
Investing in Change: Innovation and Business Models

The influence of business model innovation on business angels' willingness to invest

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ABSTRACT

The aim of this research is to identify the influence of technical business model innovation on the willingness to invest by business angels. More specifically, a quantitative approach is used to determine what the link is between characteristics of technical business model innovation and success factors of obtaining funding, and how they influence the willingness to invest. We analyse pitches derived from eleven seasons of the television show Dragons' Den, which result in 1020 interactions between entrepreneurs and business angels. This database constitutes the empirical base for our econometric analysis. This research find that an entrepreneur with a business model that brings together unconnected ideas and enters the market as a new venture is more likely to get into negotiations with a business angel. The likelihood of negotiations can be further increased by aiming for a niche market and by having a radical type of innovation. The likelihood is decreased when the idea is only based on technological breakthrough. The shares are valued higher when connecting unrelated ideas and when entering the market through external route strategies. Furthermore, the company's share value is negatively influenced by business models with a delayed market entry strategy and rental revenue model.

INTRODUCTION

In general, innovations are identified in three innovation types: product, process and organizational innovations (Hansen & Große-dunker, 2013; OECD, 2005; Rennings, 2000). However, another way of looking at innovation can be from a business model perspective (Hansen & Große-dunker, 2013). Business model innovation involves a change of business concept

to lever a strategic advantage (Chesbrough, 2010; Schaltegger, Freund, & Hansen, 2012; Teece, 2010). This type of innovation considers change in the way of converting products or services into profit.

First background information is provided about business models, business model innovation and business angel investments. This is followed by the research objective, which guides this thesis.

The theoretical foundation for the research is laid out in the chapter theoretical research, which concludes with the theoretical framework and conceptual model for the empirical part of this study. The empirical research consists of a quantitative approach towards research objective. In the final chapter conclusions are drawn on the results of the empirical model

BUSINESS MODELS

A business model defines how value is created and delivered to customers and how payment for this value is converted into profit (Tece, 2010). However, there are different perspectives applied in business model literature (Mason & Spring, 2011): technological focus (Chesbrough & Rosenbloom, 2002), interfirm perspective (Chesbrough & Schwartz, 2007) and firm perspectives (Amit & Zott, 2001; Zott & Amit, 2007, 2008). Mason and Spring (2011) combined these different perspectives and identified three key elements forming the foundation of a business model: technology, market offering and network architecture.

Technology in business models is about product, process, core and infrastructure (Mason & Spring, 2011). These aspects can be referred to as technological innovation, and are more easy to manage in start-up companies than in established enterprises, due to less complex networks (Birkinshaw, Bessant, & Delbridge, 2007).

Market offering has the focus on the interaction between producer and user (Mason & Spring, 2011). Value is created by a combination of elements: artefacts, activities and access. An artefact can be seen as a product offering, an activity as an offered service and access as a way of providing something without the provider losing ownership (Gadrey, 2000; Mason & Spring, 2011).

The network architecture considers market standards, capabilities, transactions and relations and how these are structured, which encompasses the dynamic nature of business models (Mason & Harrison, 2002). It bridges the gap between internal factors and external factors. Typical internal factors are a person or company's

capabilities and market characteristics. External stakeholders are an example of external factors.

BUSINESS MODELS AND INNOVATION

Emphasizing on innovation, the business model structure presented above shows similarities with the technological stream of business model innovation (Boons & Lüdeke-Freund, 2013). A business model can be defined "*as a mediator between technologies of production and consumption*". This definition explains a business model as the link between how a product is made, the product itself and how it is used. In short, how value is created and delivered to customers and how payment for this value is converted into profit (Tece, 2010).

Breaking down the business model in the key elements technology and market offering as defined by Mason & Spring (2011), the underlying link between new and existing technologies and new and existing business models can be researched. Taking novelty as one of the main aspects of innovation, four combinations of technology and business model can be distinguished; (1) the 'no innovation' option, (2) new business model can deploy existing technologies, (3) existing business model can take up new technologies and (4) new business model interacts with new technologies (Boons & Lüdeke-Freund, 2013).

BUSINESS ANGELS INVESTMENTS

The complexity of technological business model innovations is smaller within start-up companies, mainly due to a less complex network of stakeholders (Birkinshaw et al., 2007). In a start-up the entrepreneur plays major role in the innovation process, because the entrepreneur is the person who brings different kinds of capabilities, resources, knowledge and skills together (Galindo & Méndez-Picazo, 2013). Furthermore, they try to create value creating networks by bringing together money, people and ideas (Schaltegger & Wagner, 2011). The characteristics of the entrepreneur are important factors that influence business angel investments, such as demonstrating passion, as shown in previous research (Cardon, Sudek, & Mitteness,

2009; Chen, Yao, & Kotha, 2009; Mitteness, Sudek, & Cardon, 2012).

Another important factor is trust between entrepreneur and business angel, influenced by the entrepreneur's features of trustworthy, trusting, capable and communicative (Mason & Stark, 2004; Maxwell, Jeffrey, & Lévesque, 2011). It is important that the business angel is able to judge entrepreneurs' sincerity.

An entrepreneur requires skill, facilities, expertise and financial means to succeed. Starting up a company is associated with risk, therefore conventional forms of finance can be problematic to secure for an entrepreneur. For example, external forms of finance secured on the company assets would be less suitable, since there is no guaranteed profit and therefore the risk is higher for the business angel and entrepreneur that the start-up does not succeed (Aernoudt, 2005). This opens the way for business angels, who invest their own money in return for equity (Aernoudt, 2005; Hirsch-Kreinsen, 2011; Politis, 2008). They not only contribute with money, but also bring added value; in the form of strategic, supervising, resource acquiring and mentoring roles (Politis, 2008).

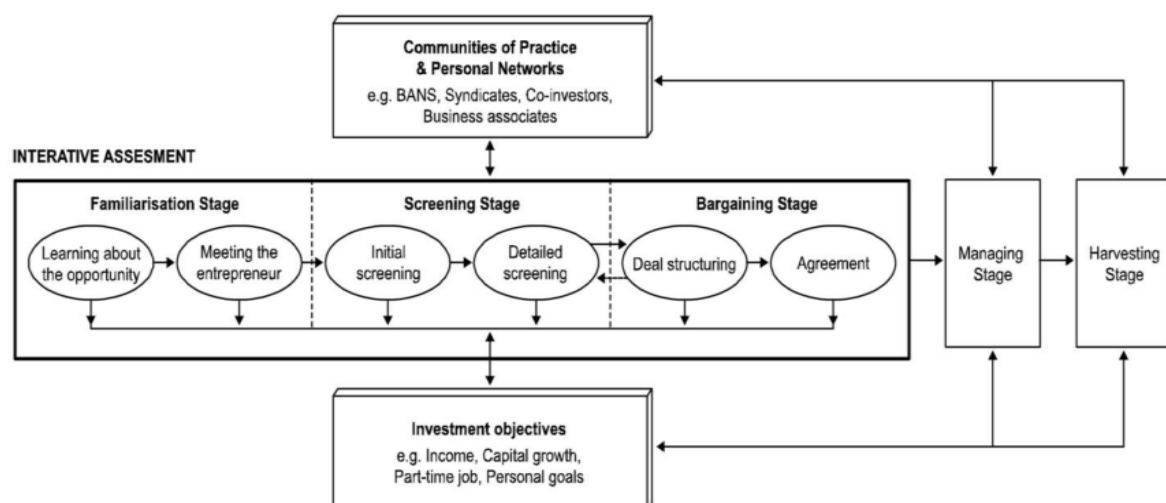
Since they bring more than financial means, business angels are known to invest more often in the early stages of finding a start-up company than the formal venture capital firms (Aernoudt, 2005; Madill, Haines Jr, & Riding, 2005). Madill et

al. (2005) argue that the involvement of business angel investments leads to larger amounts of funding from formal venture capitalist firms in later stages as they can function as accreditation.

