Clustering and Business Network Development

Effect of clustering on different spatial scale levels on the development of the scientific- and commercial business network of Radboud University spin-offs.

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§0 Executive Summary

The goal of this research was to contribute to the scientific literature about the effect of different spatial scale levels on the scientific and commercial business network development of companies, in this research university spin-offs specifically. More insight was needed in the effect local clustering, sub-local clustering and the combination between local- and sub-local clustering on the development of the business network of USOs. A quantitative theory-driven research fitted with the subject of this research. 332 separate USOs participated in this research, in at least one of the years the survey was sent out (2004, 2008, 2011). So, some USOs participated multiple times, enabling the analysis of the business network development. The results and conclusion have shown that local clustering, sub-local clustering and the combination between local- and sub-local clustering can have an influence on the development of the business network of USOs, but for some expected effects no significant results were found. This research contributed to the scientific literature about the effect of clustering on different spatial scale levels on the business network development of USOs and can form the basis for further qualitative and quantitative research.

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§1 Introduction

University spin-offs (USOs) are companies in which knowledge, technology or research results developed within a university are commercialised, often by people who studied or worked at the university (Pirnay, Surlemont, & Nlemvo, 2003, p. 355). USOs are seen as companies that provide employment, with a larger than average growth potential (Czarnitzki, Rammer, & Toole, 2014). To fully exploit the growth potential of USOs, not only the scientific business network is important, but also the commercial business network. Creating a USO is a form of entrepreneurship. ‘’Entrepreneurship is the driving force for initiating business ideas, mobilizing human, financial and physical resources, for establishing and expanding enterprises, and creating jobs’’ (Topxhiu, 2012, p. 10). With these positive influences, entrepreneurship has an important influence on the economy and economic growth (Martin, Picazo, & Navarro, 2010). In order to be successful and to reach these positive influences, entrepreneurs can make use of their network (Greve & Salaff, 2003). Entrepreneurs use their network to attract knowledge, financial capital and to attract other means to be able to realise their plans (Sullivan & Ford, 2013; Elfring & Hulsink, 2007). Maintaining an effective business network, scientific as well as commercial, is thus of importance to the entrepreneurs that are managing the USOs.

To enhance the development of the business network of USOs, clustering USOs, for example in a region or in a business park, can lead to more development of the business network, as clustering (being located) close to a university or other companies can provide scientific and commercial business networking opportunities (Huggins & Johnston, 2010), hereby aiming to improve both the scientific and the commercial business network of those USOs (Bøllingtoft & Ulhøi, 2005; Phan, Siegel, & Wright, 2005).

USOs are important, because through USOs entrepreneurs are able to develop a product or service out of their knowledge gained through a university, hereby contributing to the economy and economic growth (Rappert, Webster, & Charles, 1999; Martin et al., 2010). Universities can stimulate the creation of USOs for various reasons like creating jobs, contributing to national competitiveness and also for a financial return for the university (Mustar, Wright, & Clarysse, 2008). To enhance the development of USOs and provide a location for them close to the university, a science park can be created. Universities create science parks to ‘’foster the creation of start-up firms based on university-owned (or licensed) technologies’’ (Phan et al., 2005, p. 3-4; Link & Scott, 2003). Being located at a science park also has advantages, since ‘’science park firms are more effective than nonpark firms, in terms of generating new products, services and patents’’ (Phan et al., 2005, p. 14). Operating from a science park also has the potential to achieve greater research and development productivity

(Speldekamp, Saka-Helmhout, & Knoben, 2020; Furman, Porter, & Stern, 2002). The location of USOs thus are important because it may have a positive or negative influence on reaching the full potential of USOs through an effective business network.

This research assesses two problem contexts. The first problem context encompasses the effect of clustering on the scientific business network development. There are conflicting views on the scientific business network development of USOs. Clustering of USOs at a science park stimulates the interaction with the university and science, hereby aiming to improve the scientific business network development of USOs. On the other side, science parks attract USOs which already have frequent contact with the university and attract companies who aim to profit from the reputation of the science park. So, the USOs that are located on a science park might not show development of the scientific business network, because their scientific business network was already extensive.

The second problem context encompasses the effect of clustering on the commercial business network. There are mismatched perspectives on the commercial business network development of USOs. Clustering of companies aims to improve the business network development of USOs, but clustering at the science park may lead to over developing the scientific business network, at the cost of the commercial business network development (Perez & Sánchez, 2003). This research will conduct a direct simultaneous comparison of the development of the scientific- as well as the commercial business network of USOs, as the current scientific literature is thin on a simultaneous analysis of the business network development of USOs.

