality	✔	✔	✔	✔	✔	✔	✔	✔
▪ Mobile devices as platforms for contextual awareness (e.g. camera, accelerometer, location-tracking)	✔	✔			✔	✔		
▪ Operating platforms (e.g. Apple iOS, Google Android) as common language for coding	✔	✔			✔	✔	✔	
▪ Distribution platforms (e.g. Apple Store, Google Play)	✔						✔	
▪ Social platforms (e.g. Facebook, LinkedIn, Twitter) as tools for personal identification and access to network			✔	✔			✔	✔
▪ Mobile payment platforms (e.g. iDeal, PayPal, Minitix/Myorder)	✔	✔			✔	✔	✔	
▪ Ecommerce platforms (e.g. H&M) as tools for shopping		✔						
Platform dominance	✔	✔		✔		✔	✔	✔
▪ Use platforms that are used by, and appeal to the target market		✔		✔		✔	✔	✔
Platform compatibility	✔	✔					✔	
▪ Check platforms to see if they allow connecting/combining them		✔						
▪ Use payment platforms that are apt for mobile	✔						✔	
Matching enabling technologies to economic opportunities								
Continuous search for solutions	✔	✔	✔	✔	✔	✔	✔	✔
▪ Do not make an app just because it is popular				✔		✔		
▪ Provide solutions to real-world problems	✔			✔		✔	✔	
▪ Focus on solution, not on business model				✔				✔
▪ Continue to adapt and improve the app; an app always remains a beta version	✔	✔	✔	✔	✔		✔	
Novel complements	✔	✔		✔	✔	✔	✔	
▪ Complement products/services with social functions		✔		✔			✔	
▪ Products/services could be improved/renewed by using the contextual awareness options of mobile devices	✔				✔	✔	✔	
Efficient complements		✔	✔	✔	✔	✔	✔	✔
▪ Efficiency through activation of a customer's social network		✔	✔	✔			✔	✔
▪ Efficiency gains by providing functionality to the end-user that before needed intermediation								✔
▪ Efficiency can be gained by integrating the physical environment into the app		✔			✔	✔		

(continued on next page)

TABLE 4. *Concepts derived from data and emerging categories linked to capabilities (continued from previous page)*

Capability / **Category** / ▪ Concept	**Case** 1	2	3	4	5	6	7	8
Executing business innovation for growth								
Automation of value proposition	✔			✔	✔			✔
▪ Repeat (micro)transactions many times over without human interference	✔				✔			✔
▪ Reach large market with small organization through learning algorithms	✔			✔				
Business agility	✔	✔	✔				✔	
▪ Short iterations: idea based on an assumption → going to the marketplace to test the assumptions → implement feedback		✔	✔				✔	
▪ Flexible and easily adaptable product	✔	✔					✔	
Funding and monetization	✔	✔	✔	✔			✔	✔
▪ Need for funding/venture capital for initial and further growth	✔		✔	✔				✔
▪ Focus on how to generate revenue with the app; choice between paid app, freemium/in-app sales, ads, service fees	✔	✔					✔	
Assessing customer value								
Customer interaction	✔	✔					✔	
▪ Brainstorm sessions with potential customers to exchange ideas		✔						
▪ Use of focus groups/pilots to seek customer input	✔						✔	
Customer reviews	✔	✔	✔	✔	✔	✔	✔	
▪ Customers are enticed to email feedback based on their experiences with the product	✔	✔	✔	✔		✔	✔	
▪ Customers rate the product and give feedback through app-stores					✔	✔		
Customer analytics	✔		✔	✔	✔	✔	✔	✔
▪ Customer use/behavior is tracked	✔		✔	✔	✔	✔	✔	✔
▪ Number of downloads is tracked					✔	✔		

TABLE 5. *Business value indicators derived from data linked to app business value dimensions*

App business value dimension	Case							
▪ Business value indicator	1	2	3	4	5	6	7	8
Strategic	✔	✔	✔	✔	✔	✔	✔	✔
▪ Improved product and/or service innovation	✔	✔	✔				✔	✔
▪ Strengthened competitive capability	✔	✔	✔	✔	✔	✔		
▪ Support business growth	✔		✔	✔	✔		✔	
▪ Improved customer service and satisfaction				✔	✔	✔	✔	✔
Informational	✔	✔		✔	✔	✔	✔	
▪ Improved decision making	✔	✔		✔	✔	✔	✔	
▪ Improved market responsiveness		✔			✔		✔	
Automational	✔	✔	✔	✔	✔	✔	✔	✔
▪ Reduced delivery cost	✔	✔	✔	✔	✔	✔	✔	✔
▪ Reduced transaction cost	✔	✔	✔	✔	✔		✔	
Infrastructural	✔	✔		✔	✔		✔	
▪ Reduced IT cost	✔	✔					✔	
▪ Mitigation of privacy risks		✔		✔			✔	
▪ Reduced distribution cost	✔	✔		✔	✔		✔	

5 RESULTS: CAPABILITY DESCRIPTION & BUSINESS VALUE

5.1 OVERVIEW OF THE RESULTS

This section presents the results of the analysis of the case data according to the steps described in the previous section. Before being able to discuss the process propositions, the dynamic capabilities forming these propositions need to be described according to the data. The reason for this is that the propositions deal with the processes that link the capabilities. The propositions are contingent on the routines that make up a capability, because the descriptions of the capabilities allow proposing the mechanisms of interaction between them. An overview of the 12 data categories extracted from the cases as presented in the previous chapter and their link to the capabilities are given in table 6. The table also shows an overview of the 11 business value indicators introduced in table 5 linked to each of the capabilities. Sections (5.2) to (5.5) describe each capability by elaborating on the respective data categories as presented in table 6, followed by an explanation of the related business value. Section (6) will discuss the findings at an aggregate level by taking a process perspective and describing the interactions between the capabilities. The latter are used to confirm, refine, extend, or reject the propositions presented in section (3.2).

TABLE 6. *Data categories and business value indicators linked to capabilities*

Capability	Data categories	Related business value
Choosing enabling platform ecosystems *(section 5.2)*	- Platform functionality - Platform dominance - Platform compatibility	*Infrastructural* - Reduced IT cost - Mitigation of privacy risks - Reduced distribution cost
Matching enabling platform ecosystems to economic opportunities *(section 5.3)*	- Continuous search for solutions - Novel complements - Efficient complements	*Strategic* - Improved product and/or service innovation - Strengthened competitive capability
Executing business innovation for growth *(section 5.4)*	- Automation of value proposition - Business agility - Funding and monetization	*Automational* - Reduced delivery cost - Reduced transaction cost* *Strategic* - Support business growth - Improved customer service and satisfaction
Assessing customer value *(section 5.5)*	- Customer interaction - Customer reviews - Customer analytics	*Informational* - Improved decision making - Improved market responsiveness

*Here the term *transaction cost* is narrowly used to represent the cost of a *monetary* transaction; the term as used in the field of economics, more broadly represents the cost related to the whole process of creating and delivering a product or service, and thus includes *all* costs leading to a certain transaction.

5.2 CHOOSING CAPABILITY

5.2.1 DESCRIPTION

The *choosing* capability can best be described as routines for *choosing enabling platform ecosystems*. An app is built on multiple platforms and uses platform technologies as a set of enabling technologies. An app runs on hardware (e.g. mobile phone) combined with software (e.g.

Google Android), often makes use of large distribution platforms (e.g. Apple Store), and includes functionalities from other platforms such as social platforms (e.g. Facebook) and payment platforms (e.g. PayPal). Furthermore, an app running on a set of platforms can be accessed only by users of these platforms. Therefore, an entrepreneur does not only choose a platform technology, but they choose an entire ecosystem of interrelated platform technologies, functionalities enabled by these technologies, and associated platform users. Within the landscape of available platform ecosystems there are choices to be made regarding which to use as opportunity enabling platform ecosystem(s). The observations suggest that there are three aspects shaping the choice among available platform ecosystems.

