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Unlocking how start-ups create business value with mobile applications: Development of an App-enabled Business Innovation Cycle

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ABSTRACT

Little is known about the business value that mobile applications (apps) can create, and how start-ups can leverage this value. We present a multiple-case study to both explain the process of app-enabled value creation and the type of value outcomes associated with the use of apps for business purposes. The study develops an App-enabled Business Innovation Cycle model that includes 1) twelve routines matched to four dynamic capabilities for creating business value using apps, 2) an explanation of the interactions between these capabilities, and 3) eleven types of app-enabled business value. Based on the developed model we give directions for future research and practice.

1. Introduction

Better understanding of how businesses leverage digital technology to create value is of prime interest (Wheeler, 2002; Yoo et al., 2010). Mobile applications (apps) particularly provide organizations new opportunities to create value, for example by meeting new demands, increasing efficiency, supporting knowledge sharing and improving competitiveness (Sheng et al., 2005; Unhelkar and Murugesan, 2010). Several calls have been made to investigate how the strategic opportunities of apps can be achieved (e.g. Anthes, 2011; R.C. Basole, 2007; Ladd et al., 2010; Sheng et al., 2005).

When dealing with opportunities relating to digital technologies in new and dynamic markets, as in the case of apps, start-ups are often the first who identify and explore these opportunities (Hitt et al., 2001). Start-ups are ventures in the process of discovering, developing and implementing a viable and scalable business model to exploit market opportunities. Despite the dominance of start-ups in app development, previous theory on net-enabled value creation focuses on the value creation process of large organizations (Wheeler, 2002). Therefore we focus our research on app-enabled value creation by start-ups.

Many studies investigating the value of IT have their roots in the field of production economics. These studies investigate what part of the value at the output of a production system can be accounted for by IT related inputs (Zhu and Kraemer, 2005). However, recent studies on IT business value contest the 'black box' production models, and aim at investigating the dynamics inside the production process (Kohli and Grover, 2008). We argue that looking inside a highly dynamic production system, as in the case of apps, there is need to focus on the Dynamic Business Capabilities (DBC) that shape an IT input and ultimately create value. For this purpose, the approach to the study takes a Dynamic Capabilities Perspective (DCP) that adjusts Wheeler (2002) DBC theory to the practice of app entrepreneurs.

Following the call of DCP, the goal of this study is to explain how app-enabled business value is created by start-ups, and what the business value of apps is. Consequently, we formulate two research questions. First, we want to know how start-ups create value by using apps for business purposes. Second, we aim to answer the question what type of value is created by start-ups that use apps for business purposes. We will answer both questions by combining insights of existing theory of e-business development and the experiential insights of eight app entrepreneurs. First, we develop an App-enabled Business Innovation Cycle (ABIC) model, which gives a new theoretical perspective on processes for transforming app business opportunities into real business value. This model is a variant of Wheeler's Net Enabled Business

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Innovation Cycle Model (NEBIC) such that it becomes relevant for the specific context of startups and apps. Second, we present cases that ground the propositions of the ABIC model in the practice of start-ups that create business value through apps. Last, implications are drawn for further research and for practice.

2. Theory

To explain the process of app-enabled business value creation, we first define app-enablement. We then explain the need to use a Dynamic Capabilities Perspective (DCP) and describe a DCP developed for IT and e-business named NEBIC. Next, we develop a variant of the NEBIC for app-enabled business value, termed ABIC, including nine research propositions.

2.1. App-enablement

Apps may take on a large variety of business functions, and we therefore need to formulate a working definition of apps and app-enablement before taking a closer look at their business value. Nickerson et al. (2007, p. 2) define apps as "a use of a mobile technology by an end-user for a particular purpose." 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 (Lee et al., 2015).

However, the focus of the above definition is on mobile computing in general, and would include all uses of a mobile technology, such as mobile phones, tablet PC's, but also WiFi-enabled laptops. This study excludes laptops 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. Also, the current study focuses on apps that potentially have business value. For example, an app could be used by organizations to communicate with suppliers, facilitate collaboration between employees, or reach and attract customers.