The two problem contexts focus on the scientific and the commercial business network development of USOs. Clustering of companies, as introduced, in a region or business park can lead to development of the business network, which leads to the following research gap: The effect of clustering on the development of the business network of companies is analysed on the local level (network benefits of being located in a city (region)) (Speldekamp et al., 2020) and on sub-local level (clustering on business parks and multi-company buildings) (Bakouros, Mardas, & Varsakelis, 2002). What has not or hardly been analysed is whether or how the advantages of sub-local clustering relate to the advantages of local clustering. Does, for example, being located on a clustered environment outside of a city (region) lead to more or less business network development than being located inside a city (region) as a stand-alone location?

In this research, the focus will be on USOs from the Radboud University (RU) of

Nijmegen, enabled by using quantitative data from the USOs of the RU, which leads to the following objective of this research:

To gain more information about the effect of clustering on different spatial scale levels on the development of the scientific- and commercial business network of USOs. To contribute to the scientific knowledge about business network (development) of spin-offs and their business environment, to stimulate balanced networking of Radboud University spin-offs.

The research question and sub-questions of this research are:

What is the effect of clustering on different spatial scale levels on the development of the scientific- and commercial business network of USOs?

a. To what extent is the development of the scientific- and commercial business network of USOs of the RU influenced by local clustering?
b. To what extent is the development of the scientific- and commercial business network of USOs of the RU influenced by sub-local clustering?
c. To what extent is the development of the scientific- and commercial business network of USOs of the RU influenced by combinations from local- and sub-local clustering?

This research is scientifically relevant, because it addresses the research gap, originated from the two problem contexts in the literature, by conducting an integral research in the effect of different spatial scale levels on both the scientific and the commercial business network (development) simultaneously, leading to insights into how the different spatial scale levels differentiate on the business network development of USOs. The outcomes of this research can also help USOs to better be able to decide from which location they operate and what influences this can have on the business networks of those companies, which shows the social relevance of this research.

In order to be able to answer the research question, firstly the theory about the central concepts from the research question will be discussed in §2: Entrepreneurship, university spin-offs, business network and scientific and commercial business networks, where after local, sub-local and the combination of local and sub-local clustering will be discussed. In §3, the methodological choices will be explained and justified. Furthermore, the results will be discussed in §4 and the discussion in §5.

§2 Theory

This chapter will begin with discussing the theories about the central concepts from the research question: Entrepreneurship, USO, business network, scientific and commercial business network (development). After the central concepts have been discussed, the general principle guiding clustering and network development will be discussed. Then, the clustering of USOs will be discussed on different spatial scale levels: local, sub-local and a combination of local and sub-local clustering. The current knowledge will be discussed and the relationships between the concepts will be made clear, leading to hypotheses. The conceptual model will be made at the end of the chapter.

§2.1 Central Concepts

§2.1.1 Entrepreneurship

The first central concept that will be discussed is entrepreneurship, as it forms the basis for the research question. The definition of entrepreneurship used in this research is: ‘’Entrepreneurship is the pursuit of a discontinuous opportunity involving the creation of an organization (or sub-organization) with the expectation of value creation to the participants’’ (Carton, Hofer, & Meeks, 1998, p. 8). As introduced in the first chapter, entrepreneurship has an important influence on the economy and economic growth (Martin et al., 2010). Entrepreneurs are the people that perform entrepreneurship, and are ‘’the individual (or team) that identifies the opportunity, gathers the necessary resources, creates and is ultimately responsible for the consequences of the organization’’ (Carton et al., 1998, p. 8).

§2.1.2 University spin-offs

One way to perform entrepreneurship is through setting up a USO, as introduced in the first chapter. Pirnay et al. (2003) have conducted a research about the definitions of USOs since many authors use (somewhat) different definitions. USOs can be defined as ‘’firms whose products or services develop out of technology-based ideas or scientific / technical know-how generated in a university setting by a member of faculty, staff or student who founded (or co-founded with others) the firm’’ (Rappert et al., 1999, p. 874). This research will use a broader definition of USOs, because the companies of entrepreneurs who use (academic) skills learned at the Radboud University, are also seen as USOs. Industry start-ups, as opposed to USOs, do not involve a research academic entrepreneur. According to Czarnitzki et al. (2019), not involving a research academic entrepreneur leads to a disadvantage in terms of employment growth, because USOs create more new jobs.