(1) **Platform functionality**

The most important reason for choosing a certain platform is the functionality it provides. For example, choosing a specific mobile device as a platform might depend on the presence of a camera if this is required for supporting the initiative. A platform functionality that is often mentioned by the interviewees is the ability to use a social networking platform as personal identification system. Because of the current popularity of social networking platforms, many people have a digital identity on one or more of these platforms. Most platforms allow that an external app connects to their system and use their platform for personal identification purposes. For example, most of the entrepreneurs integrate the login procedure that Facebook offers. This practice allows the entrepreneur not to worry about creating an own login procedure and mitigates the risks of handling personal information, as one entrepreneur noted: “Facebook is very secure when it comes to login procedures.” Additionally, it creates a known and usually trusted login environment for the customers. Trust, in combination with added convenience because the customer does not need to create a new account, results in lower entry barriers for new customers. The social functionality is also a frequently mentioned reason for including a social platform, as one entrepreneur noted that “bringing a profile from Facebook into the app gives people a ‘face’ … and posting to their wall achieves the desired social effect even faster.”

(2) **Platform dominance**

A platform is dominant if it is one of the most used by the target market. For instance, choosing between Apple’s iOS, Google’s Android, RIM’s Blackberry depends on the prevalence of these among the target audience. Choosing platform functionalities on a non-dominant platform will have consequences for the value creation as it will not effectively reach the target market. For example, observations suggest that the entrepreneurs that want to integrate functionalities from a social platform into the app mostly reach to Facebook because of its growing dominance in the social network domain. However, when the target market would be teenagers in the Netherlands, the entrepreneurs also consider using Hyves, as this is a dominant social network in this market. This shows that the choice for a platform ecosystem is driven by more than only technological and functional considerations; the users are an integral part of the ecosystem. There is an issue with choosing mobile payment platforms for European initiatives, because there are no real dominant players across Europe in this domain. One entrepreneur mentioned that the mobile payment platforms in Europe are underdeveloped and segmented, noting that “there are hardly any good mobile payment platforms” and “almost every bank has a different mobile payment method.” He added: “if I want to expand to different European countries, I have to implement a different payment platform for each country, not just because of the language, but mainly because of the use of different payment platforms.” The result is that entrepreneurs that want to reach users internationally need to consider the use of multiple dominant platforms.

(3) **Platform compatibility**

Platform compatibility refers to the consistency of the technology standards across multiple platforms. For example, the consistency between the Facebook Application Programming Interface (i.e. API) standards and the IT standard on Android-based devices[15] makes these platforms compatible. Choosing platform functionalities on dominant platforms that are not compatible to each other hinders integration efforts during the programming stages of the initiative. The observations suggest that compatibility is not a prevalent issue when considering combining functionalities between the major mobile *operating* platforms and *social* platforms. These platforms are usually designed to have compatible standards. The mobile *payment* platforms do form an issue because they are underdeveloped as mentioned in the previous point, and limited compatibility sometimes hinders the use of one payment platform across multiple mobile operating platforms.

The above indicates that the *choosing* capability is shaped by routines that identify, evaluate, and select the *functional*, *dominant*, and *compatible* platform ecosystems to use for the creation of the app.

5.2.2 BUSINESS VALUE

Infrastructural business value can result from *choosing* appropriate platform ecosystems as basis for the initiative. Platforms make it possible for the entrepreneurs to **save on IT related costs**. Most of the platforms can be used free of charge because platform operators are actually seeking others to create value as an extension of their platforms, as it can make their platform more valuable.[16] Therefore, platform functionalities can often be used as free building blocks for a value creation initiative. For example, many of the interviewed entrepreneurs use Facebook for login and personal identification purposes, as it allows them to save on software development costs and server costs needed to store the personal information. Furthermore, the **mitigation of privacy and security risks** is also a form of infrastructural value related to the use of platforms, as these risks are shared with the platform owners. The risks of securely handling payments are shared or even fully transferred to the payment platforms. The use of social platforms allows an entrepreneur to avoid storing customers' personal data and transfer the privacy related issues to the owner of the used social platform. A further form of value that is related to the *choosing* of platforms is the **reduced distribution costs** associated to using app stores as infrastructure for delivering the app to the customer.

It should be noted that this infrastructural business value is a value *potential* at this phase. The realization of this value takes place during the development of the initiative. At that time, the product or service is formed and, instead of needing to spend money and time on developing own IT, the platforms are implemented for the initiative. However, the data suggest that this type of business value is explicitly sought by the entrepreneurs while *choosing* enabling platforms. Therefore, this study poses that infrastructural business value is associated with the *choosing* capability.

5.3 MATCHING CAPABILITY

5.3.1 DESCRIPTION

The *matching* capability can best be described by routines for *matching enabling platform ecosystems to economic opportunities by searching for novel or more efficient solutions*. The

[15] http://developers.facebook.com/docs/guides/mobile/

[16] See Ceccagnoli, Forman, Huang, & Wu (2012) for a recent study of business value creation in platform ecosystems, and why this is beneficial for platform owners.

observations suggest that entrepreneurs reveal economic opportunities by bundling platform ecosystems to create complementarities, i.e. combinations that are more valuable than its separate components. There are three aspects that drive the bundling of platforms and thereby matching them with economic opportunities, namely searching for (1) *solutions*, (2) *novelties*, and (3) *efficiencies*.

(1) **Continuous search for solutions**

The search for economic opportunities by the entrepreneurs is largely driven by the search for solving perceived problems. One entrepreneur argued that "you should have a passion for solutions, not business models." Platform ecosystems provide a basis for the entrepreneurs to create solutions. For example, the popularity of social platforms allow for the entrepreneurs to create economic opportunities combining 'social' with 'shopping', 'travelling', or 'gambling.' According to the entrepreneurs, these combinations provide solutions to real-world problems. However, it is not the 'app' that drives the creation of solutions; rather, the app is used as key resource for achieving the solution. This solution driven mentality means that an app is not made because it is 'hot' at this time, although its popularity does help the further exploitation of the app. Also, once a solution is found, the quest continues to find better or different solutions. Therefore, the observations suggest that an app always remains work in progress, with modifications and improvements being made continually. This continuous search for solutions is a key aspect of the *matching* capability.

(2) **Novel complements**

Many of the entrepreneurs' economic opportunities are based on the novelty that combining platforms can create. Novelty driven bundles of technologies, functionalities, and users are aimed at providing a *new* solution. This factor is actually an extension to the search for solutions, in that the solution may be in the form of a novelty. For instance, one entrepreneur is driven by combining social platforms and ecommerce platforms. He argues that although teenagers often shop together for clothes and have busy online social lives, the online shopping experience is still non-social. Additionally, the entrepreneur combines this with advice on what to wear based on the weather, for which information is obtained from yet other platforms with weather data. His economic opportunity is therefore a solution to a perceived problem in the form of a new bundle of technologies.

(3) **Efficient complements**

Searching for efficiency driven bundles of technologies, functionalities, and users also plays a role as a matching routine. Efficient complements aim at providing solutions that are faster, simpler, or cheaper than existing ones. Again, this factor is an extension to searching for a solution. It is however different from a novelty, in that the economic opportunity does not lie with the creation of a new product or service, but with making an existing one more efficient. The data suggest that efficiencies are found by searching for economic opportunities that, for example, cut out intermediaries, activate a customer's social network to gain access to a larger market, or simplify a product or service to improve the user experience. The latter is an important factor, as most of the entrepreneurs acknowledge that the limited size of the interface of an app makes them rethink about what to include and what not. This often results in the stripping of the product to include only relevant aspects. One entrepreneur stated that "the [mobile] interface should be kept as simple as possible." Therefore, a product becomes easily accessible and the time that is needed for a customer to perform a certain action is reduced.

