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# COOPERATION OF LATVIAN ENTERPRISES WITH UNIVERSITIES ON NEW PRODUCT DEVELOPMENT: LESSONS LEARNT AND FUTURE CONSTRUCTED

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# Cooperation of Latvian Enterprises with Universities on New Product Development: Lessons Learnt and Future Constructed

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**List of Abbreviations**

| | |
|---|---|
| CEO | Chief executive officer |
| CSB | Central Statistical bureau of Latvia |
| CTO | Chief Technology officer |
| EC | European Commission |
| FFE | Fuzzy front end |
| GDP | Gross domestic product |
| IP | Intellectual property |
| IND | Industry |
| MBA | Master of Business Administration |
| NASA | National Aeronautics and Space Administration |
| NPD | New product development |
| OECD | Organization for economic Co-operation and Development |
| PPP | Phased project planning |
| R&D | Research and development |
| RTU | Riga Technical University |
| TTO | Technology transfer office |
| UNI | University |

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# Abstract

Even though university and industry cooperation and new product development (NPD) as separate topics are well studied, a combination of the two has been explored to a lesser degree. The purpose of this Master's thesis was to understand the state of university-industry cooperation in Latvia and to contribute with practical insights to foster this partnership by studying the NPD process theoretically and empirically. Such an approach gave the authors an opportunity to contribute to the existing knowledge base as well as deliver practical results for universities and for entrepreneurs who are planning or considering cooperating with universities.

The authors of this research, studied the topic of cooperation in NPD from an industry perspective, as previous research on cooperation in Latvia has mostly been done from a university point of view and does not necessarily highlight the benefits and motivations of the local enterprises.

The study relies on a multiple case study with interviews of 16 local entrepreneurs, nine from established companies and seven from start-ups. The authors designed the study and made methodological choices that contributed to finding differences that exist in their NPD processes or cooperation with a university.

During the literature review the authors combined two separate literature streams on new product development and university-industry cooperation, and by mapping NPD stages and cooperation activities offered by a university, created a well-structured and unique framework. This framework served as a basis for a further empirical part of this study. During interviews the authors did not come across fully integrated university-industry cooperation in NPD; however, there were joint activities in most of the product Development stages.

Initially, the authors intended to identify factors influencing cooperation in each NPD stage, but fully integrated NPD was not discovered. That is the reason why fostering and impeding factors were attributed to the whole process as such, rather than individual phases.

Research results revealed the main cooperation fostering and impeding factors and ways to mitigate any difficulties, which were later aggregated in logical dimensions.

# 1. Introduction

University–industry cooperation has long been a subject of debate not only in Europe, but also here in Latvia. Both government and universities have integrated their intention to foster this cooperation over the long-term within their high-level planning documents. In addition, enterprises, which are a driving force of economic growth, have also expressed their interest to participate. However, one difference between enterprises and government is that the actions taken by enterprises are not governed by State strategic plans but rather by what is beneficial for their business.

The primary focus of this research is university-industry cooperation on new product development. Hence, numerous companies have been interviewed for this master thesis in order to determine findings on their cooperation experience, what motivates them, or conversely, what holds them back.

The authors consider this research to be topical not only from academic perspective, but it also reflects current trends in educational policy and economic situation. Last quarter's adjusted GDP in the European Union rose by 0,6 percent totalling 2.6 percent for the whole of 2017 (Trading Economy, n.d.). The Latvian economy in the same period grew much slower, recording only 0,3 percent growth in Q4 of the previous year, thus matching the initial yearly estimate of 1.5 percent rise compared to previous period (Trading Economy, n.d.). In order to reach the European Union average developmental level, Latvia will not only have to achieve the Union's average indicators but will also need to show much better results in the future.

One way to drive economic development is to invest in products and services that people need. Entrepreneurs have long been looking to come up with better and more useful products, but now more than ever, businesses seek to explore new ways and channels to improve their product offering and acquire leading-edge academic research (Schofield, 2013). In addition, universities have been slowly "transform[ing] from an ivory tower mentality to an entrepreneurial mind-set" (Etzkowitz, 2000). According to Etzkowitz (2004) we are witnessing a second academic revolution, as higher education institutions are becoming not only hubs for knowledge, but also socioeconomic development centres reshaping the traditional research model into an entrepreneurial university.

The authors of this work believe that by combining a university's knowledge and science base with business know-how and market understanding from an entrepreneur's perspective, both parties and Latvia as a country would benefit.

This thesis covers important gaps in existing research. Separate topics of university–industry cooperation and new product development have been broadly studied. However, to the best of the authors' knowledge and based on the literature review completed, there is no empirically justified framework to better understand new product development aspects in this cooperation. Furthermore, studies on cooperation in Latvia have mostly been done from a university point of view and do not necessarily highlight the benefits and motivations of the local enterprises. The review of academic literature on the university-industry cooperation also suggests that more studies were conducted on the university side than on the industry side. Therefore, this research has been conducted putting emphasis on the needs and wants of Latvian enterprises.

The purpose of this thesis is twofold. Firstly, to understand the state of university-industry cooperation in Latvia on NPD. Secondly, to contribute with practical insights to improve their partnership by studying the NPD process theoretically and empirically.

In addressing identified research gaps authors of this master thesis put forward the following research questions:

*1. What is the extent of the university-industry cooperation on new product development in Latvia?*

*2. How can Latvian enterprises benefit from cooperation with universities on new product development?*

*2.1. What are the key cooperation obstacles and possible means of dealing with them? and*

*2.2. What are the key advantages of cooperation and how to foster them?*

As a unique contribution to research, the authors propose several new things. First and foremost, the **new product development framework** mapping all stages of product development with cooperation types from university. This framework served as a basis for interviews and the empirical research section of this work.

Second, this research is applicable practically, is specific to Latvia, and contains **empirically tested recommendations** for industry as well as for universities who want to improve their cooperation in new product development. The authors of this paper also hope that it can serve as a guideline for better and more successful partnerships in other aspects as well.

Third, this work is a **good starting point for other research work** in the field of university industry cooperation in new product development.

This thesis is divided into five sections. The first chapter introduces the topic of master thesis. Second section reviews the existing research on university–industry

cooperation, new product development, and explores the Latvian context from international as well as local sources. The third section describes the research methodology, methods for sampling and data analysis. The last two chapters analyse results of this study, summarize lessons learnt and looks for a favourable future scenario.

# 2. Literature review

The literature review is divided into four sub-sections, each covering a specific area of university – industry cooperation in NPD. The authors start with outlining the general process of cooperation, then explore NPD, and move further to more specific topics related to the research question of this thesis. Due to more studies were done on the academic side, the authors limit their research by focusing only on the industry part of cooperation. Appendix A shows a summary table of most relevant literature reviewed in this work and key takeaway from each source.

## 2.1. University-industry cooperation

According to some sources, university-industry cooperation is defined as "all types of direct and indirect, personal and non-personal interactions between higher education institutions and businesses for reciprocal and mutual benefit" (Davey, Baaken, Muros, Meerman, 2011). And in the vast majority of academic literature, the term "collaboration" is used. Ankrah and AL-Tabbaa (2015) refer to "collaboration as the exchange of knowledge and technology between universities and industries." Instead, the authors have deliberately chosen to use the term "cooperation" that was defined by Hord (1986). Cooperation does not necessarily specify shared actions or responsibilities. In the context of this work, it includes all interaction between university and industry.

The first mention of cooperation between the academic world and entrepreneurs' dates back to mid-1800s in Europe and the beginning of 19$^{th}$ Century in the United States (Hall, Link, Scott 2001). Hounshell, Risenberg and Nelson offer further information on the historical background of these relationships. However, lately, this topic has gained wider popularity. There is an increasing demand for cooperation between the academia and the industry due to various pressures exerted on both parties. Ever growing competition, demand for shorter product lifecycles, innovation diffusion and rapid technological changes (Bettis & Hitt, 1995; Wright, Clarysseb, Lockett, & Knockaertd, 2008) are factors that force entrepreneurs to look for new ways of gaining a competitive and comparative advantage.

Battisstella, De Toni, Pillon (2016) refers to university - industry cooperation as the transfer of technology, knowledge and/or know-how. Furthermore, Davey et al. (2011) describe cooperation as eight different ways in which universities and industry can work together. The two specific ones significant to NPD and this research are: (1) cooperation in research and development (R&D) and (2) commercialization of R&D results.

Cooperation in R&D includes research done on individual agreements, consulting for R&D, innovation, networking, publications, cooperation in these projects for students and projects done by students in cooperation with industry, whereas commercialization of R&D results refer to patents, licences and disclosures of inventions.

### 2.1.1. Enterprise's motivation to cooperate

The topic of motivation on university-industry cooperation is less researched. However, in order to understand this cooperation better, it is crucial to be aware of why entrepreneurs choose to or not to cooperate. Studies show that there are several factors that motivate industry and some of them can be directly applied to the process of NPD. Among others, Siegel, Waldman and Link (1999) suggest that primary motive to cooperate is for the financial benefit through the commercialization of technology base in universities. Furthermore, risk reduction, accessibility of knowledge both scientific and technological and possibility to cut costs are motives mentioned by Bonaccorsi and Piccaluga (1994). Companies also look for all means to shorten the time it takes for a new product to be launched. This is especially important for start-ups and high-tech businesses, where its first movers have a significant competitive advantage (Siegel D. et al., 1999). Besides physical and palpable benefits, companies often look to enhance their image and reputation. According to research done by Santoro and Chakrabarti (2000), involving "prominent academic institution" in the process of NPD is a good motivator on its own. Likewise, Ahrweiler, Pyka and Gilbert (2011), who suggest that involvement of universities in R&D processes brings higher credibility and prediction of stability for potential customers.

To conclude, cooperation at its core creates a possibility to achieve far better results. As CEO of Pfizer Inc. Hank McKinnell has stated: "All of us are smarter than any of us" (Business-Higher education forum, n.d.).

### 2.1.2. Benefits of cooperation for enterprises

Examining benefits and diminishing barriers between cooperating parties in the process of NPD has been a challenge for a long time (Jasawalla, Sashittal, 1998). There are several ways industries can benefit from cooperation with universities specific in R&D. Authors have compiled a list of benefits found in Table 1.

| ***Benefits*** | ***Reprehensive studies*** |
|---|---|
| Risk sharing | Valentin (2000) |
| Access to research facilities – laboratories, equipment, reactors | Schofield (2013) & Bower (1993) |
| Specific expertise | |
| Part of a research team (local or international) | |
| Custom and specific personnel training possibilities | |
| Cost sharing benefits | |
| Access to cutting-edge research and technologies | |
| Close proximity to economic resources | |
| Positive impact on the entrepreneur's image | |
| Cross-functional integration | Jasawalla et.al (1998) |

Table 1 – Benefits of cooperation for enterprises

In addition, there are differences in the benefits each party expects from cooperation. Entrepreneurs would most likely choose tangible benefits that bring return faster, research that has a direct effect on results, and the product is very easy to replicate (mass production, cost efficient process). While academics prefer long-term research and options to publicize results openly (Kozlinska, 2012).

Although most of the researches agree on cooperation to be beneficial, there are some studies that reflect negative results. In the research carried out by Jordan and O'Leary, 2007 (cited by Ahrweiler et al. 2011), cooperation between Irish universities and Irish high-tech companies on innovation performance were examined. Research showed that companies perform worse when cooperating with universities rather than when they are on their own. That allowed Jordan and O'Leary to suggest that university-industry cooperation is a lost endeavour. Ahrweiler et al. (2011) were less pessimistic, and their research concluded that university-industry cooperation might lead to a slightly worse performance in innovation, but not significantly.

