Time-to-market forecast accuracy in Nanotechnology: Do start-up and industry experience matter?

Author: Bas Kippers
University of Twente
P.O. Box 217, 7500AE Enschede
The Netherlands

ABSTRACT,

The current economy is changing fast which makes that accurate time-to-market expectations become more important. This study aims to find out to what extent the entrepreneur's experience has an influence on the accuracy of time-to-market expectations made by venture capital backed Nanotechnology startups. Literature showed that industry experience and start-up experience are related with forecast performance which makes them interesting independent variables for this study. This research is performed with participants from a dataset of a NanoNext project which consists of venture capital backed Nanotechnology startups. From there on the necessary data is collected and a survey is conducted under the participants. Of the 22 start-ups, only 9 start-ups were able to reach the market within their expected time-to-market. A significant association was found between start-up experience and the accuracy of time-to-market expectations. However, there was no association between industry experience and the accuracy of time-to-market expectations. The results are controlled with the variables: age, educational level and sex. Because of the lack of variation within the dataset, educational level and sex could not be taken into account. There is no significant association found between age and the accuracy of time-to-market expectations. It would be interesting if future research could extend this research with a bigger sample size. Besides that, this research design could be applied on a different sector in future research as well.

Graduation Committee members:
1st Examiner: Prof. Dr. Ir. P.C. De Weerd-Nederhof
2nd Examiner: Dr. R. Harms

Keywords
Time-to-market, forecasts, entrepreneurs experience, nanotechnology, venture capitalists, startups.

1. INTRODUCTION

1.1 Situation and complication

A venture capitalist is an investor who either provides capital to startup ventures or supports small companies that wish to expand but do not have access to equities markets. Venture capitalists are willing to invest in such companies because they can earn a big return on their investments if these companies are a success. Venture capitalists also experience major losses when their picks fail, but these investors are typically wealthy enough that they can afford to take the risks associated with funding young, unproven companies that appear to have a great idea and a great management team. (Ganti, 2019)

An important factor which is influencing the choice if a venture capitalist will invest in a certain startup or not, is the expected time-to-market. It is of importance because investors often have to get their return on investment back within a certain time frame.

The economy is changing fast, which means that you can assume that the fundamentals of any market will change by the time product/services are reaching the market. This makes that an accurate expectation of a startup's time-to-market is nowadays more important than ever. Probably as well the reason that Jonathan Becher already stated the following in his article: "Time-To-Market is the new indicator of success instead of ROI." (Becher, 2016) In addition, speed-to-market leads to both improved product quality and lower development costs. (Stanko, Molina-Castillo, & Munuera-Aleman, 2012)

Because of the importance of time-to-market expectations, it is interesting to check which factors have an influence on the accuracy of these expectations. The entrepreneurs experience has an influence on forecasts made by entrepreneurs. (Mikhail, Walther, & Willis, 1997) Because time-to-market expectations are forecasts as well, this indicates a possible relationship between them. This makes it among others an interesting cause to research to what extent the entrepreneurs experience is influencing the accuracy of time-to-market expectations.

If we look at time-to-market in different sectors, we see that there are differences. Looking for example at the software sector, there are no time-to-market expectations made because they only get investments when their product is already working. To improve the validity of this research, the focus will be on a specific sector. A sector which is really promising for the future, especially in the development of medicines is the Nanotechnology sector. (Pandotra, 2017) (Huang & Huang, 2018) This means that research regarding this technology is probably of relevance in future as well.

However, it should also be kept in mind that there is enough data about the type of firms. Because the Golden Egg Check is working together with companies in the Nanotechnology sector, this sector is interesting for them as well. Recently, GEC was participating in a project which is called NanoNext, where their role was to analyze companies. From this project, a dataset was created which is interesting and directly applicable on this research. It is directly applicable because it consists of data regarding venture capital backed Nanotechnology startups which are the units of analysis in this research.

1.2 Research goal

The research goal is to find out to which extent the entrepreneurs experience is influencing the accuracy of time-to-market expectations on venture capital backed Nano-technology firms.

1.3 Central research question

The research goal leads to the general research question: *To what extent does the experience of an entrepreneur have influence on time-to-market expectations made by venture capital backed Nano-technology startups?*

To answer this question, it is divided into two sub-questions:

1. What possible factors of an entrepreneurs experience are related to time-to-market expectations according to the literature?

2. What is the accuracy of time-to-market expectations made by entrepreneurs and is there an association with the entrepreneurs experience?

1.4 Outline of this research

This study will start with literature about what is already known about time-to-market expectations, entrepreneurs experience and a possible relationship between them. With help of this literature, the hypothesis and a conceptual framework is build. After the literature chapter, the methodology used for this research will be comprehensively explained. This will be followed by a chapter where the results from the surveys and dataset will be given. Finally, these results will be discussed and the limitations of this research are given.

2. LITERATURE

The literature chapter starts with a structured literature review to gain more background knowledge. Examples of subjects where among others is searched for are the entrepreneurs experience and how this influences time-to-market expectations, the impact of time-to-market on firms and characteristics of firms operating in Nanotechnology.

To perform the structured literature review, the following sources are used: Web of Science, Scopus and relevant journals. To make different combinations with keywords, the review is done with help of Boolean operators. In this way, most relevant literature will be found.

In appendix 8.2, you can find a summary of the outcomes of the structured literature review. The findings of the structured literature review are discussed in the chapters below.