The above factors drive the formulation of strategic options regarding the related economic opportunities, and thus shape the routines that form the *matching* capability. The result of this capability can be seen as a strategic plan, although the observations show that this plan is often not very extensive or formalized. Rather, it is a rudimentary and flexible strategy to guide developing the product and setting-up the organization supporting the product.

5.3.2 BUSINESS VALUE

Strategic business value can result from matching enabling platforms to economic opportunities. The data suggest that the economic opportunities sought by the entrepreneurs are solutions that are yet inexistent, or more efficient than existing ones. Therefore, the *matching* capability can create strategic business value in the form of **improved product and/or service innovation**. This remains a value *potential* until it is realized by developing the solution. Nevertheless, the innovativeness of the solution has its roots in the routines that make up the *matching* capability. A second form of strategic business value associated to the *matching* capability is the **strengthening of the entrepreneurs' competitive capability**. Creating a novel or more efficient solution effectively differentiates the initiative from potential competitors. It cannot be stated that a novel or more efficient solution is a source of sustained competitive advantage, as the initiative might be easily copied by others. However, the data suggest that the search for solutions, which continually creates new economic opportunities, is an ongoing one, i.e. a *dynamic* capability. This could provide a more sustained competitive advantage.

5.4 EXECUTING CAPABILITY

5.4.1 DESCRIPTION

The *executing* capability can best be described by routines for *setting-up and configuring the app and the organization supporting the app*. The data suggest that there are three main factors *executing* capabilities should focus on.

(1) **Automation**

The value proposition should be automated as much as possible to be able to provide the value many times over with little human interference. The reason why this is important lies with the usually large number of users and transactions needed to be able to provide the promised app-enabled value to the customers. Additionally, the margins for each transaction are usually relatively low and, as such, many transactions are needed for the opportunity to be economically viable. As one entrepreneur stated very eloquently: "I cannot hire a million elves to go from door to door delivering my value proposition, so in that sense it's automation through the app that makes [my value proposition] possible." It is necessary to automate the process as much as possible before the economic opportunities related to apps become viable.

(2) **Agility**

The second focus of *executing* capabilities lies with the creation of an agile organization and an easily adaptable product. The data suggest that apps are in constant development. So even after the app is introduced to the market, work on improvements and new features continues. The app needs to evolve based on customer responses and market trends. This requires the app to be built in a manner that is easily adapted. A big obstacle in this is the dependence on multiple mobile operating platforms (e.g. iOS, Android) to reach a large spectrum of users. Every platform has its own set of programming rules and, therefore, multiple versions of the app are needed. If the entrepreneurs have to continually adapt an app, the changes have to be made separately for each version of the app. One of

the entrepreneurs got around this problem by developing a web-app that is easily accessed through a mobile device's browser, instead of making multiple native (platform dependent) apps. According to this entrepreneur, making native apps is on the planning, "but that would slow us down at this moment without providing us with any benefits." The web-app can be accessed by devices running on different platforms, and making adjustments requires changing only one set of codes. Another entrepreneur states that "the web-version is the app", referring to the fact that the web-app and the native apps are developed to be equal. To deal with the multiple-platform problem of native apps, he develops the app on a platform that allows having a single code base for the app, but is able to deploy on multiple platforms (i.e. Phonegap). It is essential that the time to market is short when changes are made to the app. Therefore, there is a need for an organization supporting the app that is able to quickly respond to market feedback and trends. One of the entrepreneurs nicely captures the need for business agility, by stating that "when you're working through [short] iterations, you cannot predict the outcome. It's a pity if you make a big step and it appears to be all for nothing, throwing away maybe three months of work. (…) It won't work without a good team, that's the most important thing."

(3) **Funding and monetization**

Financial resources are necessary to support the *executing* routines described in the previous two steps. An app needs to be developed (involving a design and a coding process) to automate the value proposition, and this requires funding, whether the development is done internally by an own IT department or is outsourced to an app development company. Also, every time the app has to be adjusted, additional resources are needed. Finally, setting-up an organization supporting the app requires funds to source and maintain human resources. To acquire the necessary funds, the entrepreneurs use venture capital and/or set-up revenue streams. Often, to find venture capital, revenue streams should already be present or at least planned. One entrepreneur stated that "venture capitalists ignore ideas that could change lives, but do not have a [revenue] model." App-enabled revenue streams can come from the users, for example, as a result of app sales, in-app purchases or freemium revenue streams (i.e. the app is *free*, but users pay a *premium* for additional services and functionalities), or the collection of a percentage-fee on each transaction. Revenues can also be generated by third parties, for example through advertising revenues or sponsors. Most entrepreneurs (plan to) provide the app for free and shun the idea of using advertisements to generate revenue. The freemium and fee-based revenue generation were the most popular among the entrepreneurs.

5.4.2 BUSINESS VALUE

According to the collected data, *executing* capabilities lead to the creation of **automational** business value. This is an obvious consequence because of the focus on automating the value proposition by the *executing* capabilities. There are two areas indicating the app-enabled automational value. First, the **delivery costs are reduced** because of the abilities of the app to automatically deliver the value proposition to customers. In many of the cases studied, the main value proposition involves connecting suppliers, corporate or private, to the demand. By automating this process, there is no human interference needed to connect specific instances of supply and demand, reducing the cost of the service. Second, the **costs of the monetary transaction are reduced** between the parties involved because of the payment modalities implemented by the app-entrepreneurs. Most payments are micro-transactions that can be bundled by using platforms that allow the handling of multiple payments without customers having to fill out payment information for each of them (e.g. PayPall, Credit Cards). This area of improvement might not result in monetary saving, but rather in time saving of the monetary transaction.

The data also suggest a second form of value created by the *executing* capabilities, namely **strategic** business value. As a consequence of automating the value proposition through the app, the speed of providing the value is increased. This results in an **improved service to the customer**, which could even lead to an **improved customer satisfaction**. The following example is illustrative. One of the initiatives in the sample offers an easy to use accounting package aimed at freelancers and small and medium sized enterprises. The package allows users to take a picture of an invoice with their mobile device, and automatically attach the invoice to a cost input field. This form of automation improves the accounting service that is delivered to the user. Furthermore, because the users, who often lack a dedicated financial department, can do their accounting with more ease, customer satisfaction is improved. Another form of strategic value associated to automation comes from the ability of delivering the value proposition repeatedly, without proportionally increasing the resources needed. For example, one of the initiatives allows people who want to eat at a restaurant to reserve a table through their mobile device. This value proposition is fully automated, from the search of a restaurant by a consumer, to the reservation of the table in the restaurant table-management system. Because there is no human intervention, it does not matter how many persons use the service. There is only a need to increase the capacity of traffic the app can handle when customer numbers grow. Therefore, the automation through the app **supports the growth of the business**. For obvious reasons, monetization also allows the business to grow and, therefore, the *executing* routines are associated with strategic business value.

Although the focus of the app-enabled business value creation lies on the downstream dimensions of value, it is worth mentioning that the *executing* capabilities are also associated with internal strategic value. As a result of (re)configuring the organization with attention on agility, the *executing* capability builds internal business flexibility for current and future changes. Nevertheless, this business value is not caused or preceded by the app. Rather, according to the data, it is a condition needed for the app to be successful. As such, internal strategic business value is not considered as business value of apps in this context. However, there might be apps that can be used by organizations to increase agility, but these fall outside the setting of this study.