Universities create spin-offs for various reasons, for example creating jobs, contributing to national competitiveness and also for a financial return for the university. Creating USOs does not always lead to success however, because there are of course still difficulties and USOs and the university might eventually have different interests and strategies (Mustar et al., 2008). Muster et al. (2008) further note that there are growing ‘’pressures on public research centres and universities to become more proactive in the economic development of their regions’’ (p. 79). This leads to the creation of more and more USOs with high expectations, but the outcomes are not always positive. Universities should have and develop more heterogenous spin-off policy matters, where they have a more focused strategy on creating USOs in terms of selection, growth potential and local developments (Mustar et al., 2008).

Bigliardi, Galati & Verbano (2003) have performed a literature review with the goal to form ‘’a model of ex-ante evaluation of spin-off companies’ performance’’ (p. 178). To identify performance factors, the current scientific literature was reviewed. Four factors influencing the performance of a spin-off were proposed: ‘’University’s characteristics’’, ‘’founder’s characteristics’’, ‘’environmental characteristics’’ and ‘’technological characteristics’’. The authors thus found that ‘’environmental characteristics’’ is a factor influencing the performance of a spin-off. Environmental characteristics ‘’includes the industry characteristics, the regional infrastructure, seed and venture capital availability, and the spin-offs location’’ (Bigliardi et al., 2013, p. 185). The location of a spin-off thus plays a role in the performance of that spin-off, according to Bigliardi et al. (2013), which shows the importance of the location of a USO.

§2.1.3 Business network

To provide a better understanding of the business networks of USOs, this paragraph will shortly introduce the purpose of a business network and the ties that exist in a business network.

Entrepreneurs use their network for gaining knowledge and resources they do not possess themselves (Greve & Salaff, 2003). Having a network is of great value to the entrepreneurs and influences the success of the business (Watson, 2012). The main part of the network consists of social capital, which will also form the theoretical basis of this research. The social capital theory ‘’rests on the premise that in addition to purely economics-driven contractual relationships, important socially driven dimensions also need to be taken into account’’ (Bøllingtoft & Ulhøi, 2005, p. 272). The main part of a network are the interpersonal relationships that exist in social systems, with varying sorts of ties and structures. These social ties enable entrepreneurs to exploit the opportunities and acquire resources (Aldrich & Wiedenmayer, 1993).

Social ties in a network of an entrepreneur can either be strong or weak. A tie being strong or weak depends on the emotional intensity and intimacy, the frequency of contact and the reciprocal commitments (Elfring & Hulsink, 2007, p. 1851-1852). Usually strong ties play a bigger role in the beginning phase of the company, because they give access to knowledge, feedback and financial means. When the company is moving forward, more weak ties are added, which give access to new markets and information. Weak ties can be transformed into strong ties when they prove valuable to the entrepreneurs (Elfring & Hulsink, 2007). Possessing valuable strong and weak ties is very important in having an effective network for entrepreneurs, as it can enable the company to attract new knowledge, information, resources, financial means and advice, thus developing the business network.

§2.1.4 Scientific and commercial business networks

There are different sorts of business networks. In this research, a distinction will be made between scientific (number of employees of a scientific knowledge institution with which a USO maintains personal contact) and commercial (number of (possible) clients with which a USO maintains personal contact) business networks. Both are important in setting up and running the business. A criticism to USOs is that they have an overdeveloped scientific business network, but an underdeveloped commercial business network. Perez and Sánchez (2003) found that USOs were more focused on the technology than on the market in the first years. ‘’The university spin-offs studied were polarized during their early years, more towards the technology than to the market: six out of ten spin-off companies analysed were technology-oriented and were still doing R&D projects to develop new products and improve their technology’’ (Perez & Sánchez, 2003, p. 827). The focus on technology may come with the risk that the products developed will not be market oriented, leading to a greater risk of market failure (Roberts, 1990). This shows that not only the scientific business network, but also the commercial business network is important to make sure that there is a market for the products that USOs are developing, because only having a developed scientific business network carries the risk to make products that do not fit the market.