2.1 Time-to-market expectations

Time-to-market expectations are made in different types of commerce. In the dataset, which is used for this research, there are the types Business-to-Business (B2B) and Business-to-Consumer (B2C). In most researches, they did not give an explicit definition for time-to-market. That's why I combined different views of researchers on time-to-market (Bacchiega, J.J., & Tarola, 2004) (Stanko, Molina-Castillo, & Munuera-Aleman, 2012) with definitions given on sources like Techopedia and Business dictionary. These definitions can be found in Appendix 8.1 and helped to come up with the following definitions. For the Business-to-Business type of commerce, time-to-market can be defined as a term for the period of time between the first ideas around a product and its availability on business markets. For Business-to-consumer type of commerce, time-to-market can be defined as a term for the period of time between the first ideas around a product and its availability on consumer markets.

A difficulty with assessing time-to-market expectations is that an organization could also bring for example a prototype on the market. A model which gives a better understanding of product phases is the technology readiness level (TRL). The technology readiness level describes the degree of development of a certain technology. Where TRL1 stands for the start of the development of a technology and TRL9 stands for a technology which is technologically and commercially ready. (Joren Kruit, 2017) To clarify the definition of time-to-market, TRL9 will be taken as the phase where the product/technology is ready to go to the market.

Time-to-market becomes more and more important in the fast-changing environment. (Becher, 2016) (Bacchiega, J.J., & Tarola, 2004) A faster time-to-market leads to both improved product quality and lower development costs. This is a result from less potential man hours and thus costs in development projects. Besides this, speed to market leads to superior new product quality as firms can leverage fast cycle times by including the most up-to-date components in their products. (Stanko, Molina-Castillo, & Munuera-Aleman, 2012) However, there are also researchers which looked more in depth to time-to-market and took other circumstances in account as well. Looking at companies which replaces their existing product, they state that it is better to develop a superior new product rather than to move fast to the market when the margins of the existing products are still high and the product demand rate is large. In addition, they found a positive relationship with the minimal speed to market for a profitable undertaking of a new product development and total existing product performance in the market. (Cohen, Eliashberg, & Ho, 1996)

2.2 Entrepreneurs experience

It is already known that the experience of entrepreneurs has an impact on the actual time-to-market. (Poornima Joshi, 2018) Besides that, there are also signs that the experience of an entrepreneur could have an impact on the expected time-to-market. Entrepreneurial judgement should namely be improved by work and start-up experience according to multiple papers. (Ronstadt, 1998) (Wiklund & Stephard, 2003) (Cassar G., 2014) (Baron & Ensley, 2006) (McGrath & MacMillan, 2000) (Parker, 2006) (Shane, 2000)

2.2.1 Start-up experience

In this research, start-up experience will be assessed as the number of businesses started before their current business. To explain the importance of start-up experience and the reason why start-up experience is taken into account in this research as well, first a citation from the theory of Cassar: "Experience from entrepreneurial activity allows development of strong cognitive frameworks that improve the evaluation and selection of entrepreneurial opportunities and the formulation of more sophisticated judgments (Baron and Ensley, 2006; Gruber et al., 2008). Just as firms, through experience in repeated tasks, gain greater competence and expertise in that task (Haleblian et al., 2006), entrepreneurs can refine their new business evaluation process with greater venturing forecast experience." That the evaluation process and entrepreneurial judgement are improved from learning by doing is confirmed by Corbett as well. (Corbett, 2005)

Other researchers took work experience in forecasting as a detached variable for forecasting performance. With their research, they showed that forecasting work experience have significant, beneficial effects on forecasting performance. (Šindelář, 2016) (T. & Homburg, 2018) Like we can see in the citation above, entrepreneurial work experience in forecasting is already covered in start-up experience. That's why I do not take it as a separate variable.

Cassar did not found a significant association between start-up experience and entrepreneur forecast performance. However, the theory above states differently and this does not mean that there would not be an association with the accuracy of time-to-market expectations under this specific group of participants. That's why the following hypothesis is made.

Hypothesis 1: Start-up experience has a positive association with the accuracy of time-to-market expectations.

2.2.2 Industry experience

In this research, industry experience will be assessed as the number of years' work experience an entrepreneur has with Nanotechnology. Cassar cited in his research that: "Experience in similar settings reduces the number of unknowns and assumptions an entrepreneur must make when evaluating their prospects (Chandler, 1996). Those with expertise in a certain industry are likely to get relevant and more precise information about their new business in the same arena (Landier & Thesmar, 2009)." Time-to-market can be influenced by changes in the environment which makes it important for an entrepreneur to know the environment in which they operate. This makes that the findings above from Landier, Thesmar and Chandler all give the motive that it has a positive association with the accuracy of time-to-market expectations. As a result, from that more precise information and experience in similar settings, an entrepreneur can better evaluate and understand the environment in which they operate. (Chandler, 1996) (Landier & Thesmar, 2009).

Cassar found in his research a significant association for industry experience and entrepreneur forecast performance. This in combination with the theory above, gave that the following hypothesis is made.

Hypothesis 2: Industry experience has a positive association with the accuracy of time-to-market expectations.

2.3 Control variables

To improve the validity and reliability of this research, control variables are used. There will be controlled for different entrepreneur specific variables which have a relation with forecast performance according to different literature.