5.5 ASSESSING CAPABILITY

5.5.1 DESCRIPTION

The data shows the presence of capabilities that assess customer value early in the innovation cycle. The *assessing* capability can best be described by the activity of *assessing (potential) customer value through customer interaction, reviews, and analytics*. The data suggest that entrepreneurs rely on *assessing* customer value to test whether the suggested economic opportunities are supported by potential customers, to gain additional insights for shaping and improving the economic opportunity, to test an early beta version for errors and market acceptance, and to measure the use of the app. The assessing capability seems to evolve according to the stage in the business cycle from small-scale interaction-based routines with perceptual measures to larger scale analytics-based routines with behavioral measures.

(1) **Customer interaction**

Entrepreneurs forming their economic opportunity actively engage potential customers to discuss and exchange ideas regarding their value proposition. One entrepreneur indicated that he plans to use customer groups to co-create and refine initial value propositions. He states: “we are not going to formulate ourselves what the app should do … we are going to recruit a group of five teenagers, which is our target audience … and put them in the driving-seat, while we provide them with support and guidance to create an output.” This form of customer interaction provides him with valuable information about his (untested)

assumptions regarding the value proposition, and might create new insights the entrepreneur himself did not yet think about.

(2) **Customer reviews**
An intermediate form of *assessing* routines, between 'having an idea' and 'officially introducing the product to the market,' involves the use of pilots to test an early product with a small target group. This approach combines objective data on the use of the pilot-app, which is discussed under the next point, with reviews from the target group about their ideas and suggestions for the app. Customer reviews also play a role after an app is brought to the market. Users of an app can write reviews and rate the app in the online app stores. Customer reviews provide useful feedback on the app and its value proposition. The observations suggest that this feedback is used by the entrepreneurs to improve their product. As one entrepreneur states about a functionality of the app: "we received quite bad reviews, and as we speak we are creating a solution for this functionality. The next release will include the solution."

(3) **Customer analytics**
After an app has been delivered to the market, whether it is the official introduction of the app to the market or just a pilot, the entrepreneurs can measure actual customer behavior using analytics. Analytics are data collection routines that track the use of the app. The observations suggest that collected analytics include information on at least how many users the app has, how often it is used, and what features are used most.

5.5.2 BUSINESS VALUE

Informational business value can be realized by *assessing* potential customer value. The feedback of potential customers about the use of an app provides valuable information that can guide further decision-making regarding the initiative. The value resulting from the **improved decision-making** lies with the other capabilities that actually benefit from this situation. For example, the data created by customer groups to evaluate aspects of an assumed economic opportunity can be used to improve the *matching* capability. Therefore, the *assessing* capability is only associated with informational value, not other types of value that might follow from the improved decision-making. Besides improving decision-making, the *assessing* capability can also be associated to the **improvement of market responsiveness**, another form of informational value. For obvious reasons, being able to rapidly respond to market trends and wishes depends on the knowledge available about the market. The *assessing* capability provides this knowledge.

6 DISCUSSION: APP-ENABLED VALUE CREATION CYCLE

The previous chapter presented the study results in the form of the descriptions of the dynamic capabilities needed to create value with apps, as well as a categorization of the business value associated to these capabilities. This chapter takes a process perspective on app-enabled value creation. First, an aggregated model for the app-enabled business cycle is presented, which shows the mechanisms of interaction between the capabilities. These mechanisms of interaction are discussed in section (6.2), guided by the propositions formulated a priori in section (3.2). Section (6.3) takes a synthetic sense-making approach (Langley, 1999) to transform the capabilities into variables and complete the model by making it suitable for future positivist studies. The last section of this chapter discusses differences between the theory resulting from this study and the original NEBIC theory.

6.1 OVERVIEW OF THE APP-ENABLED VALUE CREATION PROCESS

The app-enabled cycle of value creation can be described by the following proposition.

Enabling platform ecosystems lead to app-enabled economic opportunities. Selected opportunities enable growth through business innovation for the purpose of creating business value.

Figure 7 shows the above proposition as a process of interconnected capabilities, each associated with the creation of certain types of business value. The numbered processes connecting the capabilities correspond to the numbers of the theoretical propositions discussed in the following section.

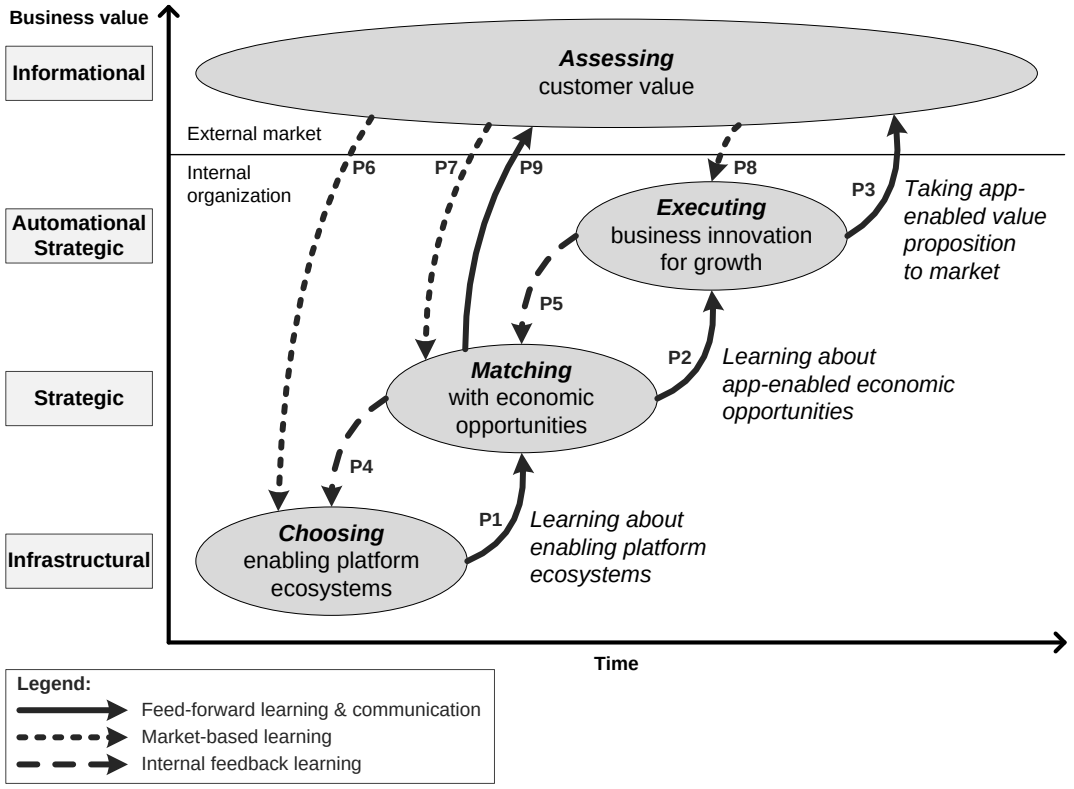

FIGURE 7. *Extended and refined app-enabled value creation process (adapted from Wheeler, 2002; P-numbers are references to the theoretical propositions discussed in the following section explaining the processes between the capabilities)*

6.2 VALUE CREATION PROCESS EXPLANATIONS

Entrepreneurs combine functionalities from dominant and compatible platforms to find efficient and/or novel solutions. As such, the *matching* capability reveals economic opportunities building on the outcomes of the *choosing* capability. Failing to combine functional platforms during the *matching* of platforms to economic opportunities will prevent an initiative to realize infrastructural value. Failing to use dominant platforms will prevent an economic opportunity from creating business value when the value proposition is brought to the market, because the initiative will not be easily accessible to large parts of the market. Failing to use compatible platforms will lead to software programming obstacles during the development of the app, and prevent an economic opportunity from creating business value if the obstacles cannot be overcome. Therefore, failing to learn from the outcomes of the *choosing* capability and use this new understanding for *matching* them to economic opportunities will prevent the creation of business value. As such, proposition 1 is supported by the data.

PROPOSITION 1. Effective entrepreneurial learning processes that create or change understanding are necessary between the *choosing* and *matching* capabilities to create business value.