Apps are often the heart of mobile services that provide value to consumers (also see, Chen and Cheng, 2010; Gallouj et al., 2015; Gurtner et al., 2014). More precisely, an app interfaces a mobile device user with a mobile service when using a mobile device. The activity performed on the mobile device takes place through the software interface (the app from the user perspective) that interfaces between front-end and backend to exchange information. Apps are offered as services on digital technology platforms, such as app stores (Basole and Karla, 2011; Karhu et al., 2014). These digital technology platforms offer members a risk-free infrastructure to develop and exploit apps as complementary services (Basole and Karla, 2011; Parker and Alstyne, 2008). On the basis of the former, we define an app as "an interface on a mobile phone or tablet pc used for accessing a mobile service that potentially holds business value." App-enablement involves the use of one or more apps by organizations to enable a value proposition.

2.2. A Dynamic Capabilities Perspective on IT business value

Dedrick et al. (2003) reviewed more than 50 empirical articles that successfully related IT to economic performance. Most of the empirical assessments used production economics models, whose train of thought is to investigate through regression analysis what part of the outputs can be explained by 'IT investment' input. However, an organization can invest in apps, but if they are poorly developed or implemented, no part of the intended value creation will be realized. 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." Research has indicated that for the purpose of linking IT to the value it creates, it is necessary to look at how an IT is used (Aral et al., 2006; Devaraj and Kohli, 2003). For this purpose, IT business value research has shifted from using production economics to employing a Resource-Based View (RBV) as theoretical basis (Santhanam and Hartono, 2003; Wade and Hulland, 2004). However, the RBV does not seem to apply in dynamic markets (Eisenhardt and Martin, 2000), like the one concerning apps. Competitive advantage from 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 resources and reconfigure their existing resources to create novel forms of competitive advantage (Chakravarty et al., 2013).

The essence of the Dynamic Capabilities Perspective (DCP) is that competitive advantage comes from having strong capabilities in the form of routines that continually create and reconfigure resources (Teece et al., 1997). Dynamic capabilities are "organizational routines through which firms achieve new resource configurations" (Eisenhardt and Martin, 2000, p. 1107). 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). In case of market dynamism, the effective evolution of the capabilities depends on the ability to assess and understand changes in the market, and respond to them in a timely manner by reconfiguring organizational resources (Teece et al., 1997). Similarly, app-enabled start-ups need to continually reconfigure resources to create long-term value because apps can quickly lose their value due to imitations and technological developments.

An IT-related DCP for net-enabled business is formulated by Wheeler (2002) and named Net Enabled Business Innovation Cycle (NEBIC). 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 the cycle of value creation in net-enabled organizations through four dynamic capabilities: (1) choosing emerging/enabling technologies, (2) matching with economic opportunities, (3) executing business innovation for growth, and (4) assessing customer value. The relations between the capabilities are processes that describe learning from each of the four capabilities, communicating the results to the following capability, and feeding back market-based metrics. The NEBIC can be approached from both a variance and a process 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. From a process perspective, the model suggests that strong capabilities and effective communication processes between them are necessary conditions to create value.

2.3. App-enabled Business Innovation Cycle (ABIC) propositions

The NEBIC framework describes value creation processes for "particularly large firms" (Wheeler, 2002, p. 139). For our purpose the NEBIC processes have to be adapted to fit the context of app-enabled start-ups. The proposed adaptation leads to the ABIC (Fig. 1). The numbered processes connecting the capabilities in Fig. 1 correspond to the numbers of the propositions discussed below, explaining the sequencing and the mechanisms of interaction of the capabilities.

Most NEBIC propositions describe the processes between capabilities as communication processes. As such, the NEBIC theory focuses on intra-organizational learning through communicating knowledge and assumes that each of the four capabilities resides with different departments in an organization. In the case of small start-ups, the entrepreneur alone or a small group is usually involved in the initiative from conception to market, and learning is usually a cognitive process (Baron, 2006). As such, there is no direct need to communicate the knowledge to a different group of people. Therefore, the ABIC will