To develop the scientific and commercial business networks, USOs make use of the current networks of the University, but also of the region; ‘’university spin-offs made use of the formally institutionalized innovation and technology transfer network developed by the regional government to promote technological innovation and entrepreneurship’’ (Perez & Sánchez, 2003, p. 829). The current promotion of innovation and entrepreneurship by the

regional governments thus also provide possible networking opportunities for USOs in the development of their scientific and commercial business networks.

§2.2 General principle guiding clustering and network development

Now that entrepreneurship, USOs and the business network (scientific and commercial) and the importance of those business networks are discussed in the previous paragraph, the focus of this paragraph will be on the scientific literature about the general principle guiding clustering and business network development. The following paragraph will give a general overview of the relation between clustering and network development, where after spatial proximity to knowledge institutions and other companies, and sub-local clustering will be shortly introduced. In the later paragraphs, the effect on the business network development regarding local clustering, sub-local clustering and the combination of local and sub-local clustering will be discussed into more detail.

Firstly, the effect of geographic location on the knowledge flow will shortly be discussed, because knowledge flows are important in network ties. Geographic location of companies has an important influence on knowledge flow. ‘’The difficulty of transmitting knowledge between individuals in organizations increases with geographic distance, or conversely, decreases with proximity’’ (Bell & Zaheer, 2007, p. 957). There are varying reasons for the increased knowledge flow when being geographically proximate, because meetings are more easily planned, tacit knowledge can more easily be given through with the use of demonstration, firm managers can more easily meet and trust is more easily generated (Bell & Zaheer, 2007). Bell & Zaheer (2007) make a distinction between institutional ties (for example industry trade associations) and organisational ties (for example alliances). It was found that being geographically proximate significantly enhanced the knowledge flow for institutional ties, however the hypothesis of more knowledge flow for geographically proximate organisational ties (in comparison with distant organizational ties) was not supported by the data. This may be caused by the way of measuring organisational ties (only as ownership or managing funds of one another), but is nonetheless an interesting result.

Huggins & Johnston (2010) did research into the influence of spatial proximity on knowledge flow. The existence of spatially proximate knowledge networks enables regions to be successful and to stay successful. ‘’Inter-firm knowledge networks are considered to be a crucial element underlying the economic success and competitiveness of regions’’ (Huggins & Johnston, 2010, p. 464). External institutions in the region, like R&D labs, universities and other firms, provide networking opportunities for companies, from which the companies can

become more competitive when being spatially proximate (Huggins & Johnston, 2010). Huggins & Johnston (2010) further point at a difference between small and large firms: ‘’The networks of small firms tend to be more localized than those of larger firms’’ (Huggins & Johnston, 2010, p. 475-476). When firms have a well-developed local network, they invest more in social capital development, which can lead to a better developed knowledge network and ultimately to higher levels of innovation (Huggins & Johnston, 2010). As USOs of course do not start off as large firms, the local networks can be very important.

Speldekamp et al. (2020) have performed a systematic review of 212 cluster studies, with the goal to better take into account the complex interrelationships that exist between geography, networks and institutions. With this study, the authors try to make the complex interrelationships between those three dimensions more clear. Combining these three dimensions, the authors discover four different views on clusters (see figure 1): ‘Clusters as location-bound networks (LBN)’, ‘Clusters as governed networks (GOV)’, ‘Clusters as location-bound institutional arrangements (LBI)’ and ‘Clusters in a system-level perspective (SYS)’. The percentage stands for the part of cluster studies that were examined, that fitted that particular dimension. The authors show with this study that there are many different views on the complex interrelationships between geography, institutions and networks, leading to those four multidimensional perspectives, which still do not fully take the complementarity of the three cluster dimensions into account. The goal of this research is to investigate the effect of geographic clustering on network development of USOs, so in this research the view on clusters as ‘location-bound networks (LBN)’ will be taken into account when analysing to what extent different business environments contribute to both scientific and commercial business network development of Radboud University spin-offs.