The entrepreneurial learning process in itself is a tacit way of learning. Results from the *choosing* capability are usually not formalized by the entrepreneurs in the sample (e.g. written down in documents) to be used for the *matching* capability. Rather, learning in this context can best be described as the process of interpreting knowledge resulting from the *choosing* capability through the entrepreneur's cognitive framework. Its cognitive framework allows an entrepreneur to 'connect the dots' between factors like technology and market trends and reveal economic opportunities (Baron, 2006). While this informal way of learning usually takes less time, it can come at the expense of clarity towards other people not involved in the learning process. However, the data suggest that this is not a problem, because the initiative is being carried by one or a few people involved in the whole process.

Feedback processes are common and necessary to improve decision-making, because of the limited availability of resources to investigate at each step what decisions have the highest probability for creating a successful outcome. The data show that there are two ways for the *matching* capability to give feedback insights to the *choosing* capability. The first is through a direct entrepreneurial learning process, where insights from the *matching* capability are used to refine the choice for certain platforms. One clear example of this feedback process comes from an entrepreneur planning to create an app that makes online shopping for clothes more social. After selecting dominant and compatible e-commerce and social platforms (i.e. *choosing* capability), functions of these platforms are combined to reveal economic opportunities (i.e. *matching* capability). This resulted in the revelation that the creation of a *used*-clothing market could be an economic opportunity that complements its original service of social online shopping. While the payments for purchasing new clothes would be handled by the chosen e-commerce platforms, for the used-clothing market the payments should be handled within the app environment. This insight is tacitly used as input for *choosing* a dominant and compatible mobile payment platform. The data show that this kind of feedback processes happens often, as combinations of platforms can reveal new economic opportunities, and new economic opportunities can induce the search for platforms to support parts of the initiative. Therefore, the data suggest the presence of a feedback learning process from the *matching* to the *choosing* capability, where the latter is strengthened by insights from the former. This supports proposition 4.

PROPOSITION 4. The *choosing* capability is strengthened when entrepreneurial learning conveys insights from the *matching* capability.

The second way for the *matching* capability to provide feedback insights to the *choosing* capability is through the *assessing* capability. The data suggest that entrepreneurs communicate their value propositions to the marketplace through customer interaction after having matched the combination of platforms to economic opportunities. This communication allows for assessing customer value at an early stage in the business cycle, creating valuable information useful for further decision-making regarding the initiative. Failing to effectively communicate the value propositions will prevent the creation of informational business value. Hence, the theory is extended with this communication process as described by proposition 9.

PROPOSITION 9. Effective communication processes are necessary from the *matching* capability to the marketplace to create *informational* business value.

The entrepreneurs assess customer value at an early stage, which creates marketplace data regarding the platforms chosen for the economic opportunities. Learning from these data can provide confirmation of the initial choices, or new insights for modification of the chosen platforms. In any case, learning from the customer through the *assessing* capability improves the *choosing* capability, supporting proposition 6.

PROPOSITION 6. The c*hoosing* capability is strengthened when entrepreneurial learning is based on marketplace data.

The data suggest that, to develop the economic opportunity and create value, entrepreneurs engage in a cycle of strategizing (i.e. through *matching* capabilities), and app development and organizational configuration (i.e. through *executing* capabilities). Plans resulting from the *matching* capabilities guide the *executing* capabilities. Without this guidance, the priorities and objectives needed for the *executing* capabilities to create business value remain unclear. Therefore, effective entrepreneurial learning processes are necessary between the *matching* and *executing* capabilities. The data point to the presence of both formal and informal learning processes between these capabilities. Informal learning is best described as a cognitive sense-making process of the economic opportunities, which is necessary for them to be transformed into a value-creating product. The informal learning mostly takes place when the number of people involved in the initiative is limited. However, the data suggest that additional resources are required to form the app and organization. There arises a need for funding in order to realize the app. *Executing* capabilities include finding funds in the form of loans or venture capital. To be successful in finding funds, it is necessary to formally communicate the priorities and objectives in, for instance, business plans. Formalizing priorities and objectives to develop the economic opportunities is also helpful when there is a need for additional human resources. Communicating the priorities and objectives to those involved in app development is necessary for them to develop a product that creates value. Because of the above, proposition 2 is supported by the data.

PROPOSITION 2. Effective entrepreneurial learning processes that clarify priorities and objectives are necessary between the *matching* and *executing* capabilities to create business value.

The data suggest that there are two ways for the *executing* capability to give feedback insights to the *matching* capability. The first is through a direct entrepreneurial learning process, where insights from the *executing* capability are used to refine and improve the perceived economic opportunities. For example, the *executing* capabilities might reveal insights on the viability of the plans made using the *matching* capability. Especially in the case a plan appears not to be viable for execution, the *matching* capability can be strengthened by feeding back the obstacles encountered during execution. For example, monetization is an *executing* routine aimed at finding funds or setting-up revenue streams for the initiative. In the case the economic opportunity is not focused on generating revenue, one entrepreneur argued that venture capitalists in Europe are not willing to invest. It is even less probable that a bank would grant a loan. The entrepreneur can learn from these insights revealed by the *executing* capability, and go back to adapt the strategy of the economic opportunity through the *matching* capability. Another feedback process mentioned by an entrepreneur was caused by regulation issues encountered while executing the initiative. These issues required the entrepreneur to 'return' to the *matching* capability and adapt the way the economic opportunity was planned. These kinds of 'adaptive business planning processes' are common among entrepreneurs in dynamic environments (Gruber, 2007). The above shows that the data supports proposition 5.

PROPOSITION 5. The *matching* capability is strengthened when entrepreneurial learning conveys insights from the *executing* capability.

The second way for the *executing* capability to provide feedback insights to the *matching* capability is through *assessing* customer value. According to the data, after the entrepreneurs have run through some of the execution routines, they test their value proposition in the market. This is done through piloting and beta testing. Usually, the entrepreneurs use a small subset of the market for

doing this testing. For example, one of the entrepreneurs brought a pilot of the initiative to the market at a university campus for testing. Because this is a small, uniform, and geographically compact market, it was relatively manageable to communicate and deliver the initiative. The testing aimed at producing data regarding the functioning of the app, to uncover possible bugs. Additionally, the testing produces marketplace data about the use of the apps in the form of 'hard' analytics and 'soft' customer feedback, to see if the value proposition is embraced by the market. As such, valuable information can be created by taking an app to a market-subset before its official launch. The process of doing so can be described by communicating and delivering the value proposition to the market, in line with the proposed process for the official launch described by proposition 3. Hence, this communication and delivery process is supported by data.

PROPOSITION 3. Effective communication and delivery processes are necessary from the *executing* capability to the marketplace to create business value.

The entrepreneurs engage in the same process when releasing the app to the whole market. The communication and delivery, however, are less directed compared to releasing a pilot because it is aimed at reaching a larger market. Depending on whether the app is native, and which platforms are chosen to target with the app, the delivery happens through the app distribution platforms associated with the operation system of a mobile device (e.g. Google Play for Android-based devices). These distribution platforms are well-known among app users and allow the apps to be delivered effectively, and create business value by reaching a large market. This provides further support to proposition 3.

The *assessing* capability creates informational value that can be used by the *matching* capability to improve its routines of revealing economic opportunities. As mentioned, this is a form of feedback from the *executing* capability, because the information is induced from communicating and delivering results from the *executing* capability. That the *matching* capability can benefit from marketplace data becomes clear by considering the previous pilot example. By understanding how the value proposition is embraced by a subset of the market, the assumed economic opportunities can be tested. The entrepreneurs use piloting to see if the value proposition is actually embraced as a solution by a small public. It gives insights that are valuable to fine-tune the revelation of app-induced economic opportunities, in fact strengthening the *matching* capability. This supports proposition 7.