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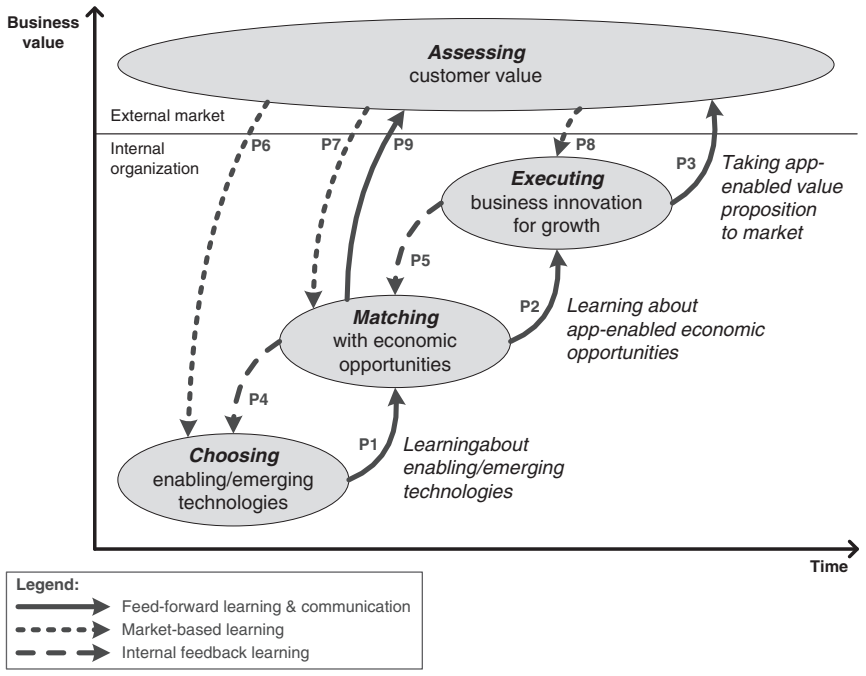

Fig. 1. The ABIC (adapted from Wheeler, 2002; P-numbers refer to the theoretical propositions).

focus on 'learning' rather than 'communication' processes. The ABIC depicts all the learning processes with same-width arrows, whereas the NEBIC puts more emphasis on the feed-forward processes. Feedback processes are an important part of entrepreneurial learning, as it allows for the adaptive sense-making needed to compete in dynamic markets (Bogner and 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. However, we propose that the choosing capability has a broader focus than just technological. In the mobile industry, choosing a technology goes together with choosing a certain platform and ecosystem (Basole and Karla, 2011; Ehrenhard et al., 2014). Therefore, next to technological insights, choosing also includes routines to create insights on the providers and users of the platform. The resulting insights are input to the matching capability, which includes routines to combine these insights with business and strategy. 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 insights from the choosing capability. For this purpose, start-ups need to engage in learning processes to create or change their understanding of enabling platform ecosystems, which we summarize in Proposition 1.

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

The executing capability includes routines that (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). It builds on the economic opportunities revealed by the matching capability. To create business value, it is therefore necessary for start-ups to engage in learning processes that clarify priorities and objectives resulting from the matching capability to guide the executing capability. Only then will executing capabilities be able to effectively achieve business innovation.

Proposition 2. *Effective 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 through communication and delivery processes. Failing to effectively communicate a value proposition to the market inhibits the realization of business value, as it 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.*[1]

The two light dotted arrows in Fig. 1 are internal learning processes that help in understanding and conveying insights back to antecedent capabilities. These insights may come from, for instance, mistakes due to wrong or obsolete 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 learning conveys insights from the matching capability.*

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

The three market-based organizational learning processes shown in Fig. 1 play an important role in the innovation cycle. Marketplace data

[1] Wheeler (2002) separated the communication and the delivery process in two propositions. Here, they are combined because both processes are related to each other in the context of apps; delivery can be seen as a communication process through a network. Additionally, it improves model parsimony, as both communication and delivery are represented by one arrow in the model.

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gathered by the assessing capability can strengthen all the capabilities by providing guidance to the routines associated with the respective capability. The assessing capability includes routines that produce marketplace data by measuring and understanding customers' preferences and evaluations of the delivered value. Learning from this data can help in adjusting the innovation cycle to a more favorable path. The marketplace data is conveyed to antecedent capabilities through learning processes that include selecting and contextualizing of the data resulting from the assessing capability.

Proposition 6. *The choosing capability is strengthened when learning is based on marketplace data.*

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

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

We propose an additional communication process at an early stage in the business cycle. Nowadays, businesses interact with the marketplace before launching a finished product because it can increase product success (Gruner and Homburg, 2000), and thus business value. Hence, the theory is extended with Proposition 9.