### 2.1.3. Types of cooperation in R&D

Although research data states a positive and negative cooperation experience, more and more studies have shown such partnerships in a positive light. In the United Kingdom, studies claim industries invest 20 times more when choosing to collaborate, rather than simply licencing technology from universities (Perkmann & Salter, 2012).

According to Davey et al. (2011), collaboration in R&D is considered to be the most frequently used method of cooperation between academia and industry both in Europe and in Latvia, while Estonia and Lithuania seem to focus more on lifelong learning.

It is even more beneficial for a company with its own R&D activities (Cassiman & Veugelers, 2006). However, in order to evaluate the contribution of the external R&D, attention should be paid to overlapping internal and external activities (Cohen & Levinthal, 1989). Failing to do so can lead to an increase in costs, internal losses in knowledge bases and a lower rate of return from collaboration with the university (Soh & Subramanian, 2013).

Also, it's worth to note that expected outcome from cooperation differ based on companies' relative investments in R&D and size of the company. Santoro & Chakrabarti (2001) argue that "smaller firms" put emphasis on technology, rather than knowledge transfer. This is to cut costs and gain access to university's technology base for their core business to foster. On the contrary, "bigger firms" favour knowledge transfer and ways to create their non-core business technology base. This is in line with research by Perkmann et.al (2012), where Shell is mentioned as an example of a company that invests in cooperation with universities in fields where they do not see business yet. In the empirical part of this study, the authors will challenge this argument by comparing cooperation in locally established companies and start-ups.

Apart from the cooperation types, there are several different channels of how university and industry interact in NPD. D'Este & Patel (2007) identify the following: (1) establishing new physical entities; (2) research contracts and advisory work; (3) joint research; (4) training; (5) conferences, meetings etc.

Choosing to cooperate might not bring immediate gains. However, it may indicate a company a path to become sustainable and grow in the long term.

### 2.1.4. Impeding factors

When it comes to factors that foster or impede cooperation, Schofield (2013) argues that there are three broad sets of aspects influencing university–industry cooperation: internal,

environmental and cultural. Looking from the enterprise perspective, most of impeding factors are connected with culture, but also other aspects exist. The authors have combined all impeding factors in Table 2.

| ***Impeding factor*** | ***Reprehensive studies*** |
|---|---|
| Internal, environmental and culture aspects | Schofield (2013) |
| Different mission and vision - curiosity for academics or gaining competitive advantage for entrepreneurs | Link & Tassey (1989), Bruneel (2011) and Perkmann & Walsch (2008) |
| Different time span - entrepreneurs are more short-term oriented while universities – more long-term | |
| Different objectives – results open for public or exclusive for the company | |
| Organizational differences | Battisstella et.al (2016) |
| Cultural differences - applied problem-solving approach or science | |
| Bureaucracy | |
| Different perception of intellectual property rights | |
| Organizational, physical and knowledge base distance | |
| Lack of trust and low intensity of communications | |

Table 2 –Impeding factors

Very often an "ivory tower mentality" from the academic side is identified as the biggest problem. In other words, this means arrogant and superiority attitude over others. And yet, some might consider entrepreneurs arrogant by emphasizing that academics don't have valuable insights. Entrepreneurs themselves stress that afore mentioned insights can only be gained through real world experience and by that understanding - business.

Identifying and knowing about factors that can hinder cooperation is a huge advantage. By identifying barriers, one can develop a strategy to overcome or avoid them in the first place. During the process of NPD, the company can already implement mechanisms to lessen the impact of these barriers. Bruneel, D'Este and Salter (2010) emphasize three mechanisms to do so – use experience, encourage trust and exploit different interaction channels. This helps if a company has previous experience in cooperating with university, but there is always a first time for everything. Besides mentioned, cooperation goes smoother if a proper project management process is in place, meaning mutually agreed goals and deadlines are set, and the process has clear agenda. It is crucial that both parties are truthful and trust each other, as the research process involves a lot of uncertainties and unknowns. It encourages

knowledge and technology transfer to be more beneficial and guarantees that there are no hidden agendas and companies can freely share sensitive information. Different interaction channels offer an opportunity for both parties to meet and interact in any phase of the cooperation. From one perspective, the authors refer to any type of positive interaction – joint researches, informal/formal meetings, conferences. While on the other hand, companies have to be ready for conflicts and communicate with different levels of university management (academics, students, management team). Different types of interactions help to grow from short-term to a sustainable type of relationships (Kogut, 2000). The authors would like to mention a positive experience from Aragon University where a Cinema Forum was created to give the ability for entrepreneurs and academics to meet, discuss and analyse innovation tendencies.

### 2.1.5. Fostering factors

Table 3 lists several factors influencing cooperation and fostering positive results.

| ***Fostering factor*** | ***Reprehensive studies*** |
|---|---|
| Make use of new technology in company's processes<br>Absorptive capacity<br>Previous project experience with university personnel<br>Sufficient resources<br>Approval and support from company's managers<br>Ability to manage change process<br>Effective internal communication<br>Confidence in results | Barbolla & Corredera (2009) and Pertuze (2010) |
| Close location<br>Selection of partners<br>Language | Duan (2010) |

Table 3 –Fostering factors

Belderbos, Carree, Diederen, Lokshin, and Veugelers (2004) underline the importance of company's ability to access new knowledge, especially when provided by the university as a professional insight into scientific development in a specific area. Rõigas, Seppo, Varblane and Mohne (2018) continue by acknowledging that universities are unique partners in terms of their know-how and assets that differ significantly from other participants in the market. And this idea is especially important in terms of NPD as an essential component of the process is dedicated to the development of new ideas.

Cooperation involves more partners than just industry and university. Madu (1989) points out that university-industry cooperation has to be well integrated into a state development strategy in order to be successful. This complements the model where three partners - university, industry and government, are cooperating. It is called Triple Helix Model. In this study, the authors are not discussing the topic of Triple Helix, but this could be an interesting shift for future research to analyse governments, as third players, potential contribution in NPD.

## 2.2. New product development

NPD itself is a very broadly researched topic. One can easily find academic literature from overall process description and best practices to very in-depth and niche cases studies. And it makes sense. Business environments nowadays are much more competitive (Bettis et al., 1995; Wright et al. 2008), and product life cycles are shorter (Griffin, 1997). And new technology becomes absolute more quickly (Bettis et al., 1995), and high product development attrition rates cost a lot of money (Cooper & Edgett, 2009). All of this have accelerated the progress of NPD as a discipline and overall effectiveness of this process.

But it has not always been like this. Almost 60 years ago in the 1960s and 1970, there were serious concerns among managers regarding new product failure rates. According to a study by Booz-Allen and Hamilton (1982), approximately half of NPD initiatives suffered failure. In fact, there was another study (Crawford, 1979), that claimed failure rates as high as 90%. Since then most companies have adapted formal NPD practices (Barczak, Griffin, & Kahn, 2009; Markham & Lee, 2013). In fact, it is no-longer the differentiator to have product development procedure in place. Some have gone even one step further to accommodate processes for new product portfolio management (Barczak et al., 2009).

According to Encyclopaedia of production engineering (Laperrière & Reinhart, 2014, p.918), NPD is "the creation of products with new or different characteristics that offer new or additional benefits to the customer. NPD may involve modification of an existing product or its presentation or formulation of an entirely new product that satisfies newly defined customer want or market niche".

In the following chapter, the authors of this work will take a look and describe the evaluation of most popular and broadly used NPD models.

### 2.2.1. New product development models

NPD as a discipline has a more than 50-year history. The phrase "Product development process" was first mentioned in 1966 edition of Industrial Research journal. In the article titled "New-Product Development: Get the whole company into the act" authors discuss a study conducted by Booz, Allen & Hamilton Inc. on product development process. His main conclusion is "every step in the entire process of new-product evolution must be carefully planned. It is the total process of product evolution, rather than just R&D, on which management is focusing." (Sherman, 1966, p.42). Later in the article, he proposes a simple six-stage process that companies can use in their product development. The proposed steps were idea exploration, screening, business analysis, technical product development, laboratory, field and consumer testing, and commercialization. In addition to these steps, the authors also define a sequence of management go/no-go decisions after each step. The project can be stopped and eliminated at each of those inter-stage gates if management sees it's unlikely to be successful or profitable (Booz et al. 1968).

In parallel to work by Booz, Allen and Hamilton, NPD as a formal process was developed and introduced by The National Aeronautics and Space Administration (NASA). It was called Phased Project Planning (PPP) or Phased Review Process (PRP) in some literature (Figure 1). NASA used this method for internal space projects as well as imposed it for some of its contractors and suppliers. Later on, PPP was adapted for US military and this lead to a number of manufacturing businesses using it. The PPP broke NPD into five well-defined stages: Preliminary analysis, Definition, Design, Development, Operations. Each stage was followed by review point with certain criteria which had to be fulfilled in order for the project to transition to next stage (Di Biase, 2015).

Initially, this control method was designed to make sure that certain formal prerequisites were met rather than to assure the quality of the output itself (NASA, 1968). Another limitation of PPP was that the process was strictly limited to physical design and development and was engineering centric. No other organizational functions, like sales, marketing or finance were included (Cooper, 1994). Other than that, it brought a form and discipline to otherwise disorderly activity and ensured completion of tasks. In academic literature, the model was referred as the *first-generation scheme*.

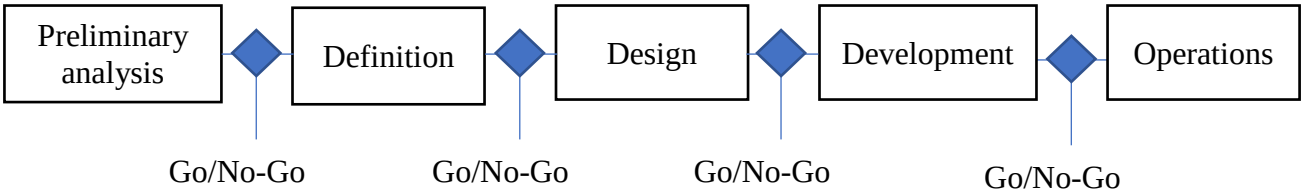


Figure 1 – First generation scheme

The second-generation model was inevitable evolution of PPP process. It was developed by scholar Robert G. Cooper, and it was called the Stage-Gate process (Figure 2). The same as PPP, this model also consisted of series of well-defined stages, where each stage finished with review meeting. This formal appraisal was called stage gate. Unlike the first model, Stage-Gate was very much cross-functional. None of the stages was executed only by engineering, sales, manufacturing or marketing and all of these functions were now an integral part of the model. The decision of gates also involved cross-functional management team. Another improvement was a bigger emphasis on work that happens prior development, which now had two dedicated stages – Preliminary investigation and Business case building (Cooper, 1976). But looking back from today's perspective, it still had a room for improvements. Development projects had to wait at the end of each stage till all stage specific tasks were finished before it was submitted to gate review. This also meant that working on two stages in parallel were all but impossible (Cooper, 1994).