The first control variable is sex, there are results which indicate that men have the tendency to express higher levels of confidence than women in the accuracy of their work. (Pallier, 2003) Besides, overestimating future performance is also higher by men than women. (Puri & Robinson, 2007) That's why an indicator variable 'sex' is added, which is representing the sex of an entrepreneur. (Options: Men or Women)

Cassar (2014) cited the following about the control variable age: "Research has also shown that overconfidence, dispositional optimism, and over optimism in prediction are associated with entrepreneur age (Arabsheibani et al., 2000; Forbes, 2005)." To check whether this is the case in this research, the control variable 'age' will be added as well.

Like already mentioned, Nanotechnology is in general in the early stage of development and is a complex technology. Because of its complexity, a certain level of knowledge is needed to understand and work with this technology. This makes education an interesting control variable as well.

Another control variable which Cassar used was a variable for the type of technology industry a company was operating. Therefore, he made use of Dun and Bradstreet's technology classification which groups industries as Low Tech, Mid Tech and High-Tech. Because this research is only focused on Nanotechnology firms, this control variable would not be of interest for this research.

2.4 Conceptual framework

With help of the literature, which is described in the subchapters above, different independent and control variables are found. The hypothesis is that both industry and start-up experience will have a positive influence on the accuracy of time-to-market expectations. Besides that, the dependent variable will be controlled for sex, age and the educational level of an entrepreneur. The conceptual framework is placed in figure 1 below, in the next chapter will be explained how this conceptual framework will be measured.

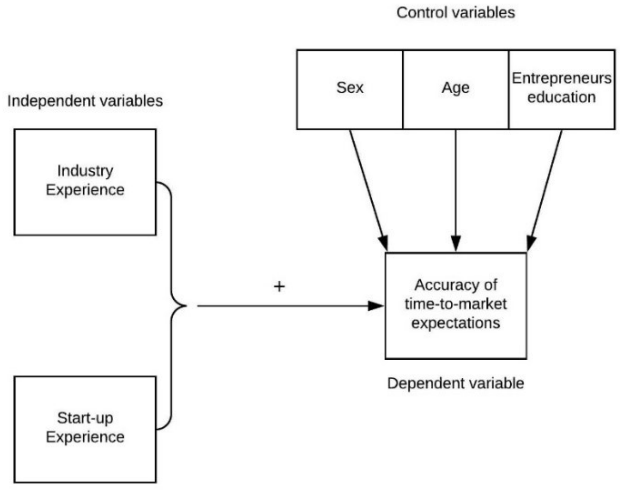

Figure 1. Conceptual framework.

3. METHODOLOGY

In this chapter about methodology, the way this research has been executed will be described. An explanation will be given about the sample, the data available, the data collection and the methods used for data analysis.

3.1 Sample

The scope will be on venture capital backed Nanotechnology start-ups, so these are the units of analysis. To get in touch and collect data from these such start-ups, a dataset of the NanoNext project is used. This list was consisting of 38 start-ups from which 22 participated in this research.

3.2 Operationalisation

3.2.1 Measurement of variables

To explain how the independent variables, control variables and dependent variables will be measured, an overview is made in table 1.

Variable	Measurement
IV: Industry experience	The number of years work experience an entrepreneur has with Nanotechnology. If the entrepreneur did an PhD related to Nanotechnology, these years are included as work experience as well.
IV: Start-up experience	The number of businesses an entrepreneur started before their current business.
DV: Accuracy of time-to-market expectations	The difference in the period between the expected time-to-market and actual time-to-market will be expressed as a percentage.
CV: Sex	The sex of an entrepreneur: men or women
CV: Age	The current age of an entrepreneur.
CV: Educational level	The highest educational level an entrepreneur has reached. These are categorized in the following levels: 0) less than high school; 1) high school; 2) technical or associate's degree; 3) bachelor's degree; and 4) post-bachelor's degree.

Table 1. Measurement of variables

3.2.2 Data collection

In this research both primary and secondary data are used. First of all, secondary data is used to find already existing literature regarding this topic. More about the collection of literature can be found in the chapter 2: Literature. In addition, a dataset (NanoNext project) provided by the Golden Egg Check is used. This dataset consists of the following small sub-chapters: Pitch, Check, Funding, Team, Lean Canvas, Product, Market, Financial, Timeline and Financial valuation. Most interesting information which should be gathered from this set are the expected time-to-market expectations made by different Nanotechnology start-ups, information about the development of the product and the age, sex and experience of the entrepreneurs.

Primary data will be used as well. Together with Daan Busch, a survey by mail will be conducted with the participating entrepreneurs. Daan Busch is researching the influence of industry- and start-up experience on the accuracy of revenue forecasts made by entrepreneurs. Because our independent variables are the same and he is researching the same units of analysis, we combined our survey. In this way the sample size

can be increased, the response rate will probably be higher, and it is more time-efficient for both of us.

First of all, the survey is used to find out what the actual time-to-market was. Most of the times, the data regarding the experience of the entrepreneur was missing in the dataset from the NanoNext project. That's why questions regarding the experience of the entrepreneur are added in the survey as well. Finally, the survey is used to find the missing information regarding the control variables age and education.