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

Routines to measure and understand customers' preferences need to be present at an early stage for Proposition 9 to hold. Therefore, assessing is modeled as a capability that is present during the whole business cycle.

2.4. App-enabled business value

The value that an IT creates can manifest itself in many forms (Kohli and Grover, 2008). For example, the use of IT can create business value which is passed on to customers in the form of price-reductions (Mithas et al., 2007). In addition, there might be manifestations that are hard to measure quantitatively, such as securing an organization's competitive position (Avgerou, 2001). Four functional types of IT business value are proposed (see, Aral and Weill, 2006; Mooney et al., 1995; Weill, 1992) and may be useful dimensions for our 'app-enabled business value' construct. These are listed here:

- ***Strategic*** value is related to transformational processes and refers to the capability of IT to gain competitive advantage through innovation and business transformation.
- ***Informational*** value is related to decision and control processes and refers to the ability of IT to collect, store, process, and distribute information.
- ***Automational*** value is related to operational process improvements and refers to the ability of IT to substitute labor for IT.
- ***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.

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 and Chen, 2008; Picoto et al., 2010; Zhu and 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.

Zahra and George (2002) suggest that researchers using Net Enabled Business Innovation Cycle frameworks incorporate outcome measures that are broader than 'customer value' created at the end of the cycle, as the NEBIC suggests. This broad view on business value allows for the identification of different types of value created throughout the ABIC, not just after introducing an app to the market. We focus on the downstream dimension because of the recent proliferation of mobile devices among consumers (Gallouj et al., 2015; Gurtner et al., 2014). Table 1 shows the 4-dimensional business value construct including indicators extracted from the abovementioned literature (overlapping indicators were combined to improve parsimony).

3. Methodology

The focus of our case studies is enriching the ABIC theory for the purpose of explaining app-enablement at start-ups. In line with the first research question on how startups created value using apps, this study takes a process perspective to explain how value is created. By investigating what kind of value is created through this process, also the second research question can be answered using this perspective. The theory of the previous section is used to guide the case study data collection and analysis. The ABIC model is used as a framework for reporting the results (Walsham, 1995).

The cases are Dutch 'app-enabled start-ups' referring to start-ups that employ at least one app in their business activities. It should be noted that pure 'app-developers' are not the aimed population; they only develop and sell an app, but do not employ it to enable a value proposition. To explain with the ABIC how value is created, initiatives must be studied from a process perspective. Because at the later stages of the process people forget details of the early stages, this study

Table 1
Downstream app-enabled business value constructs.

Strategic (transformational processes)	*Growth of:* ▪ Sales numbers ▪ Sales area *Improvement of:* ▪ Product/service innovation ▪ Customer service ▪ Customer satisfaction ▪ Competitive capability
Informational (decision and control processes)	*Improvement of:* ▪ Marketing efficiency ▪ Marketing effectiveness ▪ Customer input possibilities
Automational (operational processes)	Facilitate communication with customers *Decrease of:* ▪ Delivery costs ▪ Transaction costs[a]
Infrastructural ("supporting" IT processes)	Reduction of costs related to: ▪ Hardware (e.g. servers, laptops) ▪ Software (e.g. purchasing, developing, updating software) ▪ IT staff (e.g. development and maintenance of IT infrastructure) ▪ Maintaining customer databases (e.g. costs as result of security/privacy risks)

[a] 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.

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approached start-ups in two different phases of the initiative (Markus et al., 2000). Start-ups in the pre-market phase are developing their value proposition, but have not yet introduced it to the market. Start-ups in the market phase have brought the initiative to the market. Within both phases, multiple cases will be analyzed to allow for replication logic (Yin, 2003).

Cases in the pre-market phase are identified through current or recent participation in incubators, 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 media attention and are therefore potentially valuable (e.g. prize winner, raised venture-capital, downloaded a considerable number of times). Hence, the sample might not be representative for all app-enabled start-ups. However, it provides a higher likelihood for theoretical insights and therefore fits the aim of this study to revise and enrich the NEBIC theory – in other words analytical generalization to the relevant theory, rather than statistical generalization to a wider population – as opposed to testing it (Eisenhardt and Graebner, 2007). Four cases were sampled for each phase, giving a total of eight cases. Table 2 gives an overview of the sample.