Considering the individual aspect of entrepreneurship described in the previous section, it becomes evident that the match between entrepreneur and business angel is important (Mason & Stark, 2004; Mitteness et al., 2012). The importance of this match is shown by the business angel's commitment not only as financial support, but also by being involved in the different roles mentioned above. The pitch is a key success factors in creating this match (Mitteness et al., 2012; Paul, Whittam, & Wyper, 2007).

Paul et al. (2007) come up with a five-stage angel investment model involving five steps: familiarization, screening, bargaining, managing and harvesting. Figure 1 shows a diagram of this model. However, the first three steps described are selection and negotiation (Maxwell et al., 2011), with the selection stage corresponding to the screening stages and the negotiating stage corresponding to the bargaining stage. It is an elimination-by-aspect process; as soon as a fatal flaw is identified, the business angel will not progress after that phase (Maxwell et al., 2011). The chances of successful investment increases as the process becomes more efficient (Mason & Harrison, 2002).

FIGURE 1: A MODEL OF THE ANGEL INVESTMENT PROCESS (PAUL ET AL., 2007)



RESEARCH OUTLINE

This chapter will discuss the outline of this research. First the research objective will be presented, followed by the research questions and a framework that will help to guide the answering of these questions.

RESEARCH OBJECTIVE

The aim of this research is to identify the influence of business model innovation on the willingness to invest by business angels. Therefore, within this research each interaction between entrepreneur and business angel on technology, business model, investment offered and investment made are analysed. This research aim leads to the following objective:

To identify the relation between technical business model innovation and the willingness to invest by business angels.

In research on the link between business angel investments and entrepreneurs, this research can provide new insights on the link between innovations and investments.

RESEARCH QUESTION

To help guide this research, the following research question is formulated:

What characteristics of technical business model innovation influences the willingness to invest by business angels?

In order to answer the research question, certain information needs to be acquired. First of all, it

needs to be clear what is understood as willingness to invest. Secondly, understanding is required of what factors of success in obtaining funding have a link with technical business model innovation. To do so, the factors that determine the success of obtaining funding need to be mapped. All this information accumulated gives insight on the relation between the relevant factors of success in obtaining funding and the willingness to invest.

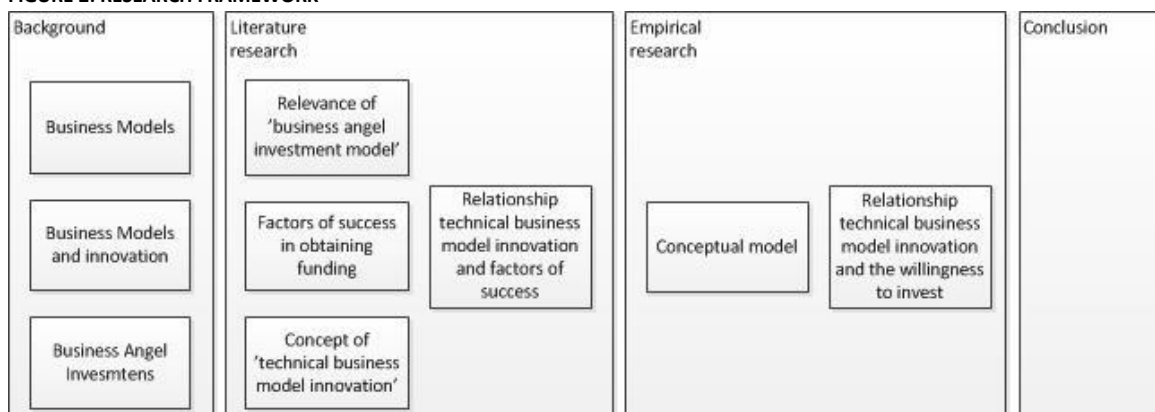
RESEARCH FRAMEWORK

The steps that need to be taken to answer the question and to realize the research objective are schematically shown in

Figure 2 below. The background part is tackled in the introduction, providing insights in the structures of business models, their link to innovation and business model investments. In the next part, literature research, the relevance of the business angel investment model and factors that determine the willingness to invest are further introduced, follow by insights in technical business model innovation. These insights are then combined into a theoretic relationship between success of obtaining funds and technical business model innovation.

In the empirical research part an econometric analysis will be performed in order to establish the relation between the relevant factors of success in obtaining funding and the willingness to invest. This research is based on data linking an entrepreneurial pitch to an investor, derived from eleven seasons of the television show Dragons' Den.

FIGURE 2: RESEARCH FRAMEWORK



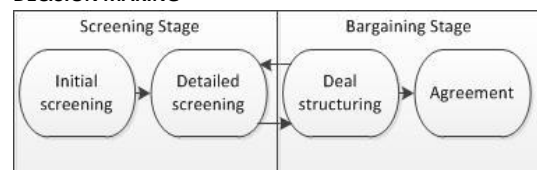
THEORETICAL RESEARCH

The concept of business angel investment process and the concept of technical business model innovation will be elaborated on here. The aim of this chapter is to create a conceptual model to advance the empirical part of this research. This model is created by operationalize concepts to be used later on in this research.

BUSINESS ANGEL INVESTMENT PROCESS

This research makes use of limited model of the angel investment process, since the focus of this study is on willingness to invest. Therefore, the stages of familiarization, management and harvesting are outside the scope of this research, since they are not directly related to the business angel decision moment. Figure 3 provides an overview of the simplified model for business angel decision making.

FIGURE 3: SIMPLIFIED MODEL FOR BUSINESS ANGEL DECISION MAKING



The attractiveness of the innovation itself shows in the screening stage. The bargaining stage contains whether there is a negotiation for a deal and whether the deal is made.

The focus of this study will be on the transition from screening stage to bargaining stage, since this is the moment that a business angel decides whether to go through with the deal or not. The influence of the fatal flaw in the elimination-by-aspect process stops here, since it is the last time the business angel evaluates the pitch on its contents; from here on it is trying to get to an agreement on equity and funds, which is the second focus in this study. The definition of willingness to invest can be derived here, which is twofold: a business angel is willing to invest if the entrepreneur moves from the screening stage to the bargaining stage (1), followed by deal structuring to determine the willingness, which can be translated as how much is the business angel willing to invest (2).