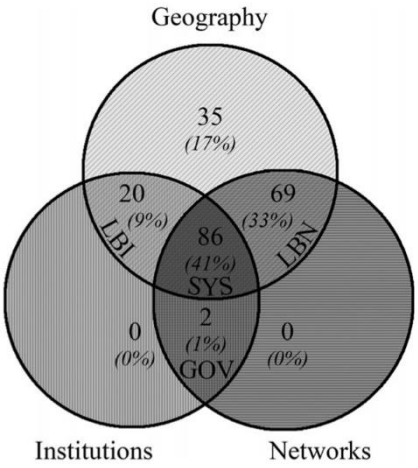

Figure 1: Multidimensional hits' empirical use of dimensions (and percentage of total). (Speldekamp et al., 2020, p. 79)

§2.2.1 Spatial proximity to knowledge institutions and development scientific business network

Now that the general principle guiding clustering and network development has been discussed, this paragraph will shortly elaborate about clustering and development of the scientific business network. As discussed in the former paragraph, Huggins, & Johnston (2010) did research about the influence of spatial proximity on knowledge flows, concluding that being spatially

proximate to universities (and other knowledge institutions) provides networking opportunities for companies. Clustering in a region where there is a university or other knowledge institutions thus provides networking opportunities and can lead to an enhanced development of the scientific business network (Huggins, & Johnston, 2010; Speldekamp et al., 2020). This effect will be discussed in more detail in the remainder of the theory chapter, while distinguishing between local clustering, sub-local clustering and the combination of local and sub-local clustering.

§2.2.2 Spatial proximity to other companies and development commercial business network

Clustering of companies can provide opportunities for the commercial business network development. As Huggins & Johnston (2010) discuss, being proximate to other firms also provides networking opportunities for companies, which is especially important for small firms, since their networks are more localised than large firms. The effect of clustering and the development of the commercial business network will also be discussed in more detail in the remainder of the theory chapter, also making the distinction between local clustering, sub-local clustering and the combination of local and sub-local clustering.

§2.2.3 Sub-local clustering on business parks

Sub-local clustering entails, in this research, companies being clustered together on a business park. There are varying sorts of business parks. Business parks are constructed to help small companies overcome some obstacles by providing them premature business facilities, administrative services and office space (Bøllingtoft & Ulhøi, 2005). But the services business parks provide are not the focus of this research, clustering of companies is. On business parks, companies cluster together, which creates opportunities for scientific and commercial business network development, as it facilitates companies getting in contact with each other through being spatially proximate (Huggins & Johnston, 2010; Bøllingtoft & Ulhøi, 2005). In this research, a distinction will be made between two forms of business parks: science parks and ordinary business parks, as will be discussed in the following paragraphs.

§2.2.4 Sub-local clustering on a science park

The business environments that will be mainly focused on are, as said, science parks and ordinary business parks. In this paragraph, the focus is on the network development of USOs located on a science park in a university city region. The networks of these firms are compared with the networks of USOs located elsewhere within a university city region or outside a university city region. The definition of a science park that will be used in this research is: ‘’A

property-based initiative which has formal and operational links with a university, designed to encourage the formation, transfer and growth of (technology) knowledge based businesses and other organizations normally resident on site'' (Bakouros et al., 2002, p. 124). This research will only research science parks that are located on the terrain of a University, such as the Mercator science park (MSP) in Nijmegen, which is involved with the Radboud University. Science parks differ from ordinary business parks, in the aspect that science parks usually have more focus on regional development and supporting regional technological strengths. Science parks also tend to have more focus on young technology-based firms (Ratinho & Henriques, 2010; Amirahmadi & Saff, 1993).

§2.2.5 Sub-local clustering on an ordinary business park

Next to science parks, there are also ordinary business parks. In this paragraph, the focus is on network development of USOs located on an ordinary business park in a university city region. Network development of these firms are compared with the networks of USOs located within a university city region on a science park as well as with other USOs (including both USOs located elsewhere within the university city region and USOs located outside the university city region). The definition of an ordinary business park that will be used in this research is: ''An economic development tool designed to accelerate the growth and success of entrepreneurial companies through an array of business support resources and services'' (Bøllingtoft & Ulhøi, 2005, p. 269). A form of the business support resources and services are the networking opportunities ordinary business parks provide, because of the network of the ordinary business park and of being spatially proximate the other companies that are located on the ordinary business park.