Data were collected in Spring 2012. Information richness and within-case triangulation of the data were improved by using multiple data sources (Yin, 2003). Per case, we followed a two-step data collection procedure. The first refers to the collection of general information about the app-enabled initiative. General data about the app-initiative (e.g. value-proposition, supporting organization) were gathered through publicly available information. The websites of the respective initiatives were consulted and interviews from public television and YouTube with the entrepreneurs were used to provide additional data. Moreover, some of the entrepreneurs who participated in the study made material available in the form of short business plans, roadmaps, or overviews of the initiative. The second data collection step contains interviews and is the primary data source, giving access to respondents' interpretations of real-life processes (Walsham, 1995). As such, the entrepreneurs' interpretations provide access to the processes at the start-ups. Table 2 shows the available data sources per case. Semi-structured interviews were held with the start-up entrepreneurs and were roughly divided into three sections: (1) general questions about the app-enabled initiative, (2) open questions about the process of value creation using the capabilities as guidelines, and (3) questions about the app-enabled business value. The interviewees were all founders of initiatives and were managing the value creation process at the time of interview (i.e. Spring 2012). The interview schema was applied loosely, as semi-structured interviews allow for developing the interview depending on the course of the conversation (Runeson and Höst, 2009). More specifically, this means that the ordering of the questions differed from one interview to the other. However, to guarantee validity of observations an interview guide was used to be certain that all the themes were touched during the interview. The duration of the interviews was in between 30 and 60 min, depending on previous data availability. Notes were taken during the interviews and the interviews were audiotaped for later reference.

The data analysis aims at: (1) the description of the ABIC-capabilities and (2) the identification of the type of business value created. It should be noted that data collection and data analysis happen concurrently in our case studies (Wheeler, 2002), and therefore four analysis steps will be iterated after the data collection of every case following the content analysis guidelines by Runeson and Höst (2009). First, concepts are identified using open coding (Strauss and Corbin, 1990). Second, by means of axial coding all the concepts are grouped by defining unifying categories that reflect multiple concepts (Strauss and Corbin, 1990). 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. Third, the emerging categories are aligned to the four ABIC capabilities by tracing back the codes forming a category to the question that produced the code. Fourth, the type of app-enabled business value is identified using the four downstream dimensions of the app-enabled business value construct.

To further enrich the ABIC and provide a basis for future studies into app-enablement, sample empirical indicators are formulated for the capabilities. 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 of these variables. In this study, the routines describing a capability will be transformed into indicators for the respective capability.

Table 2
Sample overview and data sources specified by case.

#	Start-up name	Size[a]	Founded	Value proposition	Additional data sources
Pre-market phase					
1	Peerby	5	2011	Collaborative consumption of goods; social consumption	▪ Website (*peerby.com*) ▪ Television interview (*omroep.vara.nl/media/85,166*) ▪ Interview with the Founder Institute (*youtube.com/watch?v=8UrQH7pzk04*)
2	Truienradar	7	2011	Social and contextual clothing assistant; social shopping	▪ Website (*truienradar.nl*) ▪ Television interview (*omroep.vara.nl/media/87,317*)
3	Rushkick	1	2012	Social betting and gaming	▪ Website (*rushkick.com*) ▪ Interview with the Founder Institute (*youtube.com/watch?v=RK04-Hbpfx4*) ▪ Slides with company plans
4	Sugarhabits	8	2011	Socially change and develop new habits	▪ Website (*sugarhabits.com*) ▪ Interview with the Founder Institute (*youtube.com/watch?v=nmA3FzFeEjU*) ▪ Slides with company plans
Market phase					
5	Couverts	10	2009	Restaurant table reservation system	▪ Website (*couverts.nl*) ▪ YouTube interview (*youtube.com/watch?v=rzeZa2LLH4Y*)
6	Moneybird	5	2009	Online accounting	▪ Website (*moneybird.nl*)
7	Toogethr	4	2011	Carpool assistant	▪ Website (*toogethr.nl*) ▪ Company presentation slides
8	Roots2share	4	2011	Cultural heritage storytelling	▪ Website (*roots2share.org*) ▪ Website (*museon.nl/roots2share*)

[a] Number of people working on the app-enabled initiative; numbers are indicative only, because the initiatives often employ people on a flexible basis.