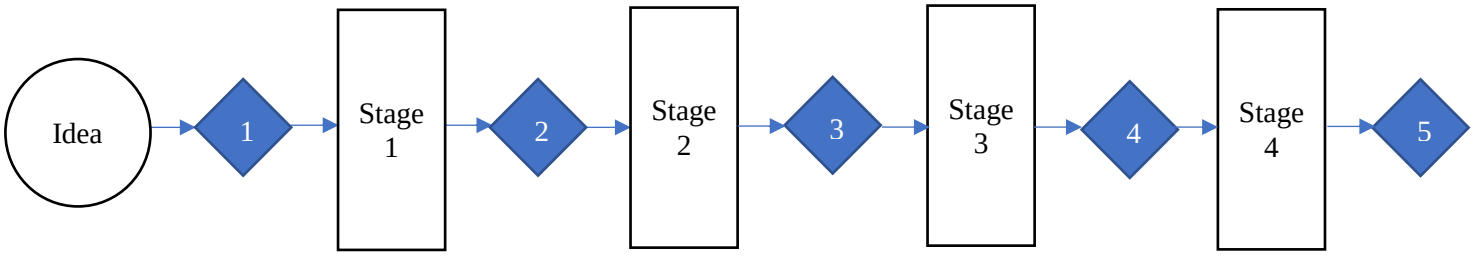


Figure 2 – 2nd generation Stage-Gate model generation

Over the next years, Cooper continued to research and develop his model further, to address main deficiencies. In 1994 his work culminated in the third generation Stage-Gate model (Figure 3). The main advancements in the new model were improvements in process efficiency, fluidity and flexibility. Now the process stages overlapped and were more fluid. Gates had preconditioned Go function that depended on the situation, so in some cases, waiting for management approval was not necessary. It also included less rigid process flow

that could accommodate a broader spectrum of different product and service development (Cooper, 1994).

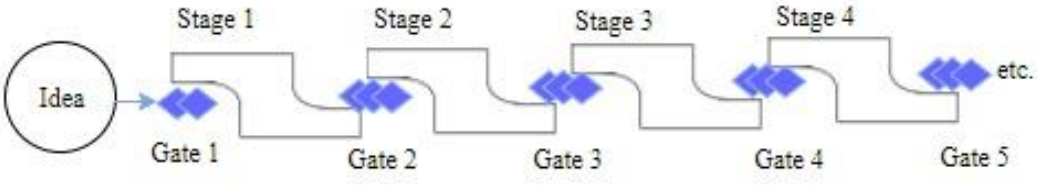


Figure 3 – 3nd generation Stage-Gate model with stage overlap

Even though Stage-Gate model is still the most popular NPD process, there is continuous effort to improve it or build something different or more suitable for specific industry or product type. Researchers kept investigating NPD to understand the aspect and steps that are associated with the positive turnout (Griffin, Price, Vojak, & Hoffman, 2014).

In general, Stage Gate model is best for linear project with little or no iterations and incremental additions in next stages. For example, large scale engineering projects with lots of prior research and data available. In contrast, there are discovery or radical innovation projects that have very "fuzzy front end", limited prior knowledge and data (Di Biase, 2015). Researchers (Jin, 2000) have proven that companies will probably use less linear process when working on radically new products. The process they use in early stages of product development is more repetitive and based on many iterations of trial and error.

As shown in Figure 3, the Stage-Gate process focuses on product development process after the initial idea has been generated. For incremental product evolution, idea generation might be simple, compared to something that is new and radical. Smith & Reinertsen (1991) in their research stresses out the necessity for stage zero for preliminary opportunity identification when a company strives for a potential breakthrough with their new product.

The relevance of Fuzzy front end (FFE) sometimes also called "front end of innovation", "stage zero", "discovery stage", or "pre-development stage" was recognized by Cooper and Kleinscmidt (1987). They referred to FFE rather chaotic actions of brainstorming and idea generation at the very beginning of product development process. Later their definition was improved, and nowadays FFE refers to the first phase of NPD process (Van Oorschot, Eling, & Langerak, 2017). It starts with the discovery of idea or opportunity for

new product and ends when organization approves of NPD and project gets more significant resources assigned (Eling, Griffin, & Langerak, 2014).

### 2.2.2. Stages of new product development

Even though there are different NPD models, most popular ones have a Stage-Gate philosophy behind them. And some of them have FFE as dedicated zero stage for more radical innovation. In this chapter, the authors will discuss different stages of Stage-Gate type NPD model.

Product development starts with **FFE**. This stage consists, but is not limited to problem or opportunity realization, analysis, screening, concept development and evaluation, testing and requirement definition (Reid & de Brentani, 2004). Because of high uncertainty, this phase can consume up to 50% of development project time with no guaranteed outcome and highest attrition rate among other phases (Smith & Reinertsen, 1991).

The next stage after FFE is called **Scoping**, Preliminary Investigation or Concept development. In this stage, the project development team is still very small and mainly consists of engineers, product manager and marketing personnel. They asses project business and technical viability based on desk research, and this phase is still reasonably inexpensive (Di Biase, 2015 & Cooper, 2014)

After scoping comes **Building the business case**. The main objective of this stage is product evaluation and justification. In this step, the project is vetted in greater detail. This might even involve primary research, like market study. The outcome of this phase is a project business case including product definition and detailed project plan for next stages (Di Biase, 2015).

The next stage is **Development**. It is at this stage where the plans of Building the business case gets executed. It usually starts with a low-level design of the product. Then first prototype or product sample is made, and some initial testing done. The outcome of this stage is a laboratory tested product. In parallel requirements for manufacturing, and/or product maintenance are drafted. Closer to the end of this phase, marketing starts working with launch plan (Di Biase, 2015 & Cooper, 2014).

The fifth stage of the NPD process is **Testing and Validation**. This includes tests like internal tests, field trials, customer trials, pilot projects and others. Apart from the product itself, also manufacturing process and supply chain can also be tested. The output of this stage is a fully tested product and a process that is ready for market launch and commercialization (Di Biase, 2015).

And finally, the last step of NPD is **Product Launch** or Commercialization. This stage marks the beginning of product full scale manufacturing, marketing and selling. All activities are executed according to marketing launch plan. This stage also includes product post launch monitoring and adjustments.

Before each stage, there is a formal review point or entry **Gate**. The effectives of the gates are one of the key aspects of process success. These gates serve as:

- quality control, to make sure project is on right track and deliverables according to what is expected;
- go/no-go decision points, where management and team has a formal tool to send for rework or kill unsuccessful projects;
- and place where plans for next stages get reviewed and discussed (Cooper, 2014).

In summary, most companies nowadays have implemented some formal NPD process as it increases their chances to succeed with development project. The mostly used development models are linear in progression and might have a Fuzzy front end for more radical innovations as the idea generation staged prior formal project gets accepted by organization.

## 2.3. Cooperation types and dimensions in new product development

To benefit from NPD cooperation and companies, need to understand how universities can help them improve NPD. Based on previous key research (Appendix A), the authors of this work have developed a comprehensive framework to map all NPD stages with types of university cooperation available. The authors consider it to be a valuable contribution to existing research.

| FFE | Scoping | Building Business case | Development | Testing and Validation | Product Launch | Gates |
|---|---|---|---|---|---|---|
| Collaboration on research | Data for feasibility study | Technical feasibility study | Prototyping and component engineering | Laboratory and field testing | Project review/lessons learned/best practices development | Help with review and decision making |
| Idea generation | Supply of publications and conference material | Market research | Laboratory and equipment supply | Pilot project facilitation | | Work on review criteria |
| Facilitation of workshops and brainstorming sessions | Demonstration and research of available technologies | Product strategy | Quality assurance | | | |
| | Investigation IP use | Design concept for product | Technology and/or material selection | | | |
| | Collection of available market data | | Workforce training | | | |
| | Identification competitive products | | | | | |
| | Preliminary business and market assessment | | | | | |
| | Strategic alignment | | | | | |
| Assignation of professors/ researchers/ students for project team | | | | | | |
| Phase/project management | | | | | | |

Table 4–NPD stages and cooperation type framework

In this framework, the authors provide novel insights into the field of collaboration. The framework (Table 4) comprises the process of NPD detailed in stages, and it is complemented with potential offers of opportunities on cooperation that universities may offer to the company. Each stage is developed as an integral part of the process and examined individually. It serves as a practical tool for companies who either plan or already are cooperating with universities in NPD.

In addition to the literature review, the authors have done series of interviews to understand if it is applicable in local context.

To conclude, this framework is a unique way to get insight into cooperation eco-system within universities and companies. It reveals the process, possible cooperation directions and series of factors to acknowledge for a positive outcome.

## 2.4. Latvian context

Before doing practical interviews, the authors explored literature on university–industry cooperation in Latvia.

Since the early 1990s when the Soviet Union and the planned economy collapsed, Latvia on the policy level has chosen to pursue the path of economic growth and development. The country has joined European Union, introduced Euro and was accepted in Organisation for economic Co-operation and Development (OECD). Unfortunately, to this day Latvia still lags

behind and has Gross domestic product (GDP) below European Union average (World Bank Group, n.d.).

It is well known that innovation and research in NPD lead to increased productivity and is the key factor in economic growth (Akcali & Sismanoglu, 2015), and therefore, it should be the top priority for a country wanting to achieve prosperity and welfare. One way to achieve better results in R&D is to foster collaboration between universities and industries (Schofield, 2013). Latvia has acknowledged both things – leading role of innovation and R&D in its economy as a primary driver of growth and need for universities and industries to engage in close collaboration. One of the main objectives in the hierarchically highest planning document "Sustainable Development Strategy of Latvia until 2030" is "to become one of the leaders of the European Union (EU) in terms of distribution of innovative and exportable enterprises." The same strategy document also acknowledges knowledge and research role in the modern economy and encourages "Educational and research institutions should create and maintain platforms, with the aid of which knowledge would become available to Latvian enterprises." (Ministry of Environmental Protection and Regional Development, 2010, p.40-42)

In following chapters, the authors will explore international and local sources to evaluate whether the government's strategy is in line with reality.

### 2.4.1. International literature on the university-industry cooperation in Latvia

To date, international-level empirical research devoted to the Latvian context has been very scarce. While there are some relevant data in international reports (e.g. Davey et al. 2011), academic papers on university-industry collaboration in Latvia, to the best of the authors' knowledge, are absent.

Most of the international reports (European Commission (EC), 2016 and 2008) states almost no increase in R&D intensity as one of the top challenges facing university- industry collaboration. The confirmation for weak collaboration and knowledge transfer can be found in statistics. Private companies have very small research budgets (less than 0.05% from GDP). Latvia is among the last in number of university-industry co-publications (almost five times less then European Union average adjusted by population) and has an insignificant number of professors employed in industry (EC, 2016). Lack of initiative to collaborate from university standpoint can be explained by the very few incentives to commercialize their research. Almost all public universities are financed by the government, and the yearly

budget has been allocated as a lump sum. This system does not incentivize or steer university research towards solving industry or commercial problems (EC, 2008). Similar results were published in recent research paper comparing university-industry collaboration in Europe, where Latvia has been placed in the country group with the weakest cooperation (Seppo, Rõigas & Varblane, 2014). The authors of the mentioned paper state that Latvia has very low results in all indicators from the viewpoint of both industry and university. This report, however, contradicts the opinion of academia. In 2010 and 2011, Europe-wide survey was carried out (Davey et al., 2011) to find out academia and higher education institution self-evaluation of university-industry collaboration. According to data provided, Latvia is among top countries in Europe to engage in industry R&D project, meaning shared R&D activities, consulting, contract research, collaboration in innovation and similar activities. Also, when asked to what extent academics are cooperating with industry, results were above average in Europe.

EC report (2008) on public and private sector cooperation also mention some positive initiatives, both on policy and practical level. Government and businesses have invested in incubators, technology parks and several policy measures target incentivising co-founded research. Public universities and Investment and development agency of Latvia organize seminars and workshops to establish university–industry dialog.

Unfortunately, that is not enough, as according to European Innovation Scoreboard (2017) and Global Innovation Index (2017), Latvia is a moderate innovator with performance below EU average. Even though performance since 2010 has experienced slight improvement by 8.5%, private sector R&D budgets are the second in Europe.