PROPOSITION 7. The *matching* capability is strengthened when entrepreneurial learning is based on marketplace data.

The data show that the executing capability can be strengthened by learning from the outcome of the *assessing* capability. Both subjective and objective forms of *assessing* customer value can help improve decision-making and market responsiveness by learning from the customers and using this knowledge to improve the app. This type of learning happens frequently, as the development of the app is often done in small iterations. This means that after bringing a minimum viable product to the market, further development is done through short cycles of *assessing* and *executing*. Also the monetization routine of the *executing* capability is strengthened by *assessing* customer value. First, the entrepreneur can use analytics to show the bank or venture capitalist the use and growth of the app. This way, the entrepreneur has a better chance of getting additional funding for further development. Second, the entrepreneur can use customer feedback and usage analytics to help in making decisions for setting up revenue streams. Usage analytics helps in identifying what are the most used sections of the app. These are apparently the most valued services, and the choice could be made to monetize them by, for example, charging a fee for these services, or showing ads in the respective sections of the app. Customer feedback can help in evaluating whether charging fees or

showing ads will be accepted by the users. This knowledge can prevent from making wrong decisions and losing customers. The above shows that learning from the market strengthens the *executing* capability and, therefore, proposition 8 is supported by the data.

PROPOSITION 8. The *executing* capability is strengthened when entrepreneurial learning is based on marketplace data.

The nine propositions above describe the interactions between the capabilities as showed in figure 7. These propositions, together with the descriptions of the capabilities and related business value, explain how entrepreneurs create value with apps (RQ1), and what type of value is actually created (RQ2).

6.3 SAMPLE EMPIRICAL INDICATORS

This study started out by using the NEBIC theory as a basis for describing the process of app-enabled value creation by entrepreneurs. As the NEBIC is a subjective understanding of reality, the theory was adapted to fit the study context and create an interpretive understanding of reality. The interpretive understanding presented in this study can form a basis for future positivist work on the subject (Lee, 1991). For this purpose, table 7 presents sample empirical indicators to measure the capabilities. The indicators are based on the data categories extracted from the observations. Langley (1999) termed this a 'synthetic' sense-making strategy, where process data describing particular events are used to construct measures. 'Stories' are transformed into 'variables' by synthesizing the critical components (i.e. routines) of these variables. The original NEBIC theory also included sample empirical indicators, but these were focused on large organizations. As was the case with the original indicators, the items in table 7 need to be tested using construct development and validation procedures before using them to test hypotheses. Indicators might be added, altered, or removed resulting from such procedures. However, they are meant to guide the future construct development and validation process. Section (7.3) discusses how measuring the capabilities can play a role in future positivist studies on the subject, where directions for further research are formulated.

TABLE 7. *Capabilities and their sample empirical indicators*

Capability	***Routines and their sample empirical indicator(s)***
Choosing enabling platform ecosystems	▪ Choosing platform functionalities - *Extent to which a platform is selected for the functionality it brings* ▪ Choosing dominant platforms - *Assessing the dominance of a platform before selecting it* ▪ Choosing compatible set of platform technologies - *Consistency of the technology standards across multiple chosen platforms*
Matching with economic opportunities	▪ Continuously searching for solutions to perceived problems by combining enabling platforms - *Early detection of problems in the market and formulation of solutions as basis for economic opportunities* - *Formulation of solutions explicitly considers combinations of enabling platforms* ▪ Finding novel complements between enabling platforms - *Early to see novel functionalities through combinations of enabling platform ecosystems* ▪ Finding efficient complements between enabling platforms - *Early to see efficiency gains through combinations of enabling*

	platform ecosystems
Executing business innovation for growth	▪ Automating the value proposition - *Extent to which the initiative can be automated* ▪ Creating product flexibility and organizational agility - *Extent to which the initiative can be implemented rapidly* - *Extent to which the initiative can be adapted rapidly* ▪ Funding and monetizing the initiative - *Extent to which the initiative can be monetized through user payments or third parties (e.g. advertising, sponsors)* - *Extent to which the initiative can be funded (e.g. banks, venture capitalists)*
Assessing customer value	▪ Assessing (potential) customer value through customer interaction - *Frequency of exchanging ideas with customers (e.g. engaging potential customers through online forum/blog discussions)* - *Frequency of using customer product development groups (e.g. using potential customers to co-create concepts)* ▪ Assessing (potential) customer value through customer reviews - *Extent to which customer reviews are fed-back* ▪ Assessing (potential) customer value through customer analytics - *Extent to which customer analytics are fed-back*

6.4 DIFFERENCES BETWEEN APP-ENABLED AND NET-ENABLED VALUE CREATION

This section discusses some differences with the original NEBIC model, indicating where the process of app-enabled value creation differs from net-enabled value creation as formulated by Wheeler (2002). Alternatively, the differences might also hold in the case of net-enablement, hereby identifying possible adaptations to improve the NEBIC theory. However, improving a model for net-enablement is not the goal of this study and, therefore, the following discusses the differences from an app-enablement perspective. There are notable differences at three levels in the theory.

(1) At the capability-level, the routines relating to each capability are different from the routines suggested by Wheeler (2002) in the case of net-enablement. As mentioned in section (4.1), the NEBIC-operationalization of the capabilities into empirical indicators is done in the context of net-enablement at large organizations. This study argued that the NEBIC indicators would not hold in the context of app-enablement at start-ups. Routines for this context were identified based on the 12 data categories discussed in the chapter (5). Section (6.3) suggested sample empirical indicators for each of the routines.

(2) At the process level, the app-enabled value creation by the start-ups in the study differs from the NEBIC on three points.
   - The NEBIC is strongly driven by feed-forward processes. Although it includes feedback processes, these have less emphasis than the feed-forward ones (also shown by the width of the arrows in figure 4). App-enabled value creation is a process that includes frequent feedback processes to form smaller cycles within the larger innovation cycle. The frequent iterations of the smaller cycles are an important characteristic of the innovation process that the start-ups engage in, indicating a scrum-like method of innovation. Therefore, the arrows in the app-enabled innovation model in figure 7 are all of the same width.
   - The *assessing* capability of the NEBIC is initiated at the end of the innovation cycle. In other words, the NEBIC asserts that the *assessing* capability includes routines that organizations engage in *after* the first three capabilities are run through. Most

of the app-enabled start-ups engage in *assessing* routines from the very beginning of their initiatives. This indicates that the start-ups are market-driven with an early customer focus.

- The original NEBIC theory states that a run of the innovation cycle is initiated by new IT. As such, the NEBIC is a technology-driven model of value creation. The start-ups in the study are driven by a *continuous search for solutions* to perceived problems. Therefore, the proposed app-enabled cycle of value creation can also be initiated when entrepreneurs perceive problems in the market, reinforcing the market-driven nature of the start-ups.

(3) At the outcome level, it was already discussed that the NEBIC model would be used with a broader outcome measure than 'customer value', namely 'business value'. This use of the model also has a consequence for the *timing* of value creation. The NEBIC asserts that customer value is realized *after* a value proposition has been delivered to the market. All the value associated with the process until delivery to the market is a value *potential*. By using an outcome measure that captures different manifestations of value, it becomes clear that there is also value realized *before* the delivery of a product or service to the market. For example, developing the app using tools and functionalities from the different available platforms realizes infrastructural value before the app is used by customers. This difference is not related to dissimilarities between app-enabled and net-enabled value creation; it comes from the way the NEBIC model is used.

7 CONCLUSION

7.1 RECAP: THE BUSINESS VALUE OF APPS

Previous studies have noted the business value potential of apps, but investigations of 'how' apps create 'what' value are unavailable. It is important for researchers, managers, and policymakers to know how apps contribute to economic performance to guide effective decision-making. An adaptation of the NEBIC theory, based on the Dynamic Capabilities perspective, was used as an a priori framework to guide the collection and analysis of data. Two research questions were answered using data provided by an interpretive analysis of eight entrepreneurial cases.