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4. Results

Table 3 shows the concepts extracted from the case-data, the categories that emerged from grouping the concepts, and the capability these relate to. Table 4 shows the business value indicators extracted from the case-data linked to the related business value-dimension and capability.

4.1. Choosing capability

The choosing capability contains routines for choosing enabling-platform ecosystems. An app is built on one or multiple platforms and uses platform technologies as a set of enabling technologies. The observations suggest that there are three aspects shaping the choice among available platform ecosystems.

4.1.1. Platform functionality

The most important reason for choosing a certain platform is the functionality it provides. A seemingly popular platform functionality is the use of a social networking platform as personal identification system, which allows the entrepreneur not to worry about creating an own login procedure and mitigates the risks of handling personal information. Additionally, it creates a reliable and usually trusted login environment, realizing low entry barriers for new customers. The social functionality is also a reason for including a social networking 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."

4.1.2. Platform dominance

A platform is dominant if it is one of the most used by the target market. Choosing platform functionalities on a non-dominant platform will hinder value creation as it fails to effectively reach the target market. This presents a problem when choosing dominant mobile payment platforms for international initiatives. One entrepreneur mentioned that the mobile payment platforms are underdeveloped and segmented, noting that "there are hardly any good mobile payment platforms" and "almost every bank has a different mobile payment method." The result is that entrepreneurs that want to reach users internationally need to consider using multiple platforms.

Table 3
Concepts extracted from data and emerging categories linked to capabilities.

Capability / Data category / ▪ Concept from data	Case # 1	2	3	4	5	6	7	8
Choosing enabling-platform ecosystems based on								
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-platforms to economic opportunities through								
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; eternal beta	✔	✔	✔	✔	✔		✔	
Novelties	✔	✔		✔	✔	✔	✔	
▪ Complement products/services with social functions		✔		✔			✔	
▪ Products/services could be improved/renewed by using the contextual awareness options of mobile devices	✔				✔	✔	✔	
Efficiencies		✔	✔	✔	✔	✔	✔	✔
▪ 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		✔			✔	✔		
Executing business innovation for growth through								
Automation of value proposition	✔			✔	✔			✔
▪ Repeat (micro)transactions many times over without human interference	✔				✔			✔
▪ Reach large market with small organization through learning algorithms	✔			✔				
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 through								
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					✔	✔		

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Table 4
Business value indicators and dimensions extracted from data linked to capabilities.

Capability								
App business value dimension	Case #							
▪ Business value indicator	1	2	3	4	5	6	7	8
Choosing enabling platform ecosystems leads to								
Infrastructural value	✔	✔		✔	✔		✔	
▪ Reduced IT cost	✔	✔					✔	
▪ Mitigation of privacy risks		✔		✔			✔	
▪ Reduced distribution cost	✔	✔		✔	✔		✔	
Matching enabling platforms to economic opportunities leads to								
Strategic value	✔	✔	✔	✔	✔	✔	✔	✔
▪ Improved product and/or service innovation	✔	✔	✔				✔	✔
▪ Strengthened competitive capability	✔	✔	✔	✔	✔	✔		
Executing business innovation for growth leads to								
Automational value	✔	✔	✔	✔	✔	✔	✔	✔
▪ Reduced delivery cost	✔	✔	✔	✔	✔	✔	✔	✔
▪ Reduced transaction cost	✔	✔	✔	✔	✔		✔	
Strategic value	✔	✔	✔	✔	✔	✔	✔	✔
▪ Support business growth	✔		✔	✔	✔		✔	
▪ Improved customer service and satisfaction				✔	✔	✔	✔	✔
Assessing customer value leads to								
Informational value	✔	✔		✔	✔	✔	✔	
▪ Improved decision making	✔	✔		✔	✔	✔	✔	
▪ Improved market responsiveness		✔			✔		✔	

4.1.3. Platform compatibility

Platform compatibility refers to the consistency of the technology standards across multiple platforms. 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.