BUSINESS ANGEL INVESTMENT CRITERIA

In a comprehensive study by Maxwell et al. (2011) into the early decision choices of business angels in the investment process, eight factors for the elimination-by-aspect process were found. These factors could either lead to continuation of the process or a critical error, which stops the process. The factors can be grouped in product, market, entrepreneurial and business fit.

The first three factors are related to the product: whether it is easy to adopt, whether the product status does present a risk and whether the innovation has an advantage over potential competition (Maxwell et al., 2011). The second group of three factors are market related. Customer engagement measures whether potential users have been consulted in the development stage in order to align the value proposition (Mason & Stark, 2004). Route to market includes supply chain elements, market dynamics and part of the business model (Mason & Harrison, 2002; Mason & Spring, 2011). The final market related factor is market potential, which is based on size, growth and level of competitiveness (Maxwell et al., 2011).

The third and fourth factor 'categories' are the entrepreneur himself, expressed in the level of experience he has, and the financial model, which is based on hard numbers and the whether the entrepreneurs forecast is realistic (Mason & Stark, 2004; Maxwell et al., 2011). The latter can also be explained as the trust of the business angel in the entrepreneur.

However, the focus in this research is on the influence of business model innovation on the willingness to invest by business angels. Therefore the focus is on the characteristics of the idea presented in the pitch, instead of on the characteristics of the entrepreneur and business angel. An overview of the groups and criteria collected from different literature can be found in Table 1 on the following page.

TABLE 1: BUSINESS ANGEL DECISION MAKING CRITERIA

Group	Factor	Criteria	Source
Product	Adoption	Product interest	(Mason & Harrison, 2002; Maxwell et al., 2011; Mora, 2013)
		Benefits	(Mason & Harrison, 2002; Maxwell et al., 2011)
		Innovation	(Mason & Stark, 2004; Maxwell et al., 2011)
	Product status	Status	(Mason & Harrison, 2002; Maxwell et al., 2011)
		Technology risk	(Mason & Harrison, 2002; Maxwell et al., 2011)
		Development risk	(Maxwell et al., 2011)
	Protectability	Protectability	(Maxwell et al., 2011; Mora, 2013; Sudek, 2006)
		Role of IP	(Maxwell et al., 2011; Sudek, 2006)
		Other barriers	(Maxwell et al., 2011)
		Manufacturing capacity	(Mora, 2013; Sudek, 2006)
Market	Customer engagement	Market validation	(Mason & Stark, 2004; Maxwell et al., 2011; Mora, 2013)
		Customer engagement	(Mason & Harrison, 2002; Maxwell et al., 2011; Mora, 2013; Sudek, 2006)
	Route to market	Operations	(Mason & Stark, 2004; Maxwell et al., 2011)
		Market entry	(Maxwell et al., 2011; Mora, 2013)
		Distribution partners	(Mason & Harrison, 2002; Maxwell et al., 2011)
	Market potential	Market size	(Maxwell et al., 2011; Mora, 2013)
		Market competitiveness	(Mason & Harrison, 2002; Mason & Stark, 2004; Maxwell et al., 2011; Mora, 2013)
		Market growth	(Maxwell et al., 2011; Mora, 2013)

TECHNICAL BUSINESS MODEL INNOVATION

Henderson and Clark (1990) defined innovation as incremental, architectural, modular or radical, based on what part of a product has changed. They made the distinction between change in core concept and change in the linkage between different core concepts. Linking this to the technical business model innovation, existing and new technology can be defined: existing technology is incremental and architectural innovation, based on reinventing the linkage between core concepts; new technology is either modular or radical innovation, thereby inventing new core concepts.

Since this research is based on data linking an entrepreneurial pitch to an investor, the business model is narrowed down to the market offering. This fits with the given definition of a business model as mediator between technology and

consumption. The network architecture is an aspect that is possible to analyse in an existing company, but not so easy to analyse through an entrepreneurial pitch. Therefore, only the link between technology and market offering is analysed.

With the technology dimension of business model innovation defined, the next step is to define market offering. Mason and Spring (2011) argue that the market offering consist of a value-creation opportunity. Such an opportunity is defined by a combination of product, process and service innovations that has an interaction with a consumer. Thus, the market offering concerns the nature of the producer-user interaction (Araujo & Spring, 2006).

There are multiple ways to bridge the gap between producer and user; one can look at

market route (Chesbrough, 2003, 2012; Smith, 2010), revenue model (Enders, Hungenberg, Denker, & Mauch, 2008; Mason & Spring, 2011; Teece, 2010) or the innovation insight (Smith, 2010). The first two focus directly on the producer-user interaction. The innovation insight emphasises on source of the idea, for example whether it is a new technology pushed on the market or a new idea providing a solution for a market demand. An example of this is adaptation, which means that an existing solution is adapted to a new problem (Smith, 2010).

THEORETICAL FRAMEWORK

In order to create a theoretical framework, the presented concepts are combined. With the focus on the technical aspects of the pitched ideas, i.e. the 'hard' aspects product and market, a list of factors and criteria was made for success in obtaining funding.

A distinction between the bargaining stage and the screening stage within the business angel decision model is made. This determines whether there is a will to invest, meaning the entrepreneur and the business angel enter in negotiations, and the willingness to invest, which is represented as the structured deal.

Business model innovation is assessed over two dimensions, of which the first is the newness of the technology. Newness of technology in relation to innovation can be observed through the different grades in innovation types, giving an indication of how new the technology in the

presented idea is. As mentioned, the newness of the market offering is a harder. Three aspects were identified that help bridge the gap between producer and user: market route, revenue model and innovation insight.

Table 2 below combines the criteria from Table 1 with the aspects explained above. The innovation type is linked to the criterion innovation, meaning that a lack of novelty increases the chance of a fatal flaw (Maxwell et al., 2011). Market route is linked to market entry, suggesting that success in obtaining funding is related to an appropriate entry. Revenue model is based on the criteria operations and role of intellectual property, implying that revenue with complicated property rights and operations increase the chance of a fatal-flaw. Innovation insight is related to the criteria benefits, customer engagement, market validation and product interest. All these criteria have to do with how a market offering is made attractive to potential customers by answering a market demand.