### 2.4.2. Local sources on the current situation

On the policy level, a partnership from university side is governed by Ministry of Education and Science and by Ministry of Economics from the industry side. Both ministries acknowledge the importance of the subject and have developed Guidelines for science, technology development and innovation year 2014 – 2020 (Cabinet of Ministers, 2013). These guidelines highlight state strategy and goals for university–industry collaboration. The document acknowledges the fact that weak links between science institutions, university and industry significantly limits adaptation and implementation of new technologies, innovative solutions and NPD. Although recently there has been various initiatives and actions to develop competence centers, technology transfer points and clusters (e.g. LETA, 2017,

Ventspils City Council, n.d.), it is important to ensure their long-term existence and development. Memorandum (Cabinet of Ministers, 2013) also mentions main problems of university-industry collaboration and innovation commercialization, like reduced funding for scientific institutions to implement market-oriented research, limited motivation to provide services to the private sector. This claim can be confirmed by OECD statistics (OECD, 2016) on public funding attracted by universities and research institutions. In 2012, it was only 8.5% of all university funding. This number is among lowest in EU. Unfortunately, low interest in innovation from the business side does not help either. Latvian companies have mostly benefited from competitive advantages based on lower labor costs rather than innovation. According to EC data (EC, 2016) between 2008 and 2010 on average, only 29.9% of Latvian enterprises were innovative, whereas this indicator is 52.9% on average in the European Union.

Furthermore, data from the Central Statistic Bureau of Latvia (CSB) (CSB, 2017) published in 2017 confirms low investments in R&D. For 2014 to 2015 Latvia's R&D expenditure shrunk by 0.06% respective to countries GDP constituting 0.62% in total. It has remained lowest in European Union, only outperforming Cyprus and Romania. Unfortunately, R&D intensity has been low for a long time and that does not give credibility to targets government has set for itself. Latvia plans to achieve a domestic R&D intensity goal of 1.5 % until 2020 and of 3 % until 2030 (CSB, 2017).

In 2017, results from "Study of alternatives to the study process and industry cooperation promotion activities" were published (Dubicskis, Eliņa, Gaile-Sarkane, Gūte, Ozoliņš, Paule, Rubina, Straujuma, Ščeulovs, Zeps, 2017). The aim of this study was to promote university-industry collaboration by analyzing publicly available information and best engagement practices from Latvia and abroad. Among other findings, it concludes that businesses can be divided into two broad categories - those who are willing to cooperate with universities and those who are not ready and do not plan to engage in any type of cooperation. It also suggests that more in-depth research should be done to find out the motivation for this phenomenon. However, a study has collected most popular barriers including complex cooperation process and high bureaucracy, low motivation and lack of time from academic staff, uncertainty and disputes about intellectual property, and lack of positive experiences. Similar results with explanation have been noted by multiple high level academic staff in Innovation magazine (Vaivare, 2017). For example, professors have limited time, as they are involved in fundamental research projects. Or cooperation with industry is not a top priority for academic staff as it is not an additional criterion when applying for the elected positions in university.

Comparatively, industry representatives have named different planning horizons and agility (business is expecting fast results, but researchers are working slower) and that there is no simple way for the industry to meet scientists and universities among top barriers (Vaivare, 2017). Others also mention that universities need to educate academic staff about life outside their laboratories and real-world business applications of their innovation. There have been cases when technology is designed without market knowledge, and therefore it's too pricey, not suitable for commercialization or impossible to manufacture in certain quantities (Vaivare, 2017).

The authors believe that university–industry collaboration is accurately described by Modris Ozolins, Director of RTU MBA program. He states that understanding of cooperation and forms of cooperation in Latvia are very diverse. One of the most widely recognized forms of cooperation are internships, but the best example is the joint action of scientists and companies in solving problems. Unfortunately, this is the least popular one (Vaivare, 2017).

# 3. Methodology

There are many studies carried out regarding general knowledge of university–industry cooperation, and yet small amount has looked into separate ways of this cooperation and even scarce are those that are country specific - Latvia. Due to limited research done to explore R&D as a way of cooperation and more closely – NPD, in Latvia, the authors have decided to choose a qualitative method – case study. A case study is a way to explore the topic of the research within a real-life context. The authors have chosen to state the question of this research by asking "why?", where Saunders, Lewis and Thornhill (2012) have noted that case study has the ability to report back sophisticated data.

According to Yin (2014), this research, case study prevails over other methods due to certain limitations – necessity to explore and not restrict research with nor limited variables (as in survey strategy) nor put any restrictions towards contextual variables as they might put credibility of the research in question (as in experimental approach). Apart from limitations, Eisenhardt and Graebner (2007) argue that case study offers deep insight into the context of the research.

The authors have chosen to do a comparative research. According to Bryman, Bell (2015) comparative research is valuable in cases of choosing to compare two or more similar phenomena where it is assumed that some similarities might emerge. The authors have chosen to compare two types of companies by exploring established companies and start-ups

separately, and within this selection, criterion compares one company with the other. Due to different size, knowledge and technology base, companies might choose different strategies for NPD. In order to get more sophisticated results, the authors set these two types of companies apart and approach them individually.

As this is exploratory research, acquired multiple case strategy enables to express valid conclusions on lessons learnt and give vision on the possible future to construct. These lessons learnt should be easy to replicate across similar cases.

### 3.1. Sample of enterprises

Replicability of specific research is often one of the strongest concerns of the researchers when applying one method or the other in country's specific case studies. The authors approach this concern by exploring cases (companies) within certain eco-system. By choosing a certain approach that could be replicated across time, the authors have chosen a purposefully done sampling as the method to explore university–industry cooperation in Latvia. The main strength of this sampling method is the ability to explore "information rich cases in depth" according to Patton (1990, p.169).

According to research done by Rõigas et al. (2018), one of the factors that contribute to the hypothesis that company is more prone to cooperate with the university is if the company is being innovative. It is somewhat hard to define the innovativeness of the company if the company is not openly spreading this information, and yet this is one of the ways to recognize such entrepreneurs. Minister for Economics of the Republic of Latvia, as cited by Vaivare (2017), states that the State will provide help to those who invest in new technologies, create innovative products, train employees and export. Furthermore, he concludes that companies that do qualify for aforementioned criteria most probably are those who cooperate with Latvian researchers.

As there is no specific register for companies that cooperate with universities, the authors have chosen to pursue rationale expressed by the Minster for Economics of Latvia and conclusions of research by Rõigas et al. (2018) – to look for those "information rich cases" that are innovative and export capable. The authors identified two different sets of award lists that enclose two different types of companies. For established companies' the authors chose Investment and development agency of Latvia in cooperation with Ministry of Economics organised annual Export and Innovation award list with participants enlisted for the 2$^{nd}$ round for the years 2017, 2016 and 2015 (Investment and development agency of

Latvia, 2017, 2016, 2015). Altogether, 83 companies were chosen for sampling. Given the assumption that there might be fewer companies in that list who cooperate with universities than those who do not, the authors chose to include not only award winners but all the companies that were enlisted for evaluation. For start-ups, the authors chose Latvian Start-up brand award (DDB Hub, 2018), where one of the criteria evaluated is start-ups performance in being innovative. This award for start-up companies is new, and 2017 was the first year to assign nominations. All the list of 47 companies were chosen for sampling.

Both lists (established companies and start-ups) were randomized separately, and each company was assigned a specific number that was the order in which the authors addressed each company. Randomization was made to mix export capable and innovative award nominees together. For start-ups, the authors used the identical method to follow the same methodology. Companies were approached by email, in case of no response, the authors called to the available info telephone. If no response persisted, the authors approached the next company on the list. The target was to identify those who cooperate with universities. For established companies – 5 and for start-ups – 3. By doing this, the authors also interviewed those companies that did not cooperate. Respectfully, established companies – 3 and for start-ups – 2. All together 130 companies were approached, and 16 companies were chosen for an in-depth case study. The only criterion for companies to be chosen for an interview was that a company must have or is developing a new product. In the interview no.12, the authors acknowledged that interviewee gave similar answers to previous interviewees. In the interview no.13, the authors realised that the saturation point is achieved, and answers start to duplicate. As the interview questions where the same in all interviews, it was quite simple to allocate the precise moment when saturation point was reached. Bernard (2012) argues that in order to reinforce data saturation, the interviewer should encompass interviewees that "one would not normally consider" (as cited in Fusch and Ness, 2015, pp 1410). Furthermore, he warns about "shaman effect" where data biases may appear in cases of one using specific information on the particular subject with or without a specific intention to do so. The authors point out that companies for interviews were chosen by randomization. The only common factor to all companies are fulfilled criterion for award nominations that are neither specific nor absolute. To further elaborate on the matter, the authors refer to Saunders (2012) as cited in Saunders et al., 2012, pp 283, who mentions the critical mass of interviews undertaken to reach the sufficient sample size. In case of semi-structured in-depth interviews, the number is mentioned in 5-25 interviews. However, Guest et al. (2006) state

that in case of a fairly homogenous group, 12 in-depth interviews would be sufficient (as cited in Saunders et al., 2012, pp 283) to reach the point of data saturation.

Apart from interviews on NPD in particular company, the authors asked every company that reported back on cooperating or not with any university, what type of cooperation with the university they have. By doing this, the authors cross-checked what the most common type of cooperation is, based on the newer evidence. Is it cooperation in R&D as mentioned in research done by Davey et al. (2011), or is it any other of the 7 types of cooperation?

## 3.2. Data collection

Data was collected by qualitative means using semi-structured in-depth interviews. Interviews were carried out during February and March, 2018. The interview covered a number of semi-structured questions that helped to explore research question in detail. Authors started with more general questions on NPD and university-industry cooperation and later transitioned to more in-depth questions combining two literature streams. See Appendix B with interview questions. Questions were organized as a guideline for interviewers (the authors), and more details on the certain topic were discussed if situation requested. Interviews are organized with the person responsible for NPD; in most of the cases, it was the founder, CEO and/or head of R&D department. Interview questions were made to identify how companies cooperate with universities, do they cooperate in NPD, what are the main benefits from this cooperation and what a person would identify as factors to impede or foster this cooperation.

All in all, the data was collected from 16 face to face and telephone interviews with 17 people. As an exception, few times written answers for questions were sent in before an interview took place to make interview time as short as possible, and it is focused on unclear issues. Whenever possible, interviews were recorded and afterward transcripts were created, in some cases, the authors made notes and transformed the answers afterward into transcripts. The authors guaranteed anonymity for all persons and companies participating in this research.

## 3.3. Content analysis using NVivo

For content analysis, the authors used a software – NVivo, which helps to structure and analyze qualitative data collected during interviews. The authors used NVivo coding

possibilities to extract information from interview transcripts and organise it into nodes. It allows the researcher to gather all relevant information and identify rising patterns and themes. Until this stage, the authors did individual coding, and later on, they used the NVivo software to compare the coding.

In the last step in the process of structuring data, the authors aggregated all material and individual analysis in aggregated dimensions (Gioia, Corley & Hamilton, 2012), and four distinctive dimensions emerged.

NVivo offers an option to use matrix coding queries to analyze data by sorting and filtering, making parallels and looking for correlations in the data at hand. This part of the research was done individually by each author, and afterward, results were combined. Similarities and patterns emerged and are fully explored in further chapters of this work. Considering that the authors have a specific target to reach, there was a specific approach laid out to achieve it.

# 4. Results and discussion

The initial objective of this study was to identify the extent of cooperation for every single stage of NPD. However, during the research process and the 16 interviews conducted, the authors were not able to find a fully integrated university– industry cooperation in NPD. Therefore, the discussion part of this study is mostly focused on aspects affecting the whole process, rather than individual NPD stages.

In the following chapters, the authors have discussed the extent of university- industry cooperation in Latvia; the main implications of successful and failed partnerships as well as the means to improve this cooperation.

## 4.1. Cooperation in different NPD stages

During the literature review the authors of this work mapped NPD stages with the types of cooperation universities can offer at each stage (Chapter 2.3./Table 4). For every stage, several cooperation options were identified. Every interviewee was asked to point out all NPD stages and activities they do together or outsource to academia. This approach helped the authors to cross-reference their model framework with real life situations and the extent to which Latvian enterprise cooperate with universities.