To increase the response rate of the survey, all participants are first called to ask if they want to participate and after that they will receive a mail with the survey. The firms from the dataset all get a number so the information from the pitch can be combined with the correct information from the survey, in this way the data is processed anonymous as well. To make sure there would not be any languages biases, for example due to different interpretations, the questions in the survey would be asked in English. In the dataset Related to this research, the following questions are asked in the survey:

1. What is your age?

2. How many years of work experience do you have with Nanotechnology?

3. Did you start any other firms before your current business? If yes, how many?

4. What was the actual time-to-market of your product in years?

A disadvantage of a survey is that probably not all entrepreneurs will respond. They are often very busy and probably do not want to spend much time on other things than their business. That's why all participants of the NanoNext dataset were first called before the surveys were send to them by mail. If they agreed on phone that they would participate but did not fill in the survey after one week, another call was made to remind them that they did not fill in the survey yet. In this way, most entrepreneurs possible will be reached.

3.3 Method of analysis

Because a possible causal relationship between the variables is researched, the following three aspects of causality should be considered:

1. Time order; X precedes Y in time.

2. Association/correlation; X and Y are correlated.

3. Non spuriousness; there is no other (third) variable accounting for the correlation.

The first aspect of causality is time order, because the experience of an entrepreneur is there before he or she makes an expectation of the time-to-market, we can state that the time order is right. The second aspect is that the variables should be correlated, with help of the data analysis in SPSS, we will see whether there is a significant association or not. The third aspect is non spuriousness, with help of the control variables is tried to create non spuriousness.

To calculate the actual accuracy of their time-to-market expectations, the data gathered from the survey and from the pitches are combined with each other. The difference in the period between the expected time-to-market and actual time-to-market will be expressed as a percentage. To include the participants who stopped already with their business or are still developing their product as well, the participants will be divided in two groups. The first group will be the participants who met their expectations and the second who did not meet their expectations. In this way, we make use of the biggest sample size possible and all participants could be used in the analysis.

To measure if there is a correlation between the experience of the entrepreneur and the accuracy of the time-to-market expectations, the idea was to perform a multiple linear regression analysis in SPSS to do a cross-sectional analysis with a normal distribution and two independent variables. That should be done with the following variables in SPSS: The accuracy of time-to-market expectations, industry experience and start-up experience.

However, for a valid multiple linear regression analysis, the sample size should consist of a certain minimum number of participants. (Veaux, Velleman, & Bock, 2015) A statistical power analysis is directly related to tests of hypotheses. A power analysis is often used to determine the smallest sample size that is suitable to detect the effect of a given test at the desired level of significance. Namely, when the sample size is too small, a researcher might commit a Type II error due to insufficient power. A Type II error occurs when one fails to reject a false null hypothesis. To perform a power analysis, a program G* Power of the University of Düsseldorf is used.

The three main parameters which are taken into account for this analysis are: the alpha value, the power and the effect size. For the alpha a value of 0,05 is used. The power refers to the probability that the null hypothesis will be correctly rejected. A generally accepted power is 0,80. (Howell, 2010) Regarding the academic team of Statistical Solutions, it is acceptable to use a medium effect in the sample size calculation. These variables combined in the G* Power test, gives the result that the desired sample size is 68.

This means that because of the small sample size, the multiple linear regression is not valid to be performed. Therefore, bivariate analyses were used to explore the data. The Pearson's Chi-square and Fisher's exact test were performed to check whether there are significant results.

For both the calculation of the time-to-market accuracy and for the assessment of the entrepreneurs experience a quantitative measure method is used.

4. RESULTS

In this chapter, the results of the gathered data from the dataset of Nanonext and surveys will be presented. First, the results of the accuracy of the time-to-market expectations made by entrepreneurs will be covered. Secondly, the results of both the independent variables: industry experience and start-up experience will be presented. This is including their influence on the dependent variable: the accuracy of time-to-market expectations. Finally, the results of the control variables will be discussed.

The dataset of the Nanonext project was small, which had as a result a sample size of 22 participants in total. Because a small sample size like this make it difficult to analyze, statistics professor Van der Kaap was asked for advice on how to do the analysis. He advised for example to do a bivariate analysis, make use of cross tables and perform the Pearson's Chi-square test and the Fisher Exact test. In addition, a book regarding statistics is used as well. (Veaux, Velleman, & Bock, 2015) These information sources made it able to still get interesting results from the dataset which are presented in the paragraphs below.

4.1 Accuracy of time-to-market expectations

With help of the dataset, the time-to-market expectations were identified. These numbers in combination with the actual time-to-market in years, which where collected through the survey, made it possible to calculate the accuracy. Through the survey, I collected different kind of answers. To focus on the fact whether firms really met their expectations and to make use of the biggest sample size possible, I will categorize the accuracy of the time-to-market expectations in two groups: 'Not Meet' (0) and 'Meet' (1). This makes it able to include companies which already stopped or are still developing because of delay as well. In addition, this shows an interesting overview of to what extent these start-ups were actually able to achieve their expectations. In table 2 below, we see that 13 of the participating firms did not meet their expectations, where 9 participants did. The best participant was able to reach the market already in half of the expected time-to-market. From the 13 participating firms who did not meet their expectations, 4 firms reached the market already. While 5 firms are still developing their product and 4 stopped the development of their product.

Valid	Frequency	Percent
0,00	13	59,1
1,00	9	40,9
Total	22	100,00

Table 2. Accuracy of time-to-market expectations.

4.2 Industry experience

The analysis for industry experience started with looking how the variable is distributed. To get a clear overview, a frequency table with a histogram was made. The distribution can be found in the histogram in figure 2 below.