§2.2.6 Multi-company building

Science parks and ordinary business parks can differ in shape and form, because there may be one multi-company building where all companies are housed, or it may be a big terrain with autonomous buildings for the companies, but since most business parks (including the MSP) exist out of a multi-company building, the focus will be on multi-company buildings. When USOs are accommodated in a multi-company building with other companies, it can be presumed that the entrepreneurs are more likely to meet the entrepreneurs of the other companies in person, as opposed to being located in autonomous buildings. This can possibly have an influence on the business network development. Cooper, Hamel & Connaughton (2012) have found that the meetings between organisations in an incubator are primary face-to-face. The meetings occur at the common areas and for example during coffee breaks, where

physical proximity is very important: ‘’Physical proximity is a primary catalyst for communication in the resident member’s network’’ (Cooper et al., 2012, p. 449). When companies are located in a multi-company building, rather than a stand-alone building, the distance between the companies is smaller and thus there is more physical proximity, which might provide more business network opportunities and therefore enhance the scientific and commercial business network development.

§2.3 Local clustering

Now that the general overview of the effect of clustering on business network development has been discussed, the effects of local clustering, sub-local clustering and the combination of local and sub-local clustering will be discussed. Before the discussion of the scientific literature about sub-local clustering and the combination of local and sub-local clustering, firstly the effect of local clustering on scientific and commercial business network development will be discussed, which relates to the first sub-question: *To what extent is the development of the scientific- and commercial business network of USOs of the RU influenced by local clustering?* Of course, companies do not always have to be located on either an ordinary business park or a science park to enhance the networking opportunities and to get the varying types of assistance that these locations offer, because the regions that the USOs are located in can also provide networking opportunities and varying types of assistance. The clusters that are discussed by Speldekamp et al. (2020) can also be formed and participated in outside ordinary business parks or science parks.

§2.3.1 Clustering and development scientific business network: the case of a university city

Regional clusters provide scientific business networking opportunities for USOs. A university in the region can be very beneficial for companies. ‘’Universities transfer scientific knowledge, whether through their faculty research or through the education carried in their students’’ (Simard & West, 2006, p. 4). Universities can create and be a source of knowledge in the region, for example through knowledge spill overs, licensing and patenting, but also from the students that enter the labour market. Venture capitalists, other companies, and regional governance can also be a source of knowledge creation in the region, which of course also provide networking opportunities (Simard & West, 2006). Huggins, Johnston, & Steffenson (2008) performed a critical review of the relation between universities, knowledge networks and regional policies. The authors note that universities are important actors in networks of regional clusters, mainly concerning the knowledge-based activities. However, Huggins et al. (2008) note that, in order to achieve and sustain this effect, ‘’it is vital that knowledge transfer and networks initiatives

are fully supported to ensure sustainability'' (p. 333). Science parks are said to be able to enhance the knowledge transfer between universities and the region. Huggins et al. (2008) further mention that probably the biggest effect of universities for knowledge creation in the region is through the students that enter the labour market, and through the education activities. Not only the university can have a positive influence on the region, USOs can also have an effect. Benneworth & Charles (2005) have tried do develop a conceptual model to see how USOs can improve their regional economies, concluding that USOs can play a role in creating a regional knowledge pool, which can also be used by other firms. The authors however note that more research is required into this effect, but it is nonetheless an interesting result.

In the region of Nijmegen, the Radboud University is active. The presence of the Radboud University is expected to lead to the described advantages for the region and for the USOs that are located near the university and the companies in Nijmegen, leading to more expected scientific business network development.

The scientific literature about the influence of local clustering on scientific business network development leads to the following hypothesis:

H1: The closer USOs are located near the city of Nijmegen, the stronger the development of their scientific business network.

§2.3.2 Clustering and development commercial business network

The view of clusters as 'location-bound networks' focusses on the ''benefits to a firm from geographic proximity with knowledge benefits from network connections'' (Speldekamp et al., 2020, p. 80). The authors further discuss the benefits of geographic proximity: ''Geographic proximity lowers communication costs and being located in a cluster increases the availability of potential collaborative partners'' (Speldekamp et al., 2020, p. 80). This shows that geographic proximity to other firms can provide opportunities for commercial business network development.

Because of the globalization, regional innovation networks have become more important. Companies can choose to locate themselves wherever they want, and can choose the region that would benefit them the most, for example in the regions where other companies are located with whom they can work together with (Hotz-Hart, 2000). The region of Nijmegen is such a region where many companies are located. Hotz-Hart (2000) has formed dimensions that are tied to a region, which can create advantages: 'Regional labour market', 'educational system', 'R&D institutions', 'professional traditions and experiences', 'economies in information flow and knowledge spill overs' and 'the institutional setting' (p. 5). All these

regional dimensions can create advantages and new opportunities for commercial business networking, leading to the following hypothesis[1]:

H2: The closer USOs are located near the city of Nijmegen, the stronger the development of their commercial business network.