All of the companies interviewed were engaged in NPD, and almost all of them had implemented a procedure for this activity. Some had a well-defined written process with

strict documentation and deliverables, whereas others (mostly smaller companies and start-ups) had a more flexible approach. Even though the authors do not have statistical data for Latvia available, we see that a stage-gate type of process with some alterations is the most popular locally. And it makes sense, as it is a comprehensive product development model with logical progression steps and review points between them.

As already mentioned, none of the respondents had or were planning to fully integrate their NPD with a university. Quite the contrary, most of them were not hiding the fact that they use a university to outsource certain well-defined tasks, where they themselves or other market players do not have the right knowledge or tools. This observation contrasts with the European Commission (2016) report indicating weak cooperation in R&D projects here in Latvia. The authors will elaborate on this in their discussion of fostering and impeding factors.

Regarding the separate steps of NPD, the **Development stage** was the most mentioned. The authors registered 18 activities of cooperation during this stage. Some of them were continuous partnerships, but most of them were one-offs, like 3D prototype printing in a university's Design laboratory or equipment rental for product samples.

According to the literature review, the Development stage is one of the most expensive and time consuming of all the stages in the NPD process. Cooperation in this stage makes perfect sense *as access to the university technological base* and *cost optimization* are two most important cooperation gains named by industry. Within the Development stage, Prototyping and component engineering activities were highest in demand. Almost all of our respondents who cooperate with a university have used this service at least once. Most of the respondents recognized a university's extensive and expensive infrastructure, laboratories and tools. Some companies use it for separate projects, while others rely heavily on university infrastructure. This gives them not only access to state of the art tools but potentially also researcher and laboratory worker insights.

The next most popular stages for cooperation activities are **Building business case** and **Scoping.** The authors counted nine activities where local enterprises cooperate with a university in the Building business case stage and eight activities for Scoping. Neither of them requires extensive spending but rely on knowledge gathering and synthesis. In most cases respondents indicated that almost all activities in both stages are done in-house, but then there are cases where they are missing some specific competence that can be outsourced from a university. Companies that manufacture physical products are mostly interested in technology or material research, but there was one case when a company ordered market

research from the business school. According to other respondents, marketing or business plan writing in cooperation with a university is not popular because such tasks usually get handed over to students and the results are of average quality and rarely satisfactory. This opinion also coincides with the point made by companies who do not cooperate with a university. They keep early-stage NPD in-house or utilize other specialized and more experienced business entities.

Besides the already mentioned stages, cooperation in **FFE** and **Testing and Validation** is moderately frequent and mostly used by established companies. The authors did not find any relevant conclusions to discuss about those two stages, as most of the examples were one-offs for single product development.

The least popular stages for collaboration are **Product launch**, where the authors of this research did not come across any examples of cooperation and **Review gates** with only three activities for all 16 companies interviewed. Most of the entrepreneurs say that launching a product is their specialty, as they know the market and potential customers better. Others do not see the added value of how universities could help them with their product launch. However, the authors of this research believe that there might be some cases where a university could help in product transitioning from development to manufacturing and market. In relation to Review gates there were two different opinions as to why universities are not involved. Firstly, companies want to maintain control over the NPD process and therefore gates where most of the decisions are made. And, secondly, simply because there is not a formal process step such as gates. Only two companies have brought a university on board in their formal NPD review process. However, here the authors have to mention that the university participates in the product idea assessment review process rather than in every review gate meeting. They feel that early stage independent scientific opinion could help them make better decisions and adds value to the whole process.

To summarize, the extent of cooperation differs from company to company. There are companies who have integrated small parts of their NPD with a university and cooperate regularly, and then there are others who only outsource one function or a strictly defined task. During this research the authors learned that most companies belong to the later part of spectrum and still do not employ even a tiny portion of the NPD services offered by a university.

A summary of all cooperation cases for each company can be found in Appendix C.

## 4.2. What Makes Cooperation Successful and What Makes It Fail

To find out why companies in Latvia only employ small part of NPD services offered by a university, the authors made an effort to discover fostering and impeding factors as seen from an enterprise perspective.

So why is a university not the preferred partner for most companies? There are many reasons that hinder cooperation, and which were mentioned during interviews. Among others the most often used **impeding factors** were the ones mentioned in the literature review, such as *different vision and perception* of cooperation, as university researchers tend to "dig too deep" while most entrepreneurs are satisfied with the simplest solution to the problem. This is also related to *project duration* as entrepreneurs seek fast results whereas universities favour long-term research. Other pushbacks for industry are *organisational* and *cultural differences*. Interviewed companies mention practical things like response time to e-mails, quality of documents submitted, and even "ivory-tower mentality" or over-confidence. Almost half of the companies who cooperate have mentioned that *universities in Latvia are far from the everyday practical problems of industry*. One example given is that the number of patents a university owns, and the fact that the vast majority of them cannot be used or implemented. Another explanation of this might be the low numbers of professors employed in local businesses (EC, 2016). An additional reason was mentioned by the Chief Technology Officer (CTO) of a manufacturing company. He said it is hard to get your research sponsored by the State unless fundamental science is mentioned in the description of the project. As an alternative, he refers to Norway where industry-specific problems are treated equally when State funds are assigned. Besides mentioned *high bureaucracy* and *contrasting viewpoint regarding intellectual property rights* often drive entrepreneurs away from cooperation.

One new impeding factor not revealed by the literature review is a great concern regarding the quality of student work. A CEO of an interviewed company explains that he was looking for "those bright, fluffy and big creative ideas" when he first started to work with students, but so far, the cooperation has not been fruitful. And this is not the only example. Entrepreneurs admit, that in several instances cooperation with students was a waste of time and resources; however, the authors also found one positive example. It can be speculated that this might be industry-specific as the successful case only involved cooperation in product design development.

At the same time, entrepreneurs see many ways how to promote cooperation in NPD. **Fostering factors,** like *ability to integrate results into manufacturing process, effective*

*communication* and, *aligned goal orientation* were amongst the top ones. Another important aspect mentioned is *University brand*. If a prominent academic institution helps to promote a product it gives it extra credibility. This also includes academics titles like "product tested by PhD researcher" which were relevant in some cases. One company exporting to the USA said that cooperation with a university in the target country has been a door opener in many cases. Another one has a lead researcher signature on every single product, to clearly state connection with the university. Some other factors are *flexibility and ability to change* scope during NPD process. The last one turned out to be especially important for Latvian start-ups. Two other aspects high on the list are *personal relationships* with the research team as an invaluable contributor to cooperation and *reduced bureaucratic barriers*. All of these factors correlate with what the authors have found in previous research.

As a unique contribution to the existing knowledge base, the authors of this research identified the following fostering factors. First, the existence of the so-called *"agent system"* as an advantage. "Agent system" is used in many European countries and it implies that there is an intermediary between a university and an entrepreneur that is managing the whole process of cooperation. Many of the responders call this a professional project manager, who could look after the scientist work, answer enquiries and generate reports. Together with the agent system, entrepreneurs mentioned the existence of technology transfer centres as a fostering factor. Apart from two established companies, no one else seemed to know anything about TTOs, even though these offices are contact points for university business cooperation in Latvia. This is in line with other aspects mentioned - *easy access of information on university products and services available to industry*. For university-business cooperation to foster, it is essential to have as much information on the subject as possible. Good cooperation examples, published case, seminars and workshops on the subject would only increase the interest. Another factor universities should adapt is *business-oriented mind-set*. Nearly every entrepreneur mentioned this in one way or the other, to foster future cooperation. A university should embrace business to business cooperation strategy and become an active market player. And last but not least, *similar level of knowledge* on both sides is helpful as researchers understand each other in more R&D intensive projects.

All of the impeding and fostering factors mentioned by entrepreneurs during interviews can be found in Appendix D.

Separate from the entrepreneurs who cooperate with universities in NPD, there were ones who hesitated. The authors interviewed five entrepreneurs - two start-ups and three established companies. All answers can be categorized in three main groups. The most

popular opinion is the 'all by ourselves' mentality, where companies have succeeded in securing all the key resources for their NPD process. This mostly applies for companies that regularly update and release new products. They see R&D as their core competence and keep it in-house. The second group has the opinion that a university has nothing to offer them. The authors discovered two such companies working in niche and innovative markets. Both of them have developed a strong research and analytics team on their own. And the third group have a strong belief that the culture differences are so vast there is no way cooperation could work. For example, a CEO of start-up mentioned: "*We measure time in minutes, universities in weeks or even months. Start-up problem solving experience differs from that in university. We often change course, scope and sometimes problem does not need to be solved to the slightest detail. Academics like to perform fundamental research and are not happy when problems are redefined during process.*"

For further analyses of these factors, the authors chose to perform systematic approach proposed by Gioia et.al (2012). From the information gathered during interviews both authors made an individual attempt to identify 1st order concepts. All concepts were categorised under – fostering factors, impeding factors and the means to overcome them. Further, all concepts were categorized into 2nd order themes. Most of the 2nd order themes coincided with factors from the literature review, but there were some unique to Latvia as well. Then, themes were grouped into aggregated dimensions. The first dimension was named **culture.** It includes things like different perceptions on how to communicate, lack of trust and flexibility. The second dimension was named **management**. This includes considerations around the management of cooperation process. In spite of the similarities with some aspects, the authors perceive culture as a feel or a mind-set, yet management, on the other hand, implies for an action and ability to change the course of the process itself. The third dimension emerged when the authors looked at the NPD process as a whole. Cooperation continues with process management in order to reach an end, in this case a **common goal**. The authors also elaborate on a broader perspective that defining and reaching goals is an essential part of successful cooperation.

Apart from these three groups, there were a couple of concepts that did not fit into any of the dimensions mentioned above. Those were the issues mentioned regarding financial concerns and use of intellectual property rights. These are "must have" elements to consider before cooperation even starts. Without them, none of the other factors or any means of overcoming barriers have any value to the entrepreneur. Therefore, the fourth dimension is called **must have.**

Detailed comments from interviews and concept distribution in dimensions can be found in Appendix E.

Even though the literature review reveals several examples of mitigating action, a study of Latvian enterprise suggests others amongst the top priorities. To simplify, the authors will use four dimensions to set a path for transition from impeding towards fostering factors.

To improve cooperation **culture** there were multiple suggestions to create a cooperation friendly eco-system with cross-university collaboration, science parks and incubators. This would also foster university–industry relationship building.

To improve **management** of NPD, companies would welcome increased process efficiency and encourage the development of different channels of interaction. Another important aspect of better cooperation in project management would be a university's ability to focus on more applied practical problem solving.

Much would be solved in **common goal** dimension if universities would have a clear understanding of a project business case. This might be a situation where both parties could easily work together to improve on existing obstacles.

And lastly, ownership rights of the end product have to be agreed – as most universities want to keep IP rights for products or ideas generated in NPD, this would solve the most pressing issue for **must have** factor dimension.

These are just the top priorities from a local industry perspective. A list of all the factors mentioned can be found in Appendix E.

### 4.3. Framework to Improve Cooperation in NPD

In order to better understand what affects university-industry cooperation in NPD and what factors define its course, the authors have developed the model (Fig.4) that derives from the literature review on university industry cooperation, new product development stages and interviews completed with Latvia based entrepreneurs. The model has all the NPD stages and is supplemented with specific types of cooperation that Latvian entrepreneurs mentioned in their interviews, as well as the fostering and impeding factors aggregated in dimensions.