Infrastructural business value can result from choosing enabling platform ecosystems. 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 adds value to their platform (Ceccagnoli et al., 2012; Haefliger et al., 2011; Von Krogh, 2012). Therefore, platform functionalities can often be used as free building blocks for a value creation initiative. 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. 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.

4.2. Matching capability

The matching capability contains routines for matching enabling platform ecosystems to economic opportunities by searching for novel or more efficient solutions. The cases illustrate three aspects that drive the bundling of platforms and thereby matching them with economic opportunities.

4.2.1. 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 entrepreneurs to create solutions. For example, the popularity of social platforms allow start-ups to create complementarities by 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 creates solutions; rather, the app is used as key resource. Additionally, observations suggest that an app always remains work in progress, with modifications and improvements being made continually.

4.2.2. Novelties

Many of the entrepreneurs' economic opportunities are based on the novelty that combining platforms can create. 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 e-commerce platforms for making online shopping experience more social. His economic opportunity is therefore a solution in the form of a new bundle of platform ecosystems.

4.2.3. Efficiencies

Efficient complements aim at providing solutions that are faster, simpler, or cheaper than existing ones. 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. Efficiencies are found by, for example, cutting out intermediaries, activating a customer's social network to gain access to a larger market, or simplifying a product or service to improve the user experience.

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. Creating a novel or more efficient solution effectively differentiates the initiative from potential competitors, but it cannot be stated that a novel or more efficient solution is a source of sustained competitive advantage, as others might easily copy the initiative. The search for solutions, which continually creates new economic opportunities, is an ongoing one, i.e. a dynamic capability.

4.3. Executing capability

The executing capability includes routines for setting-up and configuring the app and the organization supporting the app. The data suggest three factors of executing capabilities.

4.3.1. Automation

It is necessary to automate the process as much as possible before the economic opportunities related to apps become viable. This is important because of the large number of users and transactions usually needed to provide the promised app-enabled value to the customers. In several cases, the main value proposition involves connecting suppliers, corporate or private, to 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. Additionally, the margins for each transaction are usually relatively low and, as such, many transactions are needed for the opportunity to be economically viable. This requires very low (automatic) transaction processing. Another form of strategic value associated to automation comes from the ability of delivering the value proposition repeatedly, without proportionally increasing the resources needed except for the capacity of traffic that the app can handle.

4.3.2. Agility

After the app is introduced to the market, the app needs to evolve based on customer responses and market trends. This requires the app to easily adapt and high quality analytics. An obstacle in this is the dependence on multiple mobile operating platforms to reach a large spectrum of users. Every platform has its own set of programming

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rules and, therefore, multiple versions of the app are needed. One of the entrepreneurs got around this problem by developing a web-app that is accessed through a mobile device's browser, instead of making multiple native (platform dependent) apps. Devices running on different platforms can access the web-app and making adjustments requires changing only one set of codes. Another entrepreneur developed the app on a platform that allows having a single code base that can be deployed on multiple platforms. Because it is essential that the time-to-market is short, the organization supporting the app needs the ability to quickly respond to market feedback and trends.

4.3.3. Funding and monetization

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, or the collection of a percentage-fee on each transaction. Revenues can also be generated through advertising or sponsors. Most entrepreneurs (plan to) use freemium or fee-based revenue generation and shun the idea of using advertisements.

According to the collected data, there are two areas indicating that executing capabilities lead to the creation of automational business value. First, by very low service delivery costs and second by very low transaction costs.

4.4. Assessing capability

The assessing capability includes assessing (potential) customer value through customer interaction, reviews, and analytics. The assessing capability evolves according to the stage in the business cycle from small-scale interaction-based routines with perceptual measures at an early stage, to larger scale analytics-based routines with behavioral measures at later stages.

4.4.1. Customer interaction

Throughout the ABIC, start-ups actively engage potential customers to discuss and exchange ideas regarding the value proposition. One entrepreneur plans to use customer groups to co-create and refine and test initial value propositions.

4.4.2. 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 with reviews from the target group.

4.4.3. Customer analytics

After an app has been delivered to the market, the entrepreneurs can measure actual customer behavior using analytics. Collected analytics include information on how many users the app has, how often it is used, and what features are used most.