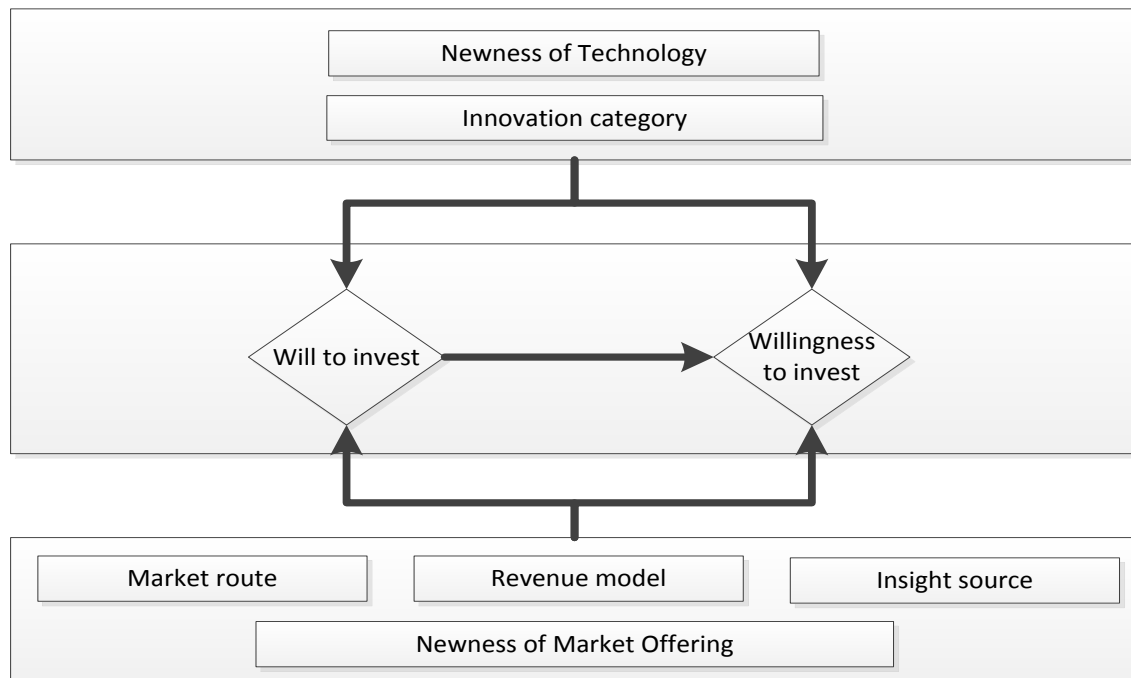
CONCEPTUAL MODEL

Willingness to invest is operationalized by clarifying the business angel decision model. By clarifying the aspects that can be tested for association between business model innovation and willingness to invest, technical business model innovation is operationalized. A conceptual framework for the empirical part is created with this operationalisations. **Figure 4** on the next page is created to guide the empirical research.

TABLE 2: DIMENSIONS OF BUSINESS MODEL INNOVATION COMBINED WITH THE CRITERIA OF SUCCESS IN OBTAINING FUNDING.

Dimension	Factor	Criterion	Source
Newness of Technology	Innovation type	Innovation	(Henderson & Clark, 1990)
Newness of Market Offering	Market route	Market entry	(Chesbrough, 2003, 2012; Smith, 2010)
	Revenue model	Operations, role of IP	(Enders et al., 2008; Mason & Spring, 2011; Teece, 2010)
	Innovation insight	Benefits, customer engagement, market validation, product interest	(Smith, 2010)

FIGURE 4: CONCEPTUAL MODEL



METHODOLOGY

A quantitative approach will be used to analyse whether the aforementioned relationships exist within the gathered data, using econometric models in the statistical software package STATA.

THE DATA

In order to analyse whether the aforementioned relations exist, the BBC television program *Dragons' Den* will be used. In *Dragons' Den* "entrepreneurs pitch for investment in the Den from our Dragons, five venture capitalists willing to invest their own money in exchange for equity" (BBC, 2015). Each episode contains multiple pitches, which could last up to three minutes, after which the business angels have time to ask questions. During this time the business angels can decide whether they want to invest or not. In the pitch the entrepreneurs state their name, their business, the amount of money they want and the percentage of equity they are willing to return for the money. The entrepreneur must secure the full amount of money they ask for, through one or multiple business angels, or they receive nothing (BBC, 2015). The pre-screening/familiarization stage is executed by the BBC (BBC, 2015; Maxwell et al., 2011).

Investigation of people's behaviour through television programs has been implemented by a number of different researchers (Beetsma & Schotman, 2001; de Roos & Sarafidis, 2010; Deck, Lee, & Reyes, 2008; Gertner, 1993; Hartley, Lanot, & Walker, 2013; Levitt, 2004; Maxwell et al., 2011; Metrick, 1995; Post, Van Den Assem, Baltussen, & Thaler, 2008). Maxwell et al. (2011) state that the study of television shows confirm the applications of these shows to research decision making, since the shows are about real people dealing with real consequences. Adding to that, before entering the show all participants were able to reflect on their decision making prior to making the decision (Maxwell et al., 2011). However, by analysing the edited episodes of *Dragons' Den*, it should be taken into account that each pitch and discussion is shortened, possibly losing data used for analysis.

VARIABLES

The database exists of different variables that can be used to analyse the episodes from *Dragon's Den*. A wide range of aspects is taken into account categorized in innovation characteristics, the entrepreneur, the actual pitch, financial situation and results. These categories are identified in previous studies as high priorities when it comes to evaluating investment opportunities (Clark, 2008; Mason & Stark, 2004; Maxwell et al., 2011).

By ways of quantifying qualitative data, dummy variables and rubrics will be used. A dummy variable is an artificial variable that is either 0 or 1, which corresponds to a certain characteristic being present or not (Dougherty, 2011). An example of this is the variable gender, with dummy variable 0 for male and 1 for female. A rubric is an assessment matrix that lists the criteria or characteristics and has gradation of quality for each criterion or characteristic (Andrade, 2005).

This research adds new variables to the existing database by recoding and building on variables that are already available in the database. It does not provide new variables generated from watching the episodes.

DEPENDENT VARIABLES

The first variable that will be discussed is the dependent variable in this research representing the willingness to invest by a business angel. The willingness to invest is earlier defined as (1) whether the entrepreneur moves from the screening stage to the negotiation stage or not and (2) how much the business angel is willing to offer the entrepreneur.

The first step is a yes or no answer, i.e. a binary choice model, with a value of 1 if the entrepreneur got through and a 0 if not (1). Secondly, the variable needs to represent the business angel's offer (2).

In this research willingness to invest will be based on the value of a company share, i.e. the price of 1% of the company's value. The equation for this calculation can be found below.

EQUATION 1: FORMULA TO CALCULATE THE VALUE OF A COMPANY'S SHARE

$$\text{share value} = \left(\frac{\text{funds offered}}{\text{equity requested}} \right) * 1\%$$

In order to determine the share value, the company value at the end of the negotiations is first calculated. The funds offered by the business angel divided by the amount of equity requested calculates the final company value. If there is no negotiation the value will be automatically zero, since the business angel and entrepreneur did not

talk numbers. In order to determine the share value, a variable 'share value' is created by multiplying the final company by 1% (0.01), to calculate the value of 1% of the company.

INDEPENDENT VARIABLES

The relevant factors for successfully obtaining funds in relation to technical business model innovation were distinguished in the previous section. These criteria are the base of the independent variables in the empirical model.

The first set of variables to discuss is the factor related to the newness of technology. Innovation type serves as a proxy for the newness of technology. Innovation type is divided into four categories ranging from slightly innovative to highly innovative: incremental, architectural, modular and radical (Henderson & Clark, 1990). This variable will be split in four dummy variables, for every type of innovation.

The sets of variables to discuss next are related to the newness of market offering. Five sets will serve as proxies. Market route will be divided into internal route strategy and external route strategy, because a company can have both. This will be discussed in the paragraph about external route strategy on the next page. Innovation insight will also be divided in two options: source and process. The final set of variables discussed is revenue model.