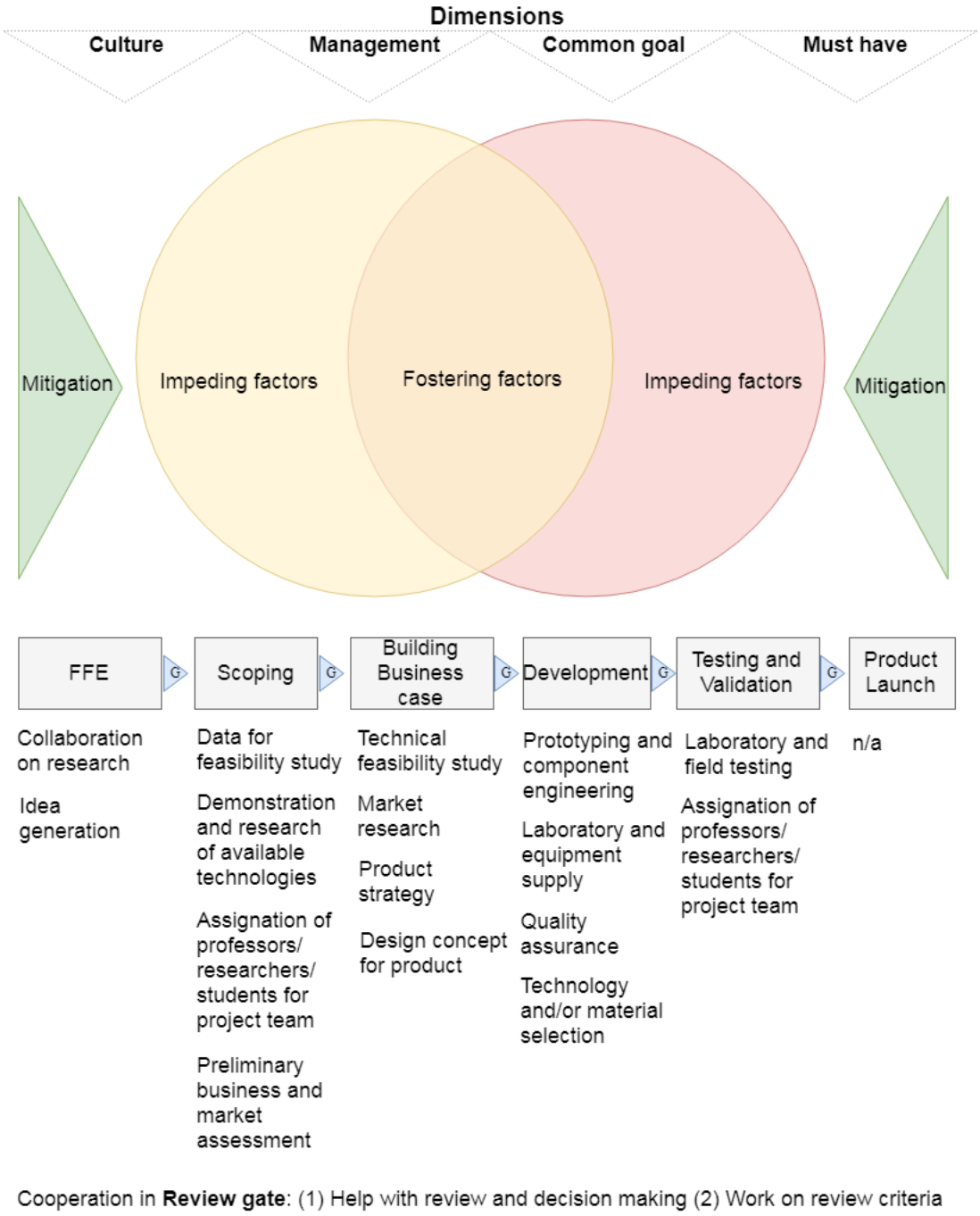


Figure 4 – University - industry cooperation in NPD in this research context (developed by the authors)

This model states that in order for cooperation to be fruitful, it is essential to be aware and exploit factors that foster it. Also, it is equally crucial to diminish the impact of impeding factors. By showing NPD stages and Latvian only context relevant cooperation activities within each stage, the model also shows the extent to which local companies engage with universities.

The authors believe that this model will be useful for academics in becoming more open to industry, as well as existing and potential entrepreneurs looking to improve or start cooperation with a university in NPD.

### 4.4. Main Differences in Cooperation Between Start-ups and Established Companies.

During the interview stage of this study, the authors found that there are some major differences between how start-ups and established companies work on NPD, how they cooperate with universities, and what gains they expect from this affair.

To begin with, established companies have a far more formal NPD process in place, whereas start-ups, with some exceptions, employ a much more rapid and iterative take on R&D. This approach was best described by the CEO of start-up. He explains that for his company all stages are compressed into very short period of time, e.g. one day or a week. The most important thing is to get from idea to the first prototype as fast as possible and then repeat the whole process again and again, until the product has been finalized and is ready to launch. On the contrary, established and especially larger companies employ a stage model with formal gates. Most of them have a strict NPD process including an FFE stage and review gates with meetings where the product's fate is decided. The formality of the process is not affected by whether or not the company cooperates with the university.

When asked to evaluate most important gain from cooperation, both start-ups and established companies named access to a university's technology base (equipment and laboratories) as the biggest benefit. However, there the similarities end. The second and third most valuable choice for start-ups are cost optimization and access to highly qualified researchers, whereas established companies value faster access to scientific research and the newest technologies. This could be explained by the cost consciousness of start-ups. They value instant material gains and practical advice (access to researchers) to succeed faster, but do not necessarily want to explore all the latest research and technologies, as it takes time and might not result in a new product.

Other research suggest that small companies and start-ups would collaborate more on technology transfer, but bigger and more established ones would collaborate more on knowledge or know how transfer. The authors of this work, however, did not find such correlation in our data. There are multiple examples on both start-ups and established companies who do cooperate on knowledge and technology transfer. What was not

mentioned in previous research is that companies with a more sophisticated and better-defined NPD process tend to gain from technology and knowledge and in some cases even know-how transfer [Appendix C]. The authors of this work can only speculate that a well-defined process gives an option to outsource more NPD tasks to a third party, being it a university or another company.

The big difference between start-ups and established companies is the number of different university services they employ in different NPD stages. Cooperation in the Development stage on Prototyping and component engineering was most popular for both groups. Established companies, however, use a broader spectrum of university offerings. There might be multiple reasons for this. First, the interviews show that start-ups, both cooperating with universities and not, are not familiar with the vast majority of offerings from universities. Another explanation as to why this might be the case is the lean thinking of start-ups. They are usually tight on money and have no extra resources to experiment with. Most of the interviewed start-ups have built their business around the knowledge base that their team members possess and try to keep key functions in-house. Outsourcing is considered an option only for tasks that are not necessary for day-to-day activities. The third explanation for this might be the start-up mentality of getting a minimally viable product to market and then developing it based on customer feedback, rather than fundamentally researching all options and trying to launch the perfect product.

To continue, multiple established companies mentioned that they would be interested in deeper cooperation and integration, instead of just the outsourcing of straightforward tasks. Two of the respondents explicitly stated they often need cross-functional cooperation (sometimes even with multiple universities). This finding is well in line with the academic literature on this topic. To continue, here is an example of a problem presented during an interview: "*One Institute, instead of cooperating with other university, turned to us separately, making the process more complicated. We concluded that we have to talk with each of our partners and this unnecessarily increases our human resources*".

Start-ups, on the other hand, tend not to overcomplicate things. Their operations are simpler (fewer and more focused products) and leaner, as they look on a university as another business entity that is available for outsourcing different tasks and functions. They will only consider a university if they are the cheapest, fastest and most skillful entity on the market. As a CEO of a high tech startup frames this problem, "*universities want to fundamentally explore issues and do not like if we redefine the problem. Therefore, it is often more beneficial for us to involve an industry expert or consultant*". This is a signal for universities

to become more business-like if they want to compete in the open markets and contribute in cooperation projects or lessen the bureaucracy and introduce project coordination to become a more integral partner for established companies.

# 5. Conclusions

During the study, the authors have developed a unique framework mapping all the stages of new product development with cooperation types from a university. By applying this framework, the authors have examined the existing literature sources on cooperation fostering and impeding factors, as well as having discovered Latvian context specific ones. The authors hope that these empirically tested recommendations will not only contribute to the existing knowledge base but also be a good starting point for further research. And most importantly, that they will be a useful practical tool for entrepreneurs and universities who want to improve or engage their cooperation in NPD.

The purpose of this research was to understand the state of university-industry cooperation on NPD in Latvia and to contribute with practical insights to improve this partnership by studying the NPD process theoretically and empirically. This is well in line with the authors' defined research question on *What is the extent of the university-industry cooperation on new product development in Latvia?* The 'lessons learnt' section and the 'future constructed' section of this chapter answers the second reserch question on *How can Latvian enterprises benefit from cooperation with universities on new product development?*

## 5.1. Lessons learnt

While doing this research, the authors did not come across fully integrated university-industry cooperation in NPD; however, there are joint activities in most of product development stages (except Product launch stage). The extent of cooperation varies, but it is important to acknowledge that companies with more formal NPD in place are often the ones who cooperate more. Interviews also suggest that local start-ups use a smaller variety of university services and that they are less informed about its offerings.

Most of the companies find the biggest value in cooperation during the Development stage of NPD, and according to the literature it is the most expensive phase of the whole process. This makes sense as most of respondents thought that access to an expensive university technology base and laboratories are the biggest value to be gained from cooperation.

Initially the authors wanted to identify factors influencing cooperation in each NPD stage. However, as already mentioned, fully integrated NPD was not discovered in a randomized sample. That is the reason why fostering and impeding factors were attributed to the whole process as such, rather than individual phases. To obtain empirical data on integrated process steps, research should be conducted in another context where cooperation in NPD is more extensive.

For further simplicity, the authors have categorized all the fostering and factors mentioned by entrepreneurs into four dimensions – culture, management, common goal and must have. The authors see most frequently used factors as trends and have summarized them in the table below.

| ***Dimension*** | ***Impeding factor*** | ***Means of dealing*** | ***Fostering factor*** |
|---|---|---|---|
| Culture | Hard to makes sense how university operates | Creating eco-system for cooperation | Inter-disciplinary cooperation and relationships |
| Management | Different perception of cooperation (time, communication, paperwork, accountability, etc.) | Encourage different channels of interaction<br>Increase process efficiency at university side | University is more pro-active in promoting cooperation |
| Common goal | Is the university interested and able to cooperate? | Clear understanding of business case | Mutual will and understanding |
| Must have | IP rights issues<br>High cost of university services | Ownership of the end product for entrepreneur | Financial aid from State<br>Project cost sharing |

Table 5 – Most frequently used factors as trends

A full list of fostering factors, impeding factors and the means to deal with them gathered during empiric study can be found in Appendix E.

To benefit from cooperation, both parties have to promote on fostering factors and be aware and try to mitigate impeding factors.

## 5.2. Future constructed

From the literature review and interview answers, the authors have identified two paths that universities can use to develop their cooperation with enterprise, based on the viewpoint of entrepreneurs. Needless to say, both options are not exclusive and can be executed in parallel. The simplest form of cooperation would be to act as a sub-contractor and complete tasks delegated by industry. In this scenario, universities are expected to compete in the free

market, meaning they should minimize bureaucracy, improve service, be more active at promoting their offering and adjust to market prices. The second option is to become an equal partner in NPD and further integrate with industry. This scenario imposes all improvements, as in the first scenario, but also urges more leadership, business understanding from the university side and bigger trust from industry. Nevertheless, the authors are confident that it is doable as there are many great examples of such integration in other European countries. The latter cooperation option can be fostered by successful academic entrepreneurs and by embracing entrepreneurial activity within the university.