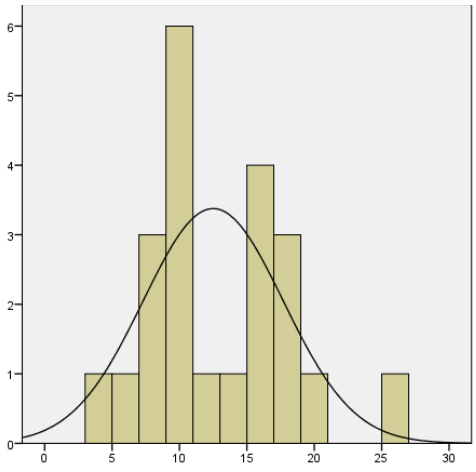

Figure 2. Histogram industry experience.

The industry experience variable is recoded into two different groups. The first group (1,00), is the group with participants who have experience up to 10 years. The second group (2,00), is the group with participants who have more experience than 10 years. Both groups consist of 11 participants. The split is made by 10 years because from this point on it is likely that entrepreneurs have more knowledge about unpredictability within the complex Nanotechnology. The entrepreneur within the set with most industry experience had 25 years of experience, where the entrepreneur with the least industry experience had only 4 years of experience.

Now, for both industry experience and the accuracy of time-to-market expectations there are dichotomous variables. This means that these can be combined in a cross table. After that, the Pearson's Chi-Square test and Fisher's exact test can be run. The variables according to the accuracy of time-to-market expectations are placed in the columns and the industry experience variables are placed in the rows. In table 3 below we can see this cross table.

Time-to-market accuracy					
			0,00	**1,00**	**Total**
Industry Experience	**1,00**	**Count**	8	3	11
		Expected Count	6,5	4,5	11,0
		Percentage within Industry experience	72,7%	27,3%	100,0%
	2,00	**Count**	5	6	11
		Expected Count	6,5	4,5	11,0
		Percentage within Industry experience	45,5%	54,5%	100,0%
Total	**Count**		13	9	22
	Expected Count		13,0	9,0	22,0
	Percentage within Industry experience		59,1%	40,9%	100,0%

Table 3. Cross table Industry experience and TTM accuracy.

With help of the cross table, the Pearson's Chi-square test can be performed. The chi-square test is testing how like it is that the observed differences between the count and expected count arose by chance. However, the Pearson's Chi-square test is only applicable if the data is checked on three assumptions: 1) the type of data needs to be categorial or counts; 2) the samples need to be independent of each other; 3) the expected count needs to be more than 5 in each cell.

	Value	Df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-square	1,692[a]	1	0,193	-	-
Fisher's Exact Test	-	-	-	0,387	0,193

Table 4. Pearson's Chi-square and Fisher's Exact Test

Like we can see in table 4 above, the Chi square test scored 0,193 which is bigger than 0,10, so there is no significant result.

Besides that, in the cross table there are also two expected counts of 4.5 which are smaller than 5, which means that we cannot use Pearson's Chi-square test. This means that the Fisher's Exact test should be performed. The hypothesis which are used for the fisher's Exact test are:
H_0 : Expected count is equal to observed count
H_1 : Expected count is not equal to observed count
$\alpha = 0.10$

With a score of 0,387 on this test, we can state that we do not have significant evidence to reject H_0, which means that industry experience is independent to the accuracy of time-to-market expectations.

4.3 Start-up experience

For start-up experience, the analysis started as well with looking how the variable is distributed. Under the participants there were entrepreneurs which started no business before and entrepreneurs who started one company before. This makes that the participants can be easily divided over two groups. The first group consists of participants who do not have start-up experience (0,00) and the second group (1,00) consists of participants who have start-up experience. There were 15 participants who did not have any start-up experience and 7 which have start-up experience.

To analyze whether there is association between start-up experience and the accuracy of time-to-market expectations, we can combine both dichotomous variables in a cross table again. The variables according to the accuracy of time-to-market expectations are placed in the columns and the start-up experience variables are placed in the rows. In table 5 below, we can see this cross table.

Time-to-market accuracy					
			0,00	**1,00**	**Total**
Start-up Experience	**0,00**	**Count**	12	3	15
		Expected Count	8,9	6,1	15,0
		Percentage within Start-up experience	80,0%	20,0%	100,0%
	1,00	**Count**	1	6	7
		Expected Count	4,1	2,9	7,0
		Percentage within Start-up experience	14,3%	85,7%	100,0%
Total	**Count**		13	9	22
	Expected Count		13,0	9,0	22,0
	Percentage within Start-up experience		59,1%	40,9%	100,0%

Table 5. Cross table start-up experience and TTM accuracy.

With help of the cross table, the Pearson's Chi-square can be performed again. Like we see in table 6, we have a significant score of 0,004 for the Pearson Chi-square. However, because we have two expected counts below 5 in our cross table, we may not use the Pearson's chi-square test. This means that the Fisher's Exact test should be performed again.

With a score of 0.007 on Fisher's exact test, it could be stated that there is significant evidence to reject H_0. This means that start-up experience is not independent to the accuracy of time-to-market expectations.

	Value	**Df**	**Asymptotic Significance (2-sided)**	**Exact Sig. (2-sided)**	**Exact Sig. (1-sided)**
Pearson Chi-square	8,526[a]	1	0,004	-	-
Fisher's Exact Test	-	-	-	0,007	0,007

Table 6. Pearson's Chi-square and Fisher's Exact Test

4.4 Control variables

The control variables used in this research are: sex, age and education. For the variables sex and education, there was almost no variation present. Under the participants were 21 men and only 1 women. Besides that, all the participants had done a PhD as highest education level, which means that they all scored level 4 for their education level. The variables sex and education are for that reason not of further interest to take into account.