§2.4 Sub-local clustering/clustering in multi-company buildings

In this paragraph, sub-local clustering in a university city region will be discussed, focusing on the question: *To what extent is the development of the scientific- and commercial business network of USOs of the RU influenced by sub-local clustering?* Sub-local clustering entails, as discussed before in the second chapter, companies being clustered together on a business park in a multi-company building (shared housing situations).

§2.4.1 Sub-local clustering and development commercial business network

In this paragraph, the influence of sub-local clustering in a multi-company building on the commercial business network development will be discussed. Firstly, a multi-company building standing on a science park will be discussed. Phan et al. (2005) argue that clustering of companies generates contacts between companies, so develops the business network. Being located on a science park provides many scientific business network opportunities and may lead to over developing the scientific business network, due to the strong presence of the university and the focus on knowledge transfer and technology. There is a risk that by focussing mainly on the scientific business network, the commercial business network might become underdeveloped, with the risks that the products are not market oriented (Perez & Sánchez, 2003; Roberts, 1990). Nonetheless, on a science park, other firms are also active, which can also create commercial business networking opportunities.

Now, the influences on the commercial business network of being located on a multi-company building in an ordinary business park will be discussed. To form a better image about ordinary business parks, some examples of the services ordinary business parks provide will be discussed, which are: ‘’assistance in developing business and marketing plans, building management teams, and obtaining capital and access to a range of other more specialized professional services’’ (Bøllingtoft & Ulhøi, 2005, p. 269; Sherman & Chappell, 1998). Ordinary business parks further give access to equipment, flexible space, administrative services and provide networking opportunities (Bøllingtoft & Ulhøi, 2005; Ratinho &

[1] Radboud University spin-offs can also be located in other big cities (as opposed to Nijmegen), where they also can get the advantages for the business network development from local clustering. However, overall the USOs (which participated in this research) are widespread.

Henriques, 2010). However, not all ordinary business parks offer the same services. Ordinary business parks facilitate the clustering of companies that are located on it. As the former discussed effects of spatial proximity of companies on providing networking opportunities (Huggins, & Johnston, 2010; Speldekamp et al., 2020), the clustering of companies in shared housing situations on business parks is expected to lead to a more extensive commercial business network compared to other USOs.

Concluding from the described positive influences of being located in a multi-company building (on a science park and on an ordinary business park) on the commercial business network development, the following hypothesis is made:

H3: USOs in shared housing situations develop a larger commercial business network, compared to other spin-offs

§2.5 Local and sub-local clustering combined

Now that the effects of local and sub-local clustering of USOs on the business network development have been discussed separately, this paragraph will focus on the combination of local and sub-local clustering. The focus will be, for example, on the question whether being located in a multi-company building inside the region of Nijmegen leads to more business network development, as opposed to being located in a multi-company building outside the region of Nijmegen, which relates to the sub-question: *To what extent is the development of the scientific- and commercial business network of USOs of the RU influenced by combinations from local- and sub-local clustering?* A distinction will be made between the scientific business network development and the commercial business network development.

§2.5.1 Sub-local clustering in a university city and development of scientific business network

In this paragraph, the influences of the combination of local and sub-local clustering on the scientific business network development of USOs will be discussed. As discussed in the theory section about local clustering and the development of the scientific business network, a university can create and be a source of knowledge in the region (Simard & West, 2006). Being located on a science park can create scientific business networking opportunities. Companies located on science parks are more effective in generating new products, services and patents, compared to companies that are not located on a science park. (Phan et al., 2005; Siegel, Waldman, & Link, 2003). ‘’As well as providing firms with subsidized laboratory space, science and technology parks often provide consulting services, networks and connections to university faculty, other firms and venture capitalists’’ (Huggins et al., 2008, p. 328). Huggins

et al. (2008) thus highlight the networks and connections to the university faculty are available for companies that are located on science parks, which can lead to more scientific business network development.

The presence of the Radboud University in the city of Nijmegen is expected to lead to more scientific business network development of USOs that are located within the city of Nijmegen, as opposed to other USOs. The effects of clustering in a multi-company building on a science park have also been discussed, summarizing that companies that are located on science parks profit from being located on them and from the proximity to the university (Phan et al., 2005; Speldekamp et al., 2020). The described advantages from local and sub-local clustering on the scientific business network development leads to the following hypothesis:

H4: USOs in shared housing situations on a science park develop a larger scientific business network, compared to other USOs.