The factor internal route strategy will be divided in five different variables: four for different strategies, and a variable for 'other' (Chesbrough, 2012; Smith, 2010). First strategy is first-mover, which means get into the market before anyone else (Suarez & Lanzolla, 2008). Second strategy that can be used is being a follower, entering the market late and copy other companies market strategies (Shankar, Carpenter, & Krishnamurthi, 1998). The third option for a company is being a side-entrant, a strategy that aims at market entry on the niche level in order to 'conquer' the market from that position (Smith, 2010). Final internal route strategy is derivative strategy, which means applying a new technology to an existing product, as a sort of updated version (Smith & Rogers, 2004).

External route strategy is split in three variables, of which one is the variable 'non applicable'. The two strategies that can be applied are licensing and spin-off/new venture. In the first case, the patents remain property of the original company, but another company is allowed to use them (Lichtenthaler, 2010). The second strategy involves creating a new company, so the innovation or idea can flourish in a new, separate business environment (Chesbrough, 2003; Clarysse, Wright, & Van de Velde, 2011). A company that has a good internal route strategy can still license its products or services, for that reason internal and external route strategies are separated.

The third set of variables to discuss is the factor Innovation insight source. The source is how the innovation insight came about. Four options can be identified here: association, adaption, analogy and serendipity (Schoenmakers & Duysters, 2010; Smith, 2010). Association is the connection of two unrelated ideas. Adaptation means adapting an existing solution to different problem. Analogy is almost the same, but instead of using an existing solution, the principle behind the solution is used for a different purpose. Serendipity means that

the insight is purely luck based. A fifth option 'unknown' is added, in case it is not clear with the insight was.

The innovation process deals with the background of the innovation. Two basic options, technology push and demand pull, can be identified, and a combined option, coupled, in case both processes take place (Chenavaz, 2012; Johnson, Whittington, & Scholes, 2012; Smith, 2010). Technology push is starting from a new invention or idea and seeks a suited market. The other way around, when a market demand needs to be fulfilled, it is called demand-pull.

The final set of variables to be discussed is the factor revenue model. Four options can be identified: direct selling, subscription/rental, licensing, and other (Enders et al., 2008; Mason & Spring, 2011; Teece, 2010). Other includes all other revenue models that are not included in the categories above.

AN OVERVIEW OF THE VARIABLES AND FACTORS SERVING AS AS PROXIES FOR THE DIMENSIONS OF TECHNICAL BUSINESS MODEL INNOVATION CAN BE FOUND IN

Table 3. These variables are the input for the empirical model.

TABLE 3: OVERVIEW OF THE FACTORS REPRESENTING THE DIMENSION OF TECHNICAL BUSINESS MODEL INNOVATION AND THE INDEPENDENT VARIABLES RELATED TO THESE FACTORS.

Dimension	Factor	Variable	Source
Newness of Technology	Innovation type	Incremental, architectural, modular or radical	(Henderson & Clark, 1990; Maxwell et al., 2011; Smith, 2010)
Newness of Market Offering	Market route (internal)	First-mover, derivative, side-entrance, follower or other	(Chesbrough, 2012; Shankar et al., 1998; Smith & Rogers, 2004; Smith, 2010; Suarez & Lanzolla, 2008)
	Market route (external)	Licensing, spin-off or NA	(Chesbrough, 2003, 2012; Clarysse et al., 2011; Lichtenthaler, 2010; Maxwell et al., 2011; Smith, 2010)
	Innovation insight source	Association, adaptation, analogy, serendipity or unknown	(Maxwell et al., 2011; Schoenmakers & Duysters, 2010; Smith, 2010)
	Innovation process	Technology push, demand pull or coupled (both)	(Chenavaz, 2012; Johnson et al., 2012; Smith, 2010)
	Revenue model	Direct selling, subscription, licensing or other	(Enders et al., 2008; Mason & Spring, 2011; Teece, 2010)

CONTROL VARIABLES

Kroeze (2015) used the same database in her research about the entrepreneur-angel fit. She concluded that the entrepreneur-investor fit is determined by pitch quality and entrepreneur's gender. These two characteristics will be used as control variables to control for fit, i.e. the 'soft' characteristics of entrepreneurs that were outside the scope of this research..

The factor pitch also came forward in literature as import in determining the entrepreneur-business angel relationship (Mitteness et al., 2012; Paul et al., 2007). The variable 'pitch' is based on adding up the values of the three-point scale variables for clarity and understanding, presentational structure, level of information provided and level of confidence. This adds up to a variable 'pitch' ranging from 4 (bad) till 12 (good). This variable is then transformed into a dummy variable for a good pitch, containing the upper third (10-12).

A dummy variables is created to simulate the entrepreneurs gender. Variable 'male_entrepreneur' receives the value 1 if the entrepreneur is male only. This means that male individuals and full male groups are taken into account, not female and mixed groups and female individuals.

THE EMPIRICAL MODEL

As mentioned in the previous section, the model needs to deal with two steps: does the entrepreneur get past the screening stage yes or no, and what deal is structured.

Only part of the database is used. Due to the focus on technical business model innovation, only manufacturing companies are used in the model.

A linear regression is performed using all variables mentioned in the previous section to test for heteroskedasticity. When the data is heteroskedastic, it means the variability of the dependent variable is unequal across the range of values of the independent variables that predicts it. This step needs to be performed, because it determines whether to use robust standard errors

or not. Using robust standard errors result in less efficient coefficients, so the standard errors will be larger. Larger standard errors decrease the significance of the coefficients, therefore efficient coefficients would be more suitable. A test for heteroskedasticity rejects the null hypothesis for constant variance, so heteroskedasticity is assumed. Therefore, robust standard errors will be used.

The first step of the model is a yes (1) or no (1) outcome. A binary choice model models the probability of dependant variable Y. The model considers all $Y > 0$ as a yes, which makes it suitable to use share price as the dependent variable, since it has a value of 0 for an entrepreneur not getting to the negotiation stage. The two binary choice model options are a probit or a logit model, with the difference being a logistic distribution versus a normal distribution. Within literature there is no clear preference, so a logit model is chosen.

For the interpretation later on, it is important to register that it is not possible to directly interpret the results of a binary choice model. Therefore, the marginal effects need to be computed. The marginal effects allows to interpret the change of an independent variable X as the change of the probability of the dependent variable Y, considering all other independent variables are constant.

Willingness to invest is approached from a share value perspective. For this reason a hedonic pricing model will be used. In short, such a model would mean that the dependant variable may be predicted by the independent variables, i.e. share value is predicted by innovation type, market route, innovation insight and revenue model, controlled for entrepreneur-investor fit by pitch quality and the entrepreneurs gender (Coulson, 2010; Diewert, 2003; Hutcheson, 2011).

A standard hedonic price model can be generally formed as:

EQUATION 2: HEDONIC PRICING MODEL

$$P = \gamma + \sum \beta M + e$$

Where P is the share price and M are a set of dummy variables for characteristics such as route strategy and innovation type, with intercept γ and error term e (Bover & Velilla, 2002).