However, age is interesting to take into account. The youngest participant was 30 years old and the oldest participant was 60 years old. For this variable, groups were made as well. Group 1 (1,00) consists of participants with an age younger than 45 and Group 2 (2,00) consists of participants with an age of 46 and older.

To analyze whether there is an association between age and the accuracy of time-to-market expectations, we can combine both dichotomous variables in a cross table again. The variables according to the accuracy of time-to-market expectations are placed in the columns and the start-up experience variables are placed in the rows. In table 7 below, this cross table is placed.

Time-to-market accuracy					
			0,00	1,00	Total
Age	1,00	Count	5	7	12
		Expected Count	7,1	4,9	12,0
		Percentage within Age	41,7%	58,3%	100,0%
	2,00	Count	8	2	10
		Expected Count	5,9	4,1	10,0
		Percentage within Age	80,0%	20,0%	100,0%
Total	Count		13	9	22
	Expected Count		13,0	9,0	22,0
	Percentage within Age		59,1%	40,9%	100,0%

Table 7. Cross table age groups and TTM accuracy.

With help of the cross table, the Pearson's Chi-square can be performed again. Like we see in table 8, we have a score of 0,069 for the Pearson Chi-square which means that there is no significant result. In addition, we have two expected counts below 5 in our cross table, so we may not use the Pearson's chi-square test at all. This means that the Fisher's Exact test should be performed again.

With a score of 0,099 on Fisher's exact test, it could be stated that there is no significant evidence to reject H_0. This means that age is independent to the accuracy of time-to-market expectations.

	Value	Df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-square	3,316[a]	1	0,069	-	-
Fisher's Exact Test	-	-	-	0,099	0,082

Table 8. Pearson's Chi-square and Fisher's Exact Test

5. DISCUSSION AND LIMITATIONS

In this final chapter, I will first summarize and discuss the results. After that, the theoretical and practical contribution will be described. This chapter will be ended with limitations of this research and some suggestions for future research.

5.1 Summary of the results

Looking at the accuracy of time-to-market expectations made by venture capital backed start-ups in Nanotechnology, we can state that 13 out of 22 entrepreneurs did not reach their expected time-to-market. Because of the small sample size and focus on this specific dataset, we cannot use this as an illustration for all start-ups in Nanotechnology. However, it gives an impression on how the start-ups in the Nanonext project performed.

To analyze if there is a dependence between the industry experience of an entrepreneur and the accuracy of time-to-market expectations, the Pearson's Chi-square test and Fisher's Exact Test were performed. From these tests, there were not significant results found. While the results were not significant, we still see an interesting pattern in the cross table. (Table 2) When we compare the different groups, we see that group 2, which is the group with the most industry experience, had a bigger share in the participants who reached their expected time-to-market then group 1.

To analyze if there is a dependence between start-up experience and the accuracy of time-to-market expectations, we made use of the same analysis as we did for the independent variable industry experience. However, for start-up experience we found significant evidence that it has an association with the accuracy of time-to-market expectations. Also for this variable, we see interesting findings in the cross table. The participants who had start-ups experience, had namely a bigger share in the group which reached their time-to-market expectations and a smaller share in the group which did not reach their expectations.

Finally, control variables are also used to check if there was an association with the accuracy of time-to-market expectations. However, the control variable sex and education are not used because under the participants there were 21 men and all of them did an PhD. So, because of the lack of variation, these control variables were not taken further into account in the analysis. Age was still useful to use and we performed a Chi-square test and Fisher's exact Test on this variable as well. While, we did not find a significant result with these tests, the cross table gave an interesting outcome. We see that that older age has a bigger share in the group which reached their time-to-market expectations and a smaller share in the group which did not reach their expectations.

5.2 Contribution

This research is contributing to both theoretical and practical purposes.

5.2.1 Theoretical contribution

This research is connected with a research done by Cassar in 2014 which is called "Industry and startup experience on entrepreneur forecast performance in new firms." This research was found through performing the literature review and its research design is an interesting basis for this research. However, there are fundamental differences as well. Where Cassar researched as dependent variable the accuracy of (financial) growth forecasts, this research will focus on the accuracy of time-to-market expectations. Besides that, this research is focusing on another target group then Cassar did in his research, namely venture capital backed Nanotechnology firms. This would probably have an big impact on the results. Nanotechnology is still in the early stages of development which makes forecasts on this technology more complex. (Malanowski & Zweck, 2007)

This research is based on a unique dataset from a NanoNext project which consists of recently started startups which could be interesting for other researchers because a lot of research is outdated.

5.2.2 Practical contribution

The Golden Egg Check is facing the issue that startups are often optimistic and overly confident about their idea/solution, while on the other hand investors are often quite skeptical about their ideas. Investors take for example often the expected time-to-market of the entrepreneur times two, because they do not believe in their expectations. GEC is wondering whether this is based on evidence or if it is just a negotiation tactic from investors. With this research, we can state that indeed more than a half of the venture capital backed startups in the Nano-technology industry did not meet their expected time-to-market. In addition, this research also found out that start-up experience had a significant association with the accuracy of time-to-market experience. However, industry experience did not have a significant association. These findings could be used by GEC when they have to access an NanoNext project again because they can for example improve their scan with these results. Another way of how they could use the outcome of this research is by using it in their meetings with startups or investors. Time-to-market is an aspect which is important when it comes to investments. With the results of this research, they can give more transparency about the accuracy of time-to-market expectations made by entrepreneurs so this will be directly applicable as well.