The first research question aims at describing how start-ups create value using apps. This question is answered by describing the process of app-enabled value creation through four interlinked dynamic capabilities: *choosing* enabling platform ecosystems, *matching* them to economic opportunities, *executing* business innovation for growth, and *assessing* customer value. Each of the capabilities was explored, and interdependencies were formulated.

The second research question aims at describing what types of business value is created by start-ups using apps for business purposes. The study revealed that the use of apps can be associated with all four types of downstream business value. First, *infrastructural* value is created through using the many available platforms as components of the app. Second, *automational* value is created because the app allows the delivery of the value proposition to a large market without much human interference. Third, *informational* value is created because an app allows its use to be tracked through 'hard' analytics and, additionally, the app stores allow users to review the apps online. These processes create valuable information for the entrepreneurs. Fourth, *strategic* value results from using an app because it allows the creation of new or improved solutions, resulting in more customer value, an improved competitive capability and, ultimately, the growth of the business.

By explaining how start-ups create value with apps, and what type of value is actually created, the research goal of 'explaining the business value of apps' is met. The following three sections discuss the study limitations and implications for theory and management, together with suggestions for future research.

7.2 LIMITATIONS AND FUTURE RESEARCH DIRECTIONS

The first limitation to the study relates to the external validity of the sample used. The results of this study are based on a sample of eight start-ups in the Netherlands. Different results could be found depending on the country or region where the study is carried out. Differences in, for example, national rules and regulation or entrepreneurial culture could result in different processes of value creation. Also, the sample was not selected to present a fair picture of Dutch start-ups. Rather, cases were selected based on an expected intensity of business value creation. In other words, the sample consists of entrepreneurs that were engaged in (potentially) successful initiatives. The aim of this study was not to present results that would be generalizable over larger populations. Rather, the aim was to formulate theory by uncovering critical aspects of a process. Future work can focus on testing whether (parts of) the theory holds in different settings. More specific directions for future positivist work will be discussed in the following section.

The second limitation relates to the reliability of using interpretive data analysis. As mentioned in the methodology section, such analysis requires considerable input from the researcher, because the coding and categorization of codes is a subjective process. As such, results may be contingent upon the researcher. Using multiple researchers to triangulate the analysis would improve the

reliability of the results. Unfortunately, this was not possible for this study. However, the coding process is described in detail in an attempt to provide clear information on how the data were analyzed, allowing methodological replication.

Regarding the data themselves, wrong interpretation and faulty or missing data could lead to a weakening of the internal validity. Relationships were proposed based on the data, for example, regarding the business value associated to a certain capability. The process of proposing each of these relationships was described in chapter (5), and is contingent data quality. The reliability of the data is improved by using within-case triangulation through multiple data sources and cross-case triangulation by using multiple cases.

The third limitation comes from the choice to focus the investigation only on 'downstream' business value creation. It was argued that the downstream dimension is an interesting focus because of the recent proliferation of mobile devices among consumers. The consequence of this choice is that the results of the study cannot be generalized to also apply for 'internal' and 'upstream' app-enabled value creation. Some aspects of this study may also play an important role in the latter two dimensions of business value, such as creating infrastructural value through the use of platform ecosystems. Other aspects may be relevant to only the downstream dimension, such as creating informational value through customer interaction. Future research could attempt to uncover the relevant internal and upstream processes and outcomes relating to the use of apps.

7.3 THEORETICAL IMPLICATIONS AND FUTURE RESEARCH DIRECTIONS

7.3.1 IT BUSINESS VALUE: PRODUCTION ECONOMICS & NEBIC

This study was motivated by exploring the business value of apps. The research background given in chapter (2) showed that most models on the subject of IT business value have their roots in the field of production economics. Several shortcomings in these models were presented and a theoretical framework for the current study was chosen from a different field. Nevertheless, production economic-based models can provide a fruitful basis for further research on the quantification of the business value of apps. As was discussed, these types of models do not concern themselves with how an app is adopted. However, it uses 'app adoption' as an input variable, usually proxied by the amount invested in apps. Obviously, only investing in a technology does not provide higher output; it also depends on, for example, the way it is implemented. By describing the routines critical to the implementation process, this study can provide some guidance for a better conceptualization of 'app adoption'. Such a construct could include items deduced from the adoption routines, for example, if the app includes platform functionalities, if it provides a novel or more efficient solution, and if it is supported by an agile organization. By including such items as input or moderators in a variance-analysis the economic value of apps can be estimated more accurately using production economics.

Regarding the NEBIC theory, the results of this study show some differences with the proposed value creation process. It appears that measurement routines of the *assessing* capability are present during the whole cycle, as opposed to the original NEBIC where it was proposed to be at the end of the cycle. This could also apply to the case of net-enabled initiatives in general. Future work could use this finding as an extension to the NEBIC theory. Another interesting contrast is that the app-enabled opportunity revealed through the *matching* capability is driven by a *continuous search for solutions* to perceived problems. This finding reinforces the market-driven nature of the process; when entrepreneurs perceive new problems in the market, a new run of the cycle is initiated. This is in contrast to the original NEBIC theory, which states that a run is initiated by new IT.

7.3.2 DYNAMIC CAPABILITIES AND A POSITIVIST UNDERSTANDING OF APP BUSINESS VALUE

The data in this study showed that the process of creating value with apps can be described by four interlinked capabilities. Each of the capabilities is described through some critical routines, and linked to the type of business value it creates. This created an interpretivist understanding of app-enabled business value creation. As such, it contributes to the literature in providing *necessary conditions* to create value with apps. For example, to create business value, entrepreneurs need to learn about platforms through the *choosing* capability before being able to reveal economic opportunities through the *matching* capability. However, this process approach does not imply that having a stronger *choosing* capability results in a stronger *matching* capability. Also, it does not imply that, for example, a stronger *choosing* capability will result in more business value. These statements could be studied using a positivist approach. The routines that make up a capability were transformed into empirical indicators of the capabilities in section (6.3). These indicators can provide a basis for future positivist work on the subject. Hypotheses can be formulated based on the model in figure 7. For example, "a weak *Choosing* capability will hinder the timely reconfiguration of resources" (Wheeler, 2002, p. 141). This could trickle down to subsequent capabilities. The following hypothesis could attempt to examine the *choosing* capability as an antecedent of the *matching* capability:

SAMPLE HYPOTHESIS 1. Organizations with a strong *choosing* capability will be able to more effectively employ the routines of the *matching* capability.

Also hypotheses related to the outcomes of the value creation process can be formulated, for example:

SAMPLE HYPOTHESIS 2. Organizations with a strong *choosing* capability will create higher levels of app-enabled *infrastructural* business value.

As mentioned, the capabilities can be measured using the items reflecting capability-routines in table 7, and the business value can be measured using the business value indicators from the third column of table 6.

7.3.3 STRATEGIC ENTREPRENEURSHIP

The observations in this study suggest a link between the dynamic capabilities under study and entrepreneurship research. The original NEBIC theory is very much based on a feed-forward approach. It includes feedback processes, but these are given less importance. The entrepreneurs in this study engaged in iterative cycles within the larger innovation cycle. Looking at the app-enabled value-creation process in figure 7 it becomes clear that there are three sub-cycles present. These sub-cycles match the three entrepreneurial phases of value creation (Groen, 2005; Shane & Venkataraman, 2000).

(1) The arrows representing propositions 1 and 4 match the *opportunity discovery/recognition* phase. The interplay between the *choosing* and the *matching* capabilities explains how an entrepreneur identifies economic opportunities through new technologies and markets.

(2) The arrows representing propositions 2 and 5 match the *opportunity evaluation/ development* phase. The interplay between the *matching* and the *executing* capabilities explains how an entrepreneur turns economic opportunities into value propositions.