Now that the effect of the combination of local and sub-local clustering on the scientific business network development has been discussed (a science park in the region of Nijmegen), it is also interesting to look at the effect of being located in the region of Nijmegen, but not on a business park. Speldekamp et al. (2020) note that clusters, where respected universities are active, are able to reach higher research and development productivity, as discussed in paragraph 2.3.1. In addition, it has been discussed that a university in the region can be very beneficial for companies, in the form of creating and being a source of knowledge, through knowledge spill overs, licensing and patenting, and also from the students that enter the labour market in the region. In addition to the university, venture capitalists, other companies and regional governance can also be a source of knowledge creation in the region, which creates scientific business network opportunities (Simard & West, 2006).

The city of Nijmegen is such a region where there is a university and there are a lot of other companies, hereby creating opportunities for the USOs that are located in the city of Nijmegen for developing their scientific business network, leading to the following hypothesis:

H5: USOs located in the city of Nijmegen, but not on a business park, develop a larger scientific business network, compared to USOs outside of the city of Nijmegen.

§2.5.2 Sub-local clustering and development of commercial business network

In this paragraph, the influences of the combination of local and sub-local clustering on the commercial business network development of USOs will be discussed. As discussed before, companies can profit from physical proximity to each other for their business network

development (Cooper et al., 2012). In a multi-company building, the companies are very closely together, which thus might lead to a more advanced commercial business network. In addition to the advantages of being located in a multi-company building, there can possible also be advantages if the multi-company building is located within the region of Nijmegen, where many companies are located, which leads to the following hypothesis:

H6: USOs in a multi-company building in Nijmegen develop a larger commercial business network, compared to other USOs.

§2.5.3 Spatial hierarchy local and sub-local clustering

The last hypothesis will be a bit more exploratory, because the current scientific literature on the spatial hierarchy of agglomeration advantages is thin; for example, is sub-local clustering outside the region of Nijmegen more or less beneficial for the development of the commercial business network, as opposed to local clustering in Nijmegen, but not on a business park? Such a company (which is located on a business park outside the region of Nijmegen) would profit from the spatial proximity of being located in a multi-company building on a business park, but would not (fully) be able to profit from the local clustering advantages of the region of Nijmegen, where there presumably are a lot more companies. Thus, when a company is located in a multi-company building outside the region of Nijmegen, it can profit from the sub-local clustering, but not (to a lesser extent) from the local clustering. This might lead to the fact that companies, which are not in a multi-company building, but are located within the region of Nijmegen, show more commercial business network development than companies located in a multi-company building outside the region of Nijmegen, which leads to the final hypothesis:

H7: USOs in a multi-company building outside Nijmegen develop a smaller commercial business network, compared to stand-alone USOs located in Nijmegen.

§2.6 Conceptual Model

In this chapter, the central concepts relevant to the research question have been discussed: Entrepreneurship, USOs, business network (development), scientific and commercial business networks and location. Entrepreneurship has been explained based on Carton et al. (1998). USOs have also been discussed as being companies ‘’whose products or services develop out of technology-based ideas or scientific / technical know-how generated in a university setting by a member of faculty, staff or student who founded (or co-founded with others) the firm’’ (Rappert et al., 1999, p. 874). Universities create spin-offs to create jobs, contribute to national competitiveness and for a financial return (Mustar et al., 2008). The location of a spin-off has

influence on the performance of that spin-off (Bigliardi et al., 2013) and on the business network development. It has been made clear that entrepreneurs use their network for gaining knowledge and resources they do not possess themselves, which is of great value to the entrepreneurs and the success of the business (Greve & Salaff, 2003; Watson, 2012). A distinction has been made between the scientific (number of employees of a scientific knowledge institution with which a USO maintains personal contact) and the commercial (number of (possible) clients with which a USO maintains personal contact) business network, which are both important for USOs. USOs are said to have an overdeveloped scientific business network, but an underdeveloped commercial business network, which leads to the risk that the products will fail in the market (Perez & Sánchez, 2003; Roberts, 1990). One factor that influences the business network development of USOs is their location. The effects of local clustering, sub-local clustering and the combination of local and sub-local clustering have been discussed, which has led to seven hypotheses. The conceptual model for this research is (Figure 2):