5.3 Limitations and Future research

There are several limitations which apply to this research. First of all, this study is carried out as a bachelor thesis, which makes that it has a time constraint of ten weeks. Because of the lack of time, as well as the small number of data available, the sample size turned out to be lower than desired. As a consequence, this made that a multiple regression analysis could not be performed. Instead, an bivariate analysis is done and the Pearson's chi-square and Fisher's exact test are performed. Future research can reinforce this study by using a larger number of variables.

Another limitation which should be kept in mind is that some responses of the survey could be unreliable. An entrepreneur could for example have given an better answer than it was in reality.

In this dataset, we had to deal with 21 men and all of them had the same educational level 4 (PhD). Because of the complexity of Nanotechnology, it's likely that this educational level is common under these entrepreneurs. But interesting would be to see whether an entrepreneur with a lower educational level could be successful with a startup Nanotechnology as well. However, when another research would extend this study with a bigger sample size, there may appear more variation in the dataset which should be interesting to take into account as well.

6. ACKNOWLEDGEMENTS

First of all, I would like to express my gratitude to my supervisors Petra de Weerd-Nederhof and Rainer Harms for their supervision and feedback during the creation of this thesis.

Besides that, I would like to thank the Golden Egg Check for the inspiration and support during the creation this thesis. Finally, I would thank the NanoNext project for the permission they gave to work with their database.

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8. APPENDIX

8.1 Time-to-market definition

Source	Time-to-market definition
Bacchiega, E., Gabszewicz, J. J., & Tarola, O. (2004). *Time-to-Market in Vertically Differentiated Industries. SSRN Electronic Journal.*	"The term time-to-market is used by analogy to designate the interval of time covered until the last stage is reached." *The last stage was described in this research as the stage where products are brought to the marketplace.*
Stanko, M. A., Molina-Castillo, F.-J., & Munuera-Aleman, J.-L. (2012). Speed to Market for Innovative Products: Blessing or Curse? *Journal of Product Innovation Management, 29(5), 751–765.*	"Different terms such as time-to-market (Chen et al., 2005), cycle time (Ittner and Larcker, 1997), innovation speed (Kessler and Chakrabarti, 1996), and speed to market (Meyer and Utterback, 1995) have been used to refer to the pace of new product development. This research focuses on speed to market, which is defined as "the pace of activities between idea conception and product implementation"
Techopedia	"Time to market is a term for the period of time between the first ideas around a product and its eventual availability on consumer markets."
Business dictionary	"Length of time taken in product development process from product idea to the finished product. It is a critical component of time-based competition."

8.2 Structured literature review

I perform a structured literate review using Boolean operators. In this way, I try a lot of different combinations to find as much as possible relevant literature. The Boolean operators which I used are 'AND', 'OR', and 'NOT'. I will use the 'AND' to make combinations, an example of this could be 'experience' AND 'time-to-market'. In addition, I used the 'OR' for synonyms, an example of this could be 'time-to-market expectations' OR 'time-to-market forecasts'. Finally, I can use 'NOT' to exclude things which are not relevant.

I used the following keywords:

("Time-to-market expect*" **AND** "accurac*") **OR**
("Time-to-market accura*" **AND** "experienc*") **OR**
(" Time-to-market accura*" **AND** "Start-up*") **OR**
("Time-expect*" **AND** "start-up") **OR**
("Forecast* performance" **AND** "Start-up*") **OR**
("Forecast* ability" **AND** "Startup*") **OR**
("Forecast* performance" **AND** "experienc*") **OR**

These keywords gave me 54 document results from where I found 7 articles with has relevance related to my research. I placed the 7 results in the table below.

Title	**Author/ Sources**	**Relevance**
Determinants of analysts' revenue forecast accuracy	Lorenz T. ; Homburg, C. *Review of Quantitative Finance and Accounting, 51(2), 389–431.*	" Gives us another insight that (forecasting) experience is one of the factors explaining forecast accuracy. "
Investigation of factors influencing employee performance: A case of sales forecasting	Jiří Šindelář *International Journal of Organizational Analysis, 24(2), 340-368*	"Finally, the research indicated that among the personal attributes related to individual forecasters, domain and forecasting work experience have significant, beneficial effects on forecasting performance, whereas formal education level was detected to have a negative effect and can be, at best, considered as non-contributor."
Industry and startup experience on entrepreneur forecast performance in new firms	Cassar G *Journal of Business Venturing, 29(1), 137-151*	"I theoretically develop and empirically investigate the role of industry and startup experience on the forecast performance of 2304 entrepreneurs who have started new businesses."
Determinants of analysts' cash flow forecast accuracy	Pae, J., Yoon, S.-S. *Journal of Accounting, Auditing & Finance, 27(1), 123-144.*	"Consistent with previous findings on earnings forecast accuracy, analyst and forecast characteristics-including cash flow forecasting frequency, cash flow forecasting experience, the number of companies followed, forecast horizon, and past cash flow forecasting performance- determine cash flow forecast accuracy "
The roles of task-specific forecasting experience and innate ability in understanding analyst forecasting performance.	Clement, M.B., Koonce, L., Lopez, T.J. *Journal of Accounting and Economics, 44 (3), 2007, 378-398*	"In addition, we find that forecast accuracy and task-specific experience are most highly correlated for those analysts who survive the longest and, thus, presumably have the greatest innate abilities."
Analyst forecast accuracy: Do ability, resources, and portfolio complexity matter?	Clement, M.B. *Journal of Accounting and Economics, 27(3), 285-303*	"Using the I/B/E/S Detail History database, this study finds that forecast accuracy is positively associated with analysts' experience (a surrogate for analyst ability and skill) and employer size (a surrogate for resources available), and negatively associated with the number of firms and industries followed by the analyst (measures of task complexity)."