(3) The arrows representing propositions 3 and 8 match the *opportunity exploitation* phase. The interplay between the *executing* and the *assessing* capabilities explains how an entrepreneur takes the value propositions to the market.

Combining a Dynamic Capabilities perspective with entrepreneurship research is valuable to explain the ability of some organizations to continuously recognize, develop, and exploit entrepreneurial opportunities (Zahra, Sapienza, & Davidsson, 2006). The above connections provide a starting point for future studies to explore the role of these capabilities in each of the entrepreneurial phases. A focus could go out to exploring the interplay between the routines that constitute a capability and the learning processes that connects them, to create an understanding of how entrepreneurs actually recognize and enact opportunities, a central theme in entrepreneurship research (Baron, 2006).

7.3.4 BUSINESS MODEL INNOVATION

Most entrepreneurs considered in the study argue that they are not led by formulating a business model when recognizing and developing app-enabled economic opportunities. However, the routines that make up the capabilities as found in this study are related to the formulation of several elements of the business model. The result of the *choosing* capability defines the platforms that will become 'key partners' for delivering the value proposition. The 'value proposition' in itself is defined by the routines from the *matching* capability. The 'cost structure' and 'revenue streams' are formulated by the funding and monetization routines from the *executing* capability. The previous examples show that the process of app-enabled value creation is actually a process implicitly aimed at formulating elements of the business model. Business model innovation is an important complement to adopting new technologies when attempting to commercialize them (Chesbrough, 2010). Scholars have argued that changing the business model when adopting electronic-business solutions is a critical factor to create value (e.g. Amit & Zott, 2001). The Dynamic Capabilities perspective and, more specifically, the capabilities and their related routines resulting from this study could be used in future studies to investigate how these drive business model innovation. In term, business model innovation drives the creation of value, and could therefore be seen as mediating construct between dynamic capabilities and business value in future studies.

7.4 MANAGERIAL IMPLICATIONS

The insights resulting from this study can be helpful for managers to guide their app-enabled value creation efforts. These apply to both entrepreneurs managing their start-ups and managers in large established organizations involved in app-based value creation processes. This study concludes with three managerial implications that follow from the value creation efforts of the studied start-ups.

- The first consideration that managers have to make is to question the adoption of an app altogether. Many organizations might choose to adopt an app because it is an IT fashion, i.e. a "belief that an information technology is new, efficient, and at the forefront of practice" (Wang, 2010). Many of the branded-apps fail because they do not deliver any functionality (Deloitte, 2011). This study suggests that adopting an app should be driven by the solution it provides, whether it is a novel solution or a more efficient solution than existing ones. Just getting an app with a brand 'out there' will likely not create any value in a market with hundreds of thousands of apps available. On the other hand, longer term data suggest that brands that use an IT in fashion, even without leading to a successful adoption, can benefit from improved brand reputation because it is associated with the hottest IT (Wang, 2010). This may also be the case with the use of apps.

- All the entrepreneurs in the study explicitly seek to build on the different platforms available. This appears to be the basis for creating value with apps. Obviously, the use of a mobile device and operating system is a necessary condition for all apps. However, extending the app-enabled initiative by integrating, for example, social platforms, contextual features from the mobile device, or e-commerce platforms, might improve the

chances for success. In any case, they provide infrastructural value, because using features of these platforms is often free of charge. This study shows that the most common practice is integrating a Facebook personal identification procedure for the app, hereby creating a known and trusted login environment. Also, posting app-activity to the respective person's Facebook wall will enable a network effect that can benefit future value creation with the app.

- The observations show that entrepreneurs seek early and frequent involvement of the customer as basis for justifying and guiding their value creation efforts. Customer involvement is transformed into value by short, frequent, and continuous iterations of (parts of) the innovation cycle to create and sustain the app-enabled initiative. This form of value creation requires organizational speed and agility. Creating agility in larger organizations might be more difficult. Especially multi-departmental organizations need to have excellent communication between the departments, to allow for the feed-forward and feedback learning. When engaging in an app-based initiative, the consideration should be made to form a cross-functional team that is involved in the whole initiative, from conception to market, to avoid the loss of knowledge and speed.

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APPENDIX 1: *APP BUSINESS VALUE TYPOLOGY & GUIDING INDICATORS*

	Upstream (B2B)	Internal (B2E/E2B)	Downstream (B2C/C2B)
Strategic (transformational processes)	– Support supplier relationship management – Support business alliance – Supplier co-creation of products and services – Build external linkages	– Increase staff motivation – Build business flexibility for current and future changes/Agility – Cycle time reduction – Quality improvement	– Sales increase/Support business growth – Sales area widened – Product and service innovation improved – Customer service improved – Customer satisfaction improved – Competitive capability
Informational (decision and control processes)	– Coordination with suppliers improved – Inventory costs decreased	– Increased control – Decision making/planning improved – Responsiveness improved – Better resource management	– Customer marketing efficiency improved – Customer marketing effectiveness improved – Customer input possibilities improved
Automational (operational processes)	– Facilitate communication with suppliers – Procurement costs decreased – Transaction costs decreased	– Facilitate communication with and among employees – Internal processes more efficient – Reduce administration workload by elimination of manual routine – Reduction of number of employees	– Facilitate communication with customers – Delivery costs decreased – Transaction costs decreased*
IInfrastructural ("supporting" IT processes)	Reduction of: – Hardware costs (e.g. servers, laptops) – Software costs (e.g. purchasing, developing, updating software) – Cost of IT staff (e.g. development and maintenance of IT infrastructure) – Costs related to customer databases (e.g. costs as a result of security and privacy risks)		

*Here the term *transaction cost* is narrowly used to represent the cost of a *monetary* transaction; the term as used in the field of economics, more broadly represents the cost related to the whole process of creating and delivering a product or service, and thus includes *all* costs leading to a certain transaction.

APPENDIX 2: *INTERVIEW INSTRUMENT*

Introduction and background (±5 min)

1. Researcher gives an introduction to the study *(EC/TNO investigation on web-platforms and applications; as part of that investigation and for MSc graduation assignment this study aims at explaining how entrepreneurs create value with apps → mobile applications).*
2. OK to record? *(note that records are not made public)*
3. [General company info]*
   What is the company's value proposition and main activities? Are there any formal business plans and can these be viewed by the researcher?
4. [General interviewee info]
   What is your personal role in the organization and responsibilities related to the process of app creation? *(e.g. strategy, development, operations)*

App info (±10 min)

1. [General app info]
   What is the role of the app in the initiative?
2. [Deployment]
   What is the current state of development or release of the app? *(When deployed or planned to be released? In what stadium of development was or will it be released?)*
3. [Functions]
   What does the app do?
4. [Users]
   Who uses the app? For which users is the app intended?
5. [Platform]
   For which platform is the app developed? *(e.g. iOS, Android, web-based, etc.)*

App capabilities (±20 min)

1. [***Choosing*** capability]
   What is important in creating an understanding (i.e. identification, evaluation, and selection) of relevant technologies (hardware and/or software) to use for the creation of the app?
2. [***Matching*** capability]
   What is important for matching relevant technologies with business strategy and context to create economic opportunities?
3. [***Executing*** capability]
   What is important in the creation of the organization and the product or service?
4. [***Assessing*** capability]
   What is important for assessing customer value?

* Between '[ ]' represent description tags

App business value (±10 min)

1. [Realized value]
   What sort of value does the app create for your organization?
2. [Potential value]
   What sort of value will the app potentially create for your organization in the future?

(The business value indicators from appendix 1 are used as guiding examples to advance the respondent's answers.)

Closure

1. Do you have any relevant comments or additions?
2. Do you have any questions about the study?
3. Researcher finishes with thanking the interviewee and offers to send finished study.