The left-hand side of the equation is skewed, i.e. there is exponential distribution instead of a normal distribution. Therefore, a generalized linear model (GLM) will be used (Hutcheson, 2011; McCue et al., 2008). A GLM gives the possibility to change the 'family' of the model to gamma, which can deal with the exponential distribution. The normalize the data, a the 'link function' can be changed to 'log' in the GLM, which makes it possible to interpret the data as normal (McCue et al., 2008). This will be the model of choice for the second part.

Both models can be combined in the two-part model (TPM). In the first step it uses the logit model as a sample selection model for the second step, so the GLM only uses the cases where the entrepreneur made it to the bargaining stage.

OPERATIONALIZATION

Now the model(s) and variables to be used are established, the next step is to build the relevant model(s). The empirical model deals with what the relationship is *'between the dimensions of technical business model innovation and the willingness to invest'*.

The Two-Part Model is used in two slightly different ways: one using dummy variables as they are defined in the previous section, and a second time using the factors as categorical variables. Each model thus has an logit and GLM step.

First the model using dummy variables will be discussed, named model 1 from here on. The formula for the logit and GLM is the same, therefore it can be written as one equation. The formula can be found in equation 3 below.

EQUATION 3: FIRST STEP LOGIT AND SECOND STEP GLM FOR MODEL 1

$$P = \beta_0 + \sum \beta_o T_o + \sum \beta_n M_n + \sum \beta_p C_p$$

P is the share price and T is related to the set of dummy variables of innovation type, each dummy

variable indicated by number o . M is related to the dummy variables representing factors internal route strategy, external route strategy, innovation insight source, innovation process and revenue model, indicated by number n , and C is related control variables, indicated by number p .

The second model (from here on model 2) will be using the factors as categorical variables. The statistics program (STATA) identifies a variable as a category instead of a numerical variable. A set of 'invisible' dummy variables is then automatically created, opposed to manually creating them as in model 1. The advantage of this approach is that STATA knows which variables are related. This means that factor innovation type has the 'invisible' dummies incremental, architectural, modular and radical. The formula in Equation 4 is the equation for model 2.

EQUATION 4: FIRST STEP LOGIT AND SECOND STEP GLM FOR MODEL 2

$$P = \beta_0 + \beta_1 i.T + \sum \beta_n i.M_n + \sum \beta_p C_p$$

P is the share price and $i.T$ is factor variable innovation type. $i.M$ is related to the factor variables, indicated by number n . This means that internal route strategy is $n=1$, external route strategy $n=2$, and so on. C is related control variables, indicated by number p .

Factor variables use the first option as a base level and comparing the other options to it (StataCorp, 2009). For example, if there are four directions (north, east, south and west) and every observation lay in one direction (either north, east, south and west). The base level means that if an observation does not lay in east, south or west, it has to lie in north. Therefore, north is the base level, and omitted from the regression.

This makes it possible to compare the different options within one category, for example incremental innovation to radical innovation, without losing information about other variables. In case of a dummy variable the base value would be 0, and the 'other' option would be 1. In case of a categorical variable where every observation has a value of 1, 2 or 3, the base level would be 1 and option 2 and 3 would be compared to it. By taking the marginal effects, which (for example)

indicate a change from option 1 to option 3, a conclusion can be drawn in how much option 1 and 3 influence the dependant variable.

RESULTS

In this section, the outputs from the models are reported. All coefficients are reported with robust standard errors, to take care of the heteroskedasticity mentioned in the previous section.

The coefficients are reported, with their significance level indicated and their robust standard errors between brackets. In both parts of the model the marginal effects are reported, in order to interpret them, because the models deal

with discrete changes from the base level. This means that the coefficients report how much that variable differs from the base level. The variables that are used as base levels are indicated with ^{BL}. In both models, the baseline is: direct selling revenue model; an unknown innovation insight source; the external route strategy is not applicable (NA); a coupled innovation process; first-mover internal route strategy; the innovation type is incremental; the pitch not explicitly good; not a full male team.

Table 4 below provides insights in the first step of the two-part model that explains the relation between the willingness to investments and technical business model innovation.

TABLE 4: OUTPUT OF THE FIRST STEP OF THE TWO-PART MODEL, COMPUTED MARGINAL EFFECTS

Logit model

Factor	Variables	Model 1 Estimates		Model 2 Estimates	
Innovation type	Incremental ^{BL}				
	Architectural	.0235109	(.0317232)	.0210937	(.0283369)
	Modular	.0191717	(.0382385)	.0169899	(.0344741)
	Radical	.1341653	(.0382375) ***	.160699	(.0506833) ***
Internal route strategy	First-mover ^{BL}				
	Derivative	.0237158	(.0370215)	.0237336	(.0386421)
	Side-entrance	.107771	(.0344312) ***	.1329691	(.0496962) ***
	Follower	-.0488197	(.060931)	-.0399828	(.044289)
External route strategy	Licensing	.0527356	(.0420392)	.057615	(.050851)
	Spin-off/New venture	.1333096	(.0534668) **	.175432	(.0876057) **
	NA ^{BL}				
Innovation insight source	Association	.0625935	(.0379167) *	.0639248	(.0353649)*
	Adaptation	-.028512	(.0407163)	-.0225467	(.0332042)
	Analogy	.0249339	(.0497932)	.0229663	(.0462015)
	Serendipity	.1016332	(.0754802)	.1147748	(.0993733)
	Unknown ^{BL}				
Innovation Process	Technology push	-.1069223	(.0273266) ***	-.1122074	(.0310211) ***
	Coupled ^{BL}				
	Demand pull	.0206074	(.0362069)	.0288843	(.051863)
Revenue model	Direct selling ^{BL}				
	Subscription/rental	.1238279	(.1250467)	.1676189	(.2096726)
	Licensing/franchise	-.0797608	(.0782006)	-.0649599	(.050725)
Control	Pitch_good	.1742583	(.0264025) ***	.1671171	(.0247018) ***
	Male_entrepreneur	.0322741	(.0257978)	.0314569	(.0245096)
1st step observations		1020		1020	
Wald chi2		0.1458		0.1458	
McFadden's Pseudo R2		135.42		135.42	
Probability > chi2		0.0000		0.0000	

A first glance at the table above shows that both models yield similar results, which makes it easy to discuss the results from the regressions. First the logit model will be discussed.

First factor is the innovation type, in which 'T4 Radical' is highly significant and positively correlated to the likelihood of going to the bargaining stage. The coefficients are 13.4% for model 1 and 16.1% for model 2.

Next is internal route strategy, in which 'Side-entrance' is significant on the 1% level, with 10.8% and 13.3% for models 1 and 2.

The third factor in the logic model is external route strategy. 'Spin-off/New venture' show in both models good significance (< 5%), so an entrepreneur with that specific external route strategy increases its likelihood of getting into the negotiation stage with 13.3% or 17.5%. 'Licensing' is not significant.

Next factor is innovation insight source, in which only 'Association' is different on a 10% significant

level from the base level 'Unknown'. This can be interpreted as when the insight source of the innovation is association, the entrepreneur is 6.3% (model 1) or 6.4% (model 2) more likely to get into negotiations. 'Technology push' in the factor innovation process is negatively correlated to the likelihood of negotiation, respectively -10.7% and -11.2% (< 1% significance level).