Unfortunately, the general feeling expressed by most of interviewed entrepreneurs was that they did not feel that universities have genuine interest and even more – the need to cooperate. If this is the case and universities do not change their course, entrepreneurs will have to be pro-active. There are many proven ways to enhance cooperation in NPD. One practical way to mitigate the problems on cooperation management and to educate academics about the business environment is to employ more professors or co-teach courses in university. Both of those factors would encourage different channels of interaction and form better relationships between both parties.

There are lot of things to work on, on both sides, but the authors of this work agree with the CEO of an established company who said, that "not only university or industry, but whole Latvian society would benefit it we could make this cooperation work out".

## 5.3. Further research

This research is focused on analysing the Latvian enterprise side of cooperation. For any further studies, the authors suggest exploring both sides of this partnership. As an option, a multiple case study form is suggested - interviewing both parties and identifying whether there are any differences how fostering and impeding factors are perceived by each. Also, the authors suggest triangulating obtained data using quantitative methods.

This research focuses on industry motivation to cooperate and be pro-active, despite the common consensus that universities are there to promote cooperation. As a further research, the authors suggest exploring this question from the perspective of local universities' motivations. The role of State policy by encouraging cooperation might be a starting point.

## 5.4. Limitations

In order to have a deeper understanding on how entrepreneurs can benefit from cooperation with a university, the authors narrowed down their research scope. The authors explored NPD only from the entrepreneurial side of the cooperation. The focus set significant limits on this research as the other party has not had a chance to contribute or comment on any of the topics included in this master thesis. Yet this has been concious authors decision reasoned by less reaserch that explores industry side. The research followed the multiple case study design, carried out by qualitative means using semi-structured interviews and is not meant to be generalized to the population. To a certain degree the authors recognize that interpretation of the data might be subjective as is typical in quantitative research. However, the authors tackled it by discussing the individual interpretations and coming to a common consensus.

The authors limited their choice for enterprises by selecting specific awards and their winners, but in this case, it could have been one of the best means of purposeful sampling, in light of the randomization tactic used.

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# 7. Appendices

## 7.1. Appendix A - Literature review table (most significant sources)

| No | Authors, year | Title | Methodology Used in Analysis of Data | Main Findings |
|---|---|---|---|---|
| 1 | Davey, T., Baaken, T., Muros, V., & Meerman, A. (2011) | The State of European-University Business Cooperation. | Semi-structured interviews with academics | Thorough university-industry cooperation research - Europe specific. |
| 2 | Ankrah, S., & AL-Tabbaa, O. (2015) | Universities–industry collaboration: A systematic review. | Research compiled from other research papers. | History of UNI-IND collaboration, process of formation relationships. |
| 3 | Hord, S.M. (1986) | A Synthesis of research on organizational collaboration. Association of Supervision and curriculum development. | Analysis of other research on theory and models | Term "collaboration" explained in detail. |
| 4 | Hall, H.B., Link, A.N., & Scott J,T. (2001) | Barriers Inhibiting Industry from Partnering with universities: Evidence from the advanced technology program | Literature review | History of cooperation |
| 5 | Battisstella, C., De Toni, A.F., & Pillon, R. (2016) | Inter-organisational technology/knowledge transfer: a framework from critical literature review | Analysis of other research on theory and models | Paper identifies three possible objects of the transfer – technology, knowledge and know-how. |
| 6 | Siegel, D., Waldman, D., & Link, A. (2003) | Assessing the impact of organizational practices on the relative productivity of university technology transfer offices: An exploratory study. | Inductive, qualitative method - semi-structured interviews with stakeholders of cooperation. | Exploring entrepreneur's motivation to cooperate with universities |

| | | | | |
|---|---|---|---|---|
| 7 | Bonarccorsi, A., & Piccaluga, A. (1994) | A theoretical framework for the evaluation of university—industry relationships. | Analysis of other research on theory and models | Exploring entrepreneur's motivation to cooperate with universities |
| 8 | Santoro, M.D., & Chakrabarti A. (2000) | Success breeds success; The linkage between relationship intensity and tangible outcomes in industry -univeristy collaborative ventures | Qualitative analysis with semi-structured interviews | 1. Geographic proximity is a factor fostering university industry cooperation. 2. Existence of university industry cooperation correlates with positive and tangible outcomes generated. |
| 9 | Ahrweiler, P., Pyka, A., & Gilbert N., (2011) | A New Model for University-Industry Links in Knowledge-Based Economies. | Agent-based SKIN model | Involvement of universities in innovation processes, brings higher credibility and prediction of stability for potential customers |
| 10 | Jassawalla, A.R., & Sashittal, H.C., (1998) | An examination of collaboration in High-Technology new product development processes | Exploratory study and collected qualitative data - 10 hi-tech industrial firms. | 1. High-tech firms integrate customers and suppliers into new product development (NPD) process. 2. Cross functional project teams perform better in complicated product development. 3. Flatter organizational design helps overcome problems in innovation etc. 4. High levels of collaboration among participants in NPD, suggests significantly better new product performance. |
| 11 | Schofield (2013) | Critical Success Factors for Knowledge Transfer Collaborations between University and Industry | Literature review, surveys concluded. | Identify factors that influence university–industry cooperation. |

| | | | | |
|---|---|---|---|---|
| 12 | Valentin E.M.M. (2000) | University–industry cooperation: a framework of benefits and obstacles | Analysis of other research on theory and models | This study lists main benefits, motivations and obstacles for university-industry collaboration. One of the key benefits from cooperation for the company is risk sharing |
| 13 | Perkmann M., & Salter A. (2012) | How to create productive partnerships with univeristies | Interviews conducted, literature review. . | 4 models of UNI-IND collaboration. The first of these is the time horizon of the collaboration. The second dimension is the degree of disclosure of the results of the partnership. |
| 14 | Soh, P.-H., & Subramanian, A. M. (2014) | When do firms benefit from university-industry R&D collaborations? The implications of firm R&D focus on scientific research and technological recombination | Qualitative analysis with semi-structured interviews | Paper examines how focus on R&D can improve or reduce companies' performance while cooperating with universities. |
| 15 | Santoro, M., and Chakrabarti A. (2001) | Firms size and technology centrality in industry-university interactions | Qualitative analysis with semi-structured interviews. Quantitative analysis using regression. | 1. Large firms tend to aim for knowledge transfer and research support. 2. Small firms look for technology transfer relationships and less for support in research. |
| 16 | P.D'Este, & Patel P. (2007) | University–industry linkages in the UK: What are the factors underlying the variety of interactions with industry? | Literature review. Qualitative analysis - survey. | Research addresses industry-university communication channels and forms of cooperation |
| 17 | Bruneel, J., D'Este, P., & Salter, A. (2010) | Investigating the factors that diminish the barriers to university–industry collaboration | Large-scale survey and public records | Means to diminish barriers in case of university-industry cooperation - use experience, encourage trust and exploit different interaction channels. |

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|---|---|---|---|---|
| 18 | Rõigas, K., Seppo, M., Varblane, U., & Mohne P. (2018) | Which firms use universities as cooperation partners? - the comparative view in Europe | Literature review. Empirical part based on Davey et.al (2011) report data. | Universities as unique partners |
| 19 | Booz-Allen & Hamilton (1982) | New product Management for 1980s. | Literature review. Empirical part based on Davey et.al (2011) report data. | Amount of failure in new product development |
| 20 | Sherman, R. F. (1966) | New-product development: Get the whole company into the act. | Case studies of 50 companies. | Simple six-stage process that companies can use in their product development. In addition to these steps, author also defines sequence of management go/no-go decisions after each step. |
| 21 | Cooper, R. G. (1994). | Third-Generation New Product Processes | Study of the NPD process and proposal of new framework. | Third generation Stage-Gate model |
| 22 | Cooper, R. G. (1976) | Introducing successful new industrial products. | Study of the NPD process and proposal of new framework. | Second generation model - stage gate process. |
| 23 | Cooper, R. G., and E. J. Kleinschmidt (1987) | New products: What separates winners from losers? | Study of the NPD process and proposal of new framework. | The relevance of Fuzzy front end (FFE) |
| 24 | Barczak, G., Griffin, A., & Kahn, K. B. (2009) | Perspective: trends and drivers of success in NPD practices: Results of the 2003 PDMA best practices study. | Study of the NPD process and proposal of new framework. | Formal new product development practices. |

7.2. Appendix B - Interview questions (in Latvian)
All of interviews were concluded in local language

**Kopējie jautājumi**
1)Vai jūsu uzņēmums rada jaunus produktus un nodarbojas ar R&D?
2) Vai varat aprakstīt, kā jūsu uzņēmumā notiek jaunu produktu izstrāde? Vai strādājot pie jaunu produktu izveides jūs vadāties pēc noteikta procesa, sekojat konkrētiem izstrādes soļiem?
3) Cik daudz jaunu produktu izstrādē jūs balstāties uz pētījumiem un cik daudz uz sajūtām, savu pārliecību un pieredzi (gut feeling)?
4) Vai Jūsu uzņēmums sadarbojas vai kādreiz ir sadarbojies ar universitāti jaunu produktu izstrādes jomā?

**Nesadarbojas ar UNI**
5a) Kādi ir iemesli, kāpēc jūs nesadarbojaties ar augstskolu jaunu produktu izstrādē? Kādas jūsuprāt ir barjeras sadarbībai (iekšējas/uzņēmumā vai ārējas)? Vai kāpēc sadarbība pārtrūka/bija neveiksmīga, ja tāda ir bijusi?
6a) Kas motivētu jūs sadarboties ar universitātēm turpmāk?
7a) Vai ir kādi jaunu produktu izstrādes posmi, kur jūs redzat iespējamo sadarbību? Kāpēc sadarbību nevirzāt konkrēti šajos izstrādes posmos?
8a) Vai uzskatāt, ka esat labi informēts par sadarbības iespējām ar universitātēm (gan Latvijā, gan ārzemēs)?

**Sadarbojas ar UNI**
5b) Kā nolēmāt sadarboties ar universitāti(ēm) jaunu produktu izstrādē? Kas iniciēja šo sadarbību? Kādu ceļu izvēlējāties, lai uzrunātu augstskolas, ja netikāt uzrunāts pirmais?
6b) Kas ir jūsu galvenie sadarbības motīvi?
7b) Ko no šīs sadarbības iegūstat jūs, kāds ieguvums jūsuprāt ir universitātei?
8b) Kas ir galvenie + un - jaunu produktu izstrādi veicot in-house vai gluži pretēji – piesaistot universitāti, kā sadarbības partneri?
9b) Kāda ir universitātes loma jauno produktu izstrādē? Līdzvērtīgs partneri, deliģētā darba veicējs ar konkrētu uzdevumu, kas cits?
10b) Kas varētu veicināt vēl ciešāku vai biežāku sadarbību? Ko, Jūsuprāt, vajadzētu darīt, lai vēl vairāki uzņēmumi Latvijā sadarbotos ar universitātēm?
11b) No jūsu sadarbības pieredzes, kas ir traucējošie faktori sadarbībai (miniet gan iekšējos organizācijas, gan ārējos).
12b) Vai kopumā esat apmierināts ar sadarbību?
13b) Par sadarbību konkrētās jauna produkta izstrādes fāzēs:
13.1. Priekšizpētes stadija:
13.2. Apjoma noteikšanas stadija:
13.3. Veidojot biznesa konceptu jaunajam produktam:
13.4. Produkta izpētes stadija:
13.5. Produkta testēšanas stadija:
13.6. Virzot produktu tirgū stadija:
13.7. Starpposmi:
14. Vai Jūs piekristu, ka visi šeit minētie faktori, var tikt uzskatīti par ieguvumiem no sadarbības ar universitātēm?
14.1. Iespēja iegūt ātrāku pieeju zinātniskajiem pētījumiem
14.2. Iespēja iegūt ātrāku pieeju progresīvām tehnoloģijām
14.3. Pieeja augsti kvalificētiem pētniekiem (doktori, profesori)

14.4. Iespēja apmainīties ar zināšanām – starp uzņēmumu un universitāti –
14.5. Izmaksu optimizācija
14.6. Pieeja tehnoloģiskajai bāzei (laboratorijas)
14.7. Publiskā imidža spodrināšana
14.8. Citi ieguvumi
15. Nobeigumā mēs vēlētos jautāt, vai ir kas tāds, ko savos jautājumos neesam pieminējuši, bet Jūs uzskatāt par svarīgu pateikt.