In the search results above, I did unfortunately not find much related to time-to market. That's why I expanded my literature review to a search database which include a lot of interesting journals. To increase the findings related to time-to-market, I used this time more synonyms and some subjects related to time-to-market as well. Examples of some extra keywords which I used in my combinations are: "Speed-to-market", "New-venture", "NPD", "R&D Length" , "New product development", "Market entry duration" , "Time-driven product development".

Title	Author/ Source	Relevance
Speed to Market for Innovative Products: Blessing or Curse?	Michael A. Stanko, Francisco-Jose Molina-Castillo, Jose-Luis Munuera-Aleman *The journal of product innovation management.*	"This research learns us that speed to market leads to both improved product quality and lower development costs. These findings suggest that speed to market limits potential man-hours (and thus costs) in development projects. Further, speed is also shown to be positively related to new product quality—speed to market leads to superior new product quality as firms are able to leverage fast cycle times by including the most up-to-date components in their products. "
The Effects of Innovation Implementation And Speed To Market On The Relationship Between Team Sense-Making, Trust, And Npd Success	Amaya, A.A., Liao, Y.K. & Chang, S. (2018) *International Journal of Innovation Management*	This research shows that the moderating effect of speed to market demonstrates the importance of the effective management of knowledge to strengthen an organisation's innovation implementation and success.
Speed-to-Market and New Product Performance Trade-offs	Barry L. Bayus *The journal of product innovation management.*	"The findings in this article show that the fast development of products with low performance levels is optimal for markets with short product lifetimes, sharply decling margins, or weak competitive offerings."
Time-to-market in vertically differentiated industries.	Bacchiega, E., Gabszewicz, J. J., & Tarola, O. (2007). *International Journal of Economic Theory, 3(4), 279–295*	"In high-tech industries: quite often expensive goods embedding new technologies are then followed by cheaper and low-quality versions of the same good. Also, it might happen that two variants that share the same technology are labeled as high-quality and low-quality versions of a product depending on the time when they are commercialized: indeed, the sooner the commercialization date, the more innovative seems to be the technology that it embeds."
New Product Development Processes and New Product Profitability: Exploring the Mediating Role of Speed to Market and Product Quality	Regina C. McNally, M. Billur Akdeniz, and Roger J. Calantone *Journal of Product Innovation Management, 28(s1), 63–77.*	"This research demonstrates that process matters in delivering product profitability because it positively impacts profits directly as well as indirectly through speed to market and product quality. "
New Product Development: The Performance and Time-to-Market Tradeoff	Morris A. Cohen, Jehoshua Eliashberg and Teck-Hua Ho *Management Science, Vol. 42, No. 2 (Feb., 1996), pp. 173-186*	"In this paper, they have focused on the tradeoff between target performance and the time-to-market a new product. They did this for both existing and new products. "
Reliability in a time-driven product development process	Yuan Lu H. T. Loh Y. Ibrahim P. C. Sander A. C. Brombacher *Quality and Reliability Engineering International Volume 15, Issue 6*	"Time and cost are the main concerns and quality is ignored. To achieve high reliability with short time to market, it is worthwhile to understand the non-linear behaviours of time and cost during the PDP." "Problems should have been tackled by introducing fast feedback on root cause level as soon as possible. Making these changes to the existing PDP would

		mean an important step in the direction of producing products in the right time to market with high quality and reliability."
Time to market prediction using type-2 fuzzy sets	P. Baguley (School of Engineering, Durham University, Durham, UK) T. Page (Department of Design and Technology, Loughborough University, Loughborough, UK) V. Koliza (Smiths Detection Ltd, Watford, UK) P. Maropoulos (School of Engineering, Durham University, Durham, UK) *Journal of Manufacturing Technology Management 17(4):513-520*	"As time to market has become the focus of new product introduction processes. The performance measures, which form the background to this work, impinge on decision-making criteria at this crucial early stage of the process. The application of fuzzy set theory as a proven method for the quantitative analysis of qualitative data and subjective opinion has been instrumental in formulating such decision models."
Bridging the gap between foresight and market research: Integrating methods to assess the economic potential of nanotechnology	Malanowski, N., & Zweck, A *Technological Forecasting and Social Change, 74(9), 1805–1822.*	"This research provides more information about different characteristics of Nanotechnology firms in combination with foresights made in this sector."
Ilieva, V., Brudermann, T., & Drakulevski, L. (2018).	"Yes, we know!" (Over)confidence in general knowledge among Austrian entrepreneurs. *Plos One, 13(5),*	"In this paper they researched the extent to which Austrian entrepreneurs made decisions/forecast with (over) confidence."