Considering the factor revenue model: there is no indication that a different revenue model would lead to a higher chance of getting to the negotiation phase, since all the variables in the factor are not significant.

Finally the two control variables, of which only 'Pitch_good' is significant (< 1% significance level) with a positive influence of 17.4% and 16.7%.

Table 5 below provides insights in the second step of the two-part model that explains the relation between the willingness to investments and technical business model innovation.

TABLE 5: OUTPUT OF THE SECOND STEP OF THE TWO-PART MODEL, COMPUTED MARGINAL EFFECTS

Generalized Linear Model

		Estimates		Estimates	
Innovation type	Incremental ^{BL}				
	Architectural	-233.9457	(405.1823)	-223.4219	(390.986)
	Modular	-274.6395	(546.02)	-260.7076	(516.6508)
Internal route strategy	Radical	533.3439	(519.1123)	572.0478	(558.3518)
	First-mover ^{BL}				
	Derivative	-658.7378	(446.5057)	-617.1911	(391.285)
	Side-entrance	3.616876	(436.6379)	3.737048	(451.3072)
External route strategy	Follower	-953.1931	(496.5193) *	-855.9703	(397.7508) **
	Licensing	1794.482	(930.7872) *	2191.596	(1397.304)
	Spin-off/New venture	1457.5	(514.834) ***	1685.279	(717.682) **
Innovation insight source	NA ^{BL}				
	Association	857.8125	(521.5989)	820.5704	(464.0013) *
	Adaptation	547.7634	(631.7934)	499.3277	(570.4386)
	Analogy	494.1748	(538.9757)	446.7734	(477.8433)
	Serendipity	-908.5482	(757.2169)	-666.8418	(539.4487)
Innovation Process	Unknown ^{BL}				
	Technology push	-429.2606	(377.7344)	423.6694	(368.1343)
	Coupled ^{BL}				
Revenue	Demand pull	-144.7171	(395.4514)	-148.9759	(402.3665)
	Direct selling ^{BL}				

model	Subscription/rental	-3332.573	(545.2138) ***	-2142.541	(230.1675) ***
	Licensing/franchise	-1003.99	(1045.511)	-881.8709	(796.5731)
Control	Pitch_good	1066.086	(412.4731) **	967.0846	(339.2668) ***
	Male_entrepreneur	943.7097	(334.8975) ***	894.816	(302.4932) ***
2nd step observations		203		203	
Deviance		63.19950681 (.341619)		63.19950681 (.341619)	
Pearson		75.53866375 (.4083171)		75.53866375 (.4083171)	

The GLM model will be discussed here. In the GLM part of the table it can be noted that there are some small differences between the two models. On two occasions the models disagree on the relevance of a variable. These will be discussed when the relevant factor is discussed.

Firstly, no innovation types are significant. The second factor internal route strategy's variable 'Follower' is significant in both models, on a 10% level and 5% level respectively. In model 1 this internal route strategy is results in -£953.19 and in -£855.97 in model 2.

In external route strategy, the third factor, 'Spin-off/New venture' is highly significant in both and 'Licensing' only in the first model. Both are positively correlated, licensing only on the significance level of 10% with a coefficient 1794.48 in model 1 and spin-off with a significance level of 1% with 1457.5 in the first model and a significance level of 5% with 1685.28 in the second model.

In the factor innovation insight source, the variable 'Association' is only significant in the second model. It is only significant on the 10% level, with a coefficient indicating that association leads to an increase of £820.57. Next is innovation process, which yields no significant results when it comes to influencing the share value.

The last factor is revenue model, with a highly significant (< 1%) negative correlation between the share value representing the willingness to invest and 'Subscription/rental'. If an entrepreneur chooses this revenue model, the share value will be reduced in model 1 by £3332.57 and in model 2 by £2142.54.

Both control variables are significant. The control variable for a good pitch is 5% significant in model

1 and 1% in model 2, increasing the share value with respectively £1066.09 and £967.08. The significance of a full male team is high in both cases (1%) and correspond to £943.71 and £894.82 in models 1 and 2.

DISCUSSION

That both models yield similar results is not surprising, since the models are basically the same. The difference is in the way the statistical software understands the variables. In model 1 the variables are conceived as individual dummy variables, so STATA does not know to what factors the different variables belong. This is the difference with model 2, in which the software knows which variables are in one factor (StataCorp, 2009).

First the logit step, which yields exactly the same results in both models in terms of significant variables, although with slightly different coefficients. Reading from the table, it becomes evident that most variables that are tested do not increase or decrease the likelihood of the getting into the negotiation stage, with only 5 significant variables (not including the control variable).

However, it can be concluded that every factor has one variable that actually influences the likelihood, except for revenue model. First factor is the innovation type. The positive value of radical innovation is surprising, since more radical technology are generally linked to lower investment potential (Arrow, 1962; Carpenter & Petersen, 2002; Zott & Amit, 2008). However since a business angel is an informal investor compared to for example formal investors such as a venture capital firm, investments are made earlier on and with less emphasis on risk (Aernoudt, 2005; Madill et al., 2005; Nofsinger & Wang, 2011).

The next factor is internal route strategy. The variable side-entrance is positively significant. This is not surprising, because it fits small new ventures to enter the market through a niche and from there 'conquer' the market by becoming more mainstream (Shankar et al., 1998).

It is striking that the external route strategy actually yields a positive result. The reason for this to be surprising is that the entrepreneurs in Dragon's Den are mostly in the (pre)start-up stage. Therefore one could reason that it would make more sense to actually focus on an internal market route. Even more surprising is the positive coefficient of the external route strategy variable spin-off/new venture. However, this could mean that the entrepreneur has a more realistic view on what he can and cannot do, representing the ability of an entrepreneur to recognize his or her lack of certain characteristics (Chesbrough, 2003, 2012; Smith, 2010).

On the other hand, it is not surprising that technology push in the innovation process factor is negatively correlated to the likelihood. The base level is coupled, meaning demand pull and technology push are both happening, from which demand pull does not significantly differ. This can be explained as demand pull being the norm, and if there is no demand pull at all, so only technology push, then the likelihood of investment is lower. Thus, the presence of technology push only decreases the likelihood of entering negotiations by approximately 10-11%.

Related to this, the innovation insight source association means bringing together two seemingly unrelated ideas, which together result in an innovation. Therefore, the positive relation between likelihood of entering in negotiations and association can be explained as bringing together two ideas that are already proven in practice. This would increase the chance of success of a new innovation, since it finds its origins in two proven concepts (Smith, 2010).

Finally, in the logit step the quality of the pitch comes forward as an important factor, what was also to be expected, due to earlier research.

However, the gender of the entrepreneur does not make a difference at this point.

Next up is the GLM step of the models. The first thing that can be noted is there is no difference within the factors innovation process and innovation type, i.e. it does not matter what kind of innovation process or innovation type is present.