## 7.3. Appendix C – Stages of NPD and cooperation activities (Authors work)

| Company | Sophisticated NPD | Cooperate | Form | Size | FFE | Scoping | Building business cas | Development | Testing and validation | Product launch | Gates | Knowledge/technology/know-how |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Company 1** | Medium | Yes | Established | Small | Idea generation | Collection of available market data<br>Preliminary business and market assessment | Market research<br>Design concept for product | Prototyping and component engineering | | | | Knowledge |
| **Company 2** | Medium | Yes | Start up | Micro | | Preliminary business and market assessment | Design concept for product | | | | | Knowledge |
| **Company 3** | High | Yes | Established | Micro | Collaboration on research | | | Prototyping and component engineering<br>Quality assurance | Laboratory and field testing | | | Knowledge/Technology |
| **Company 4** | Low | No | Established | Micro | | | | | | | | - |
| **Company 5** | High | Yes | Established | Small | Idea generation | | Market research<br>Product strategy | Prototyping and component engineering<br>Laboratory and equipment supply<br>Quality assurance<br>Technology and/or material selection | Laboratory and field testing | | | Knowledge/Technology/Know-how |
| **Company 6** | Medium | No | Start up | Micro | | | | | | | | - |
| **Company 7** | Low | Yes | Start up | Micro | | | | Prototyping and component engineering | | | | Knowledge |
| **Company 8** | Medium | Yes | Start up | Small | | | Technical feasibility study | | | | | Knowledge |
| **Company 9** | Medium | No | Start up | Small | | | | | | | | - |
| **Company 10** | High | Yes | Established | Big | Idea generation | Demonstration and research of available technologies<br>Preliminary business and market assessment | Technical feasibility study | Prototyping and component engineering<br>Technology and/or material selection | | | Help with review and decision making | Knowledge/Technology/Know-how |
| **Company 11** | Low | Yes | Start up | Micro | | | | Prototyping and component engineering | | | | Technology |
| **Company 12** | High | Yes | Established | Big | | | Design concept for product | Prototyping and component engineering<br>Technology and/or material selection | | | | Technology |
| **Company 13** | Medium | Yes | Start up | Micro | Idea generation | | | Prototyping and component engineering | | | | Technology |
| **Company 14** | High | No | Established | Micro | | | | | | | | - |
| **Company 15** | High | No | Established | Small | | | | | | | | - |
| **Company 16** | High | Yes | Established | Small | Collaboration on research | Data for feasibility study<br>Assignation of professors/ researchers/students for project team | Technical feasibility study | Prototyping and component engineering<br>Laboratory and equipment supply<br>Quality assurance<br>Technology and/or material selection | Laboratory and field testing<br>Assignation of professors/ researchers/students for project team | | Help with review and decision making<br>Work on review criteria | Knowledge/Technology/Know-how |

7.4. Appendix D – Fostering and impeding factors mentioned by entrepreneurs (Authors work)

| **Fostering factors mentioned by entrepreneurs** | |
|---|---|
| Availability of technology base | Company 1, 3, 5, 8, 10, 11, 13, 16 |
| Reputation and prestige gained from cooperating with world's best universities. | Company 2, 3, 8 |
| Without heavy financial incentives one can gain access to a team with wide expertise | Company 2 |
| No need to find answers to questions one has already found | Company 2 |
| No need for a specific employee as it can be substituted with outsourcing specific tasks to university | Company 3, 10 |
| Personal relationships and friendship within research team, that can accelerate processes and promotes trust | Company 5, 16 |
| During in-class competition within the course of design, company could gather many product designs to cover a whole new season product line | Company 7 |
| Cheap and high-quality work force | Company 8 |
| University is ready to cooperate even if the result is rather small tool and yet requires a lot of attention to details | Company 13 |
| Cost reduction | Company 5, 10, 16, |
| In-depth and specific knowledge of physics | Company 16 |
| Company employees are current/former academics or students of the cooperating university | Company 1, 5, 11, 16 |
| Opportunity to cooperate only with the scientists themselves | Company 5, 8 |

| **Impeding factors mentioned by entrepreneurs** | |
|---|---|
| Difficulties with project organization between two different institutions | Company 2 |
| Very hard to change project scope after university has started working on it | Company 6 |
| Inadequate payment is required | Company 7 |
| Students don't do what they have promised | Company 1, 10 |
| Multiple universities cannot cooperate together on one industry project | Company 10 |
| One researcher does his work well, the other the same and yet when put together two separate researches the outcome is worthless | Company 1 |
| Researchers find those projects less attractive, when there are no fundamental issues to be solved. Hard to attract funding | Company 5 |
| University does research and offer something that has no use within the industry. | Company 5 |
| Bureaucracy | Company 1, 3, 5, 8, 11 |

7.5. Appendix E – Concepts and themes aggregated into dimensions

| | 1st order concepts | 2nd order themes | Dimension |
|---|---|---|---|
| Obstacles | Researchers are artists<br>University has different culture<br>Entrepreneurs do not trust university<br>Universities are not flexible<br>Very hard to change project scope after university has started working on it | Lack of trust for university (1)<br>Entrepreneurs wish university to be more flexible (2)<br>**Hard to make sense of how university operates (4)** | Culture |
| Means of dealing | University contribution in developing incubators and science parks<br>University more open to solve existing industry problems<br>University offers inter-disciplinary teams with different experts and project team management<br>Multiple universities can cooperate together on one industry project<br>Informal relationship building<br>Encourage flexibility<br>Motivate students to be more open-minded and result oriented | **Creating eco-system for cooperation (4)**<br>University embracing business mind-set (2)<br>Relationships (2) | |
| Fostering factors | University offers scientists from different fields that work together in solving one problem<br>Management of company is familiar with university culture<br>Management of company trusts university<br>Change of communication culture in university<br>University has business mind-set and orientation<br>Down to earth and understandable communication (with no formulas)<br>Personal relationship and friendship between research team<br>Employees are part time academics<br>Mutual trust<br>University has skin in the game | **Inter-disciplinary cooperation (3)**<br>Previous experience of cooperation (1)<br>**Relationships (5)**<br>University skin in the game (1)<br>Communication culture (1)<br>Trust (2) | |
| Obstacles | No clear guidelines regarding the process of cooperation<br>Legal paperwork concerning collaboration takes too much time<br>University has problems meeting deadlines<br>Difficulties with project organization between two different institutions | **Different perception of cooperation (time, communication, paperwork, accountability) (11)**<br>Location (2)<br>How to find balance? (1) | Management |

| | | | |
|---|---|---|---|
| | Hard to balance interests of both parties<br>Personnel in university is not managed resourcefully<br>Scientists and researchers are hard to manage<br>Physical distance<br>Lots of bureaucracy form University side<br>Low credibility to students work if not supervised by professor | | |
| Means of dealing | Informal meeting between university and entrepreneurs<br><br>Positive examples made public<br>Increasing efficiency of cooperation process<br>Full entrepreneurs' involvement in the research process by supervising everything<br><br>Reduce bureaucracy issues on university's side in legal processes<br>University should implement variety of channels when communicating with entrepreneurs<br>Organizing workshops with university's' and entrepreneurs' involvement<br>University offers permanent cooperation programmed<br>University takes into account manufacturing resources of company, while doing research for new product development<br>University offers its master and PhD students industry specific problems to solve in thesis<br>Project manager form university's side | **Encourage different channels of interaction (4)**<br>University pro-active in promoting cooperation (1)<br>Permanent cooperation programmed (2)<br>University gets closer to industry and steps back from fundamental science (3)<br>Involve entrepreneur in the research even more (1)<br>**Increasing process efficiency (4)**<br>Test company's absorptive capacity (3) | |
| Fostering factors | Existence of so called "agent system" where cooperation is settled via agent who supervises the whole process<br><br>Business to business approach from university's side<br>Existence of technology transfer offices<br>Dedicated person for cooperation with university in company<br><br>Lead researcher in university as a recognized professional in industry<br>Close physical proximity | Supervising and facilitating cooperation (2)<br>University embracing business mind-set (3)<br>Location (3)<br>Relationships (1)<br>Students and academic require different approach (1)<br>Clear boundaries (2)<br>Wide spectrum of communication | |

| | | |
|---|---|---|
| Low bureaucracy<br><br>University should embrace more business oriented mind-set<br><br>Encouraging informal cooperation<br>Clear definition of cooperation and boundaries<br>University brand helps to promote product and gives extra credibility<br>University and entrepreneur's employees poses same academic knowledge that sufficiently decreases necessity to explain otherwise simple things<br>Employees of entrepreneur are part time academics<br>Access of information on university products and services available to entrepreneurs<br>University gives access to many brilliant students that are not yet over-priced<br>Students are cheaper workforce<br>Entrepreneur uses university's' stuff for credibility (PhD, MD titles)<br>University posses titles entrepreneur lacks (MD, PhD)<br>University plays an active part in entrepreneurs' marketing/promotion campaigns<br>University able for ad-hoc meetings<br>University opens its technology base for entrepreneurs to work with | channels (1)<br>**University pro-active in promoting cooperation (5)**<br>Ease of knowledge and technology transfer processes (1)<br>Awareness of absorptive capacity (2) | |
| Entrepreneurs are uncertain will the result be of value for them<br>Negative result is a result for University, not for Entrepreneurs<br>Different vision of the depth of the research. Most often entrepreneurs are ok with minimal viable product.<br>University researchers tend to dig too deep.<br>Entrepreneurs do not know of what knowledge University possesses<br>No sense of responsibility towards result form University side<br>University seems to be not innovative enough for entrepreneurs<br>Entrepreneurs are uncertain if there will be result in the end of research. It is a gamble for them<br>University has "Ivory tower" mind-set - too arrogant of their own capabilities | Result of no value (2)<br>Existence of boundaries (2)<br>**Is university interested and capable to cooperate? (4)**<br>Gamble (2) | Common goal |

Obstacles

| | | | |
|---|---|---|---|
| Means of dealing | Lack of interest from university side towards importance of the result | | |
| Fostering factors | Setting and agreeing on mutual goals for project<br>Communication and acknowledgment of business case<br>Encouraging mutual desire to innovate<br>Increasing credibility and ease of use of research results<br>Increasing credibility that research results can be fully integrated into supply chain | Awareness of company's absorptive capacity (2)<br>Ease of use of results (1)<br>**Clear understanding on business case (4)** | |
| | Mutual desire to innovate<br>Sense of responsibility from university<br>Risk sharing<br>Clear definition of delegated task | **Mutual will** to create (2)<br>**Mutual understanding** for risk vs return (2) | |
| Means of dealing Obstacles | IP rights issues<br>University services are expensive | Ownership of end product (2)<br>High costs (2) | Must have factors |
| | IP rights should favor entrepreneur<br>Financial incentives for researchers | Ownership for entrepreneur (2)<br>Incentives for university (1) | |
| Fostering factors | State financial aid to incentivize cooperation<br>University services should be cheaper of free of charge<br>university splits new product development costs with industry | Financial aid from State (2)<br>Cost sharing (1) | |