Informational business value can be realized by assessing potential customer value. 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. Furthermore, the assessing capability can be associated to improving market responsiveness, another form of informational value. The knowledge provided by the assessing capability allows for rapid response to market trends and wishes.

Table 5
ABIC 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 – *Speed of problems detection in the market.* – *Frequency of solutions formulations on basis of economic opportunities* – *Frequency of formulation of solutions explicitly considering combinations of enabling platforms* ▪ Finding novel complements between enabling platforms – *Speed of seeing novel functionalities through combinations of enabling platform ecosystems* ▪ Finding efficient complements between enabling platforms – *Speed of seeing 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*

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4.5. Sample empirical indicators

The ABIC presented in this study is a first step towards understanding app-enabled business, which forms a structured basis for future research. For this purpose, Table 5 presents sample empirical indicators to measure the ABIC capabilities. The indicators are based on the data categories extracted from the observations and formulated following the synthetic sense-making approach described in Section 3. Indicators might be added, altered, or removed by further construct development and validation procedures.

5. Discussion and conclusion

5.1. 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. An adaptation of the NEBIC theory, based on the DCP, 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 analysis of eight cases.

The first research question aimed at describing how start-ups create value while using apps. This question is answered by describing the ABIC through four interlinked dynamic capabilities: choosing enabling platform ecosystems, matching them to economic opportunities, executing business innovation for growth, and assessing customer value. The second research question aimed at describing what types of business value is created through the ABIC. This 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 apps. Second, automational value is created by apps through 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. 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. The ABIC explains how start-ups create value with apps.

5.2. Research limitations

There are two research limitations to this study. The first limitation 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. Differences in, for example, national rules and regulation or entrepreneurial culture could result in different processes of value creation. Also, cases were not selected to be representative for all app-enabled start-ups. The aim of this study was to ground an enriched theory. Future work can focus on testing whether (parts of) the theory holds in different settings. The second 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 (Gallouj et al., 2015; Gurtner et al., 2014). The consequence of this choice is that the results of the study cannot be generalized to 'internal' and 'upstream' app-enabled value creation.

5.3. Research implications

Production economic-based models of IT business value 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 (for the influence of age on app adoption, see, Gurtner et al., 2014; for more general mobile service adoption, see, Shieh et al., 2014). However, these models use 'app adoption' as an input variable, usually estimated by the amount invested in apps. Obviously, only investing in a technology does not provide higher output. 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.

The proposed ABIC shows some differences with the NEBIC theory (Table 6). At the capability-level, the NEBIC-operationalization of the capabilities into routines is done in the context of net-enablement at large organizations. We argued that the NEBIC routines would not hold in the context of app-enablement at start-ups for the following reasons:

First, 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 Fig. 1). The ABIC 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 of the ABIC in Fig. 1 are all of the same width.

Second, the assessing capability of the NEBIC is initiated at the end of the innovation cycle. 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.

Third, the 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 ABIC can also be initiated when entrepreneurs perceive problems in the market, reinforcing the market-driven nature of the start-ups.

Fourth, at the outcome level, the ABIC uses 'business value', a broader outcome measure than the NEBIC's 'customer value'. The use of this outcome measure 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 the app to the market. For example, developing the app using tools and functionalities from the different available platforms realizes infrastructural value in the form of cost-savings before the app is used by customers.

The ABIC describes four interlinked capabilities. Each of these capabilities is described through some critical routines, and linked to the type of business value it creates. 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

Table 6
Differences between NEBIC and ABIC.

	NEBIC	ABIC
Capability	▪ Routines at large organizations	▪ Routines at start-ups
Process	▪ Strongly feed-forward	▪ Iterative, scrum
	▪ Customer at end of the value-chain	▪ Early customer involvement
	▪ Technology-driven	▪ Market-driven
Outcome	▪ Value potential until going to market	▪ Value realization during whole process

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more business value. The following hypotheses are useful for examining 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 sample indicators in Table 5, and the business value can be measured using the business value indicators from Table 4.

5.4. Practical implications

We conclude with three practical implications. 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 providing a novel or more efficient solution should drive adopting an app. 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.

Second, all entrepreneurs in the study explicitly seek to build on the different platforms available. 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, creates infrastructural business value and might improve the chances for success.

Last, this study shows 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 ABIC 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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