The first factor with a relevant variable is internal route strategy. Most strategies perform on par, except of the variable follower. Follower means waiting to enter the market in order to benefit from companies who went before you, in order to copy things that work such as a certain business model or marketing strategy (Smith, 2010). This variable is negatively correlated to share value, indicating that companies that tend to do this are valued lower than companies with another internal route strategy. Both control variables are positively correlated, which fortify findings from other research.

The first discrepancy shows up in the factor external route strategy. In this case, the variable licensing is significant in the first model, but not in the second. Besides, spin-off/new venture is significant in both models, making this the only factor with two significant variables (in one model). The same argument here goes as in the previous step: if an entrepreneur comes to the conclusion he or she lacks the competences needed in order to successfully exploit an innovation, an external route might provide an option for strategic advantage. Going with this reasoning, one can argue why these variables are positively related to share value.

The second difference between the two models in terms of significant variables is in the factor innovation insight source the variable association. This variable is only significant in model 2. The same reasoning can be applied here as with the same variable in the previous step of the model, although less convincing due to a much lower significance (higher p-value in the second step compared to the first step).

Contrary to the previous step, a variable from the factor revenue model is significant.

Subscription/licensing is highly significant and negatively correlated with share value. A reason for this can be the reasoning that a subscription or rental requires more manpower than a direct selling revenue model, due to maintenance and customer service.

When taking a look at the dimensions of technical business model innovation it becomes clear that the newness of technology dimension is of significant importance on the likelihood of entering into negotiations and the newness of market offering is of significant importance on the likelihood and the share value.

Whether or not to enter into negotiations, is positively influenced by radical (innovation type), side-entrance (internal route market), spin-off/new venture (external route strategy) and association (innovation insight source), and negatively influenced by technology push (innovation process).

The share value is negatively determined by follower (internal route strategy) and subscription/rental (revenue model). Clearly, spin-off/new venture (external route strategy) determines the share value positive, added by association (innovation insight source) and licensing (external route strategy). However, there is no consensus reached between the models on these last two variables, so they should be treated with caution.

CONCLUSION

This research aimed to identify the influence of business model innovation on the willingness to invest by business angels. To fulfil the goal the main research question was:

“What characteristics of technical business model innovation influences the willingness to invest by business angels?”

During this research six points could be concluded that help answer this question. The following conclusions can be drawn:

- ❖ Willingness to invest relates to likelihood of entering into negotiations and share value.

- ❖ Newness of technology is related to the type of innovation.
- ❖ Newness of market offering is related to internal route strategy, external route strategy, innovation insight source, innovation process and revenue model.
- ❖ Likelihood of entering into negotiations is determined by newness of technology and newness of market offering.
- ❖ The share value is determined by newness of market offering.

Combining the conclusions above, the main research question can be answered about the influence of technical business model innovation on the willingness to invest.

An entrepreneur with a business model that brings together two or more seemingly unconnected ideas and brings this to the market as a new venture is more likely to get into negotiations with a business angel and has his shares valued higher by the same business angels.

The likelihood of a business model generating interest from business angels is further improved by aiming for a niche market, by starting to grow from that position, and have a radical type of innovation that triggers the business angels to invest. When it comes to the likelihood of getting in negotiations, situations in which an entrepreneurs idea is purely based on technological breakthrough without any form of market demand should be avoided.

In case of the share value, giving an indication of how much a business angel is actually willing to invest, business models with a delayed market entry strategy and rental revenue model should be avoided.

The possibility to secure investments for radical innovative ideas that connect different ideas and start small may count on business angels willing to back them. However, the same business angels show some hesitation when it comes to doing business in a different way: there is no proof for innovative revenue models and market demand still reigns. This calls for entrepreneurs who are not afraid to stick their necks out and challenge the current way business is done.

LIMITATIONS

The research performed has several limitations that need to be kept in mind. This section gives an overview of the major concerns found in this research.

STRENGTH OF DATA

As mentioned before, there are some side notes to keep in mind using data from the Dragons' Den television show that need to be taken into account. There is a potential selection bias, since it is unclear how the pre-selection by the BBC is performed. It is also important to take into account that following the negotiations shown in the programme there is a due diligence phase, in which both the entrepreneur and business angel are still able to stand down from the deal. However, since this research is about the willingness to invest, which is based around the negotiations, this problem is not as big as when to focus would be on the actually investments that were made. Even if an investment made in the show is cancelled, the negotiation stage did not change.

The data used to compose the database is from the online available episodes of Dragons' Den and therefore make use of the edited footage made available by the BBC. Although Dragon's Den is used before as research material, the research had access to the unedited tapes (Maxwell et al., 2011). This could lead unobserved factors in the database.

The database is mainly coded by one person, making it at the very least subjective. This would not be a problem for 'hard' data such as the amounts invested, but for 'soft' data this could lead to inaccuracies, since it is the opinion of observer that gets coded.

VARIABLES

All the variables used are dummy variables based on categorical and dummy variables from the original database. The selection of which variables to use is based on literature. Therefore it is important to take into account that the influence of the created independent variables are mere estimations of the examined link, and probably do

not provide an accurate estimation to predict likelihood in the future. This is due to a possible difference in conception between the coder of the database and the researcher.

SELECTION BIAS

Due to the focus subject, technical business model innovation, only the manufacturing sector was included in this research. In the original database, 374 out of 1701 pitches entered the negotiation stage, resulting in a group of 28.2%. After recoding, removing missing values and only using the manufacturing companies, the database contains 203 negotiations out of 1020 pitches, resulting in a group of 19.9%. Therefore the selection used in this research differs slightly from the group in the original database.

FURTHER RESEARCH

Although previous research provided interesting insights, further research is still recommended to create a better understanding about the link between business angel investments and entrepreneurs. Using this research as base some recommendations for further research will be done.

In future research, the strength of the data could be improved. To deal with the observation bias, multiple people should watch all the episodes. This could be done in such way that all episodes are randomly divided among the observers, so there is no possibility of a season effect. To enhance the strength of the results of the research, in-depth interview with real life business angels could be held, to cross check the information provided by literature and/or models used.

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APPENDIX II

Overview of dummy variables

	Dummy	Freq.	Percent
Revenue model			
Direct selling	M1	1,342	82.48
Subscription/rental	M2	160	9.83
Licensing/franchise	M3	105	6.45
Other		15	0.92
Freemium	M4	5	0.31
Innovation insight source			
Association	M5	695	42.72
Adaptation	M6	355	21.82
Analogy	M7	313	19.24
Unknown		244	15.00
Serendipity	M8	20	1.23
External route strategy			
NA		1,462	89.86
Licensing	M9	105	6.45
Spin-off/New venture	M10	60	3.69
Innovation process			
Technology push	M11	1,1017	62.70
Coupled	M12	510	31.44
Demand pull	M13	95	5.86
Internal route strategy			
First-mover	M14	959	58.94
Derivative	M15	325	19.98
Side-entrance	M16	168	10.33
Follower	M17	155	9.53
NA		20	1.23
Innovation type			
Incremental	T1	653	36.98
Architectural	T2	560	31.71
Modular	T3	344	19.48
Radical	T4	209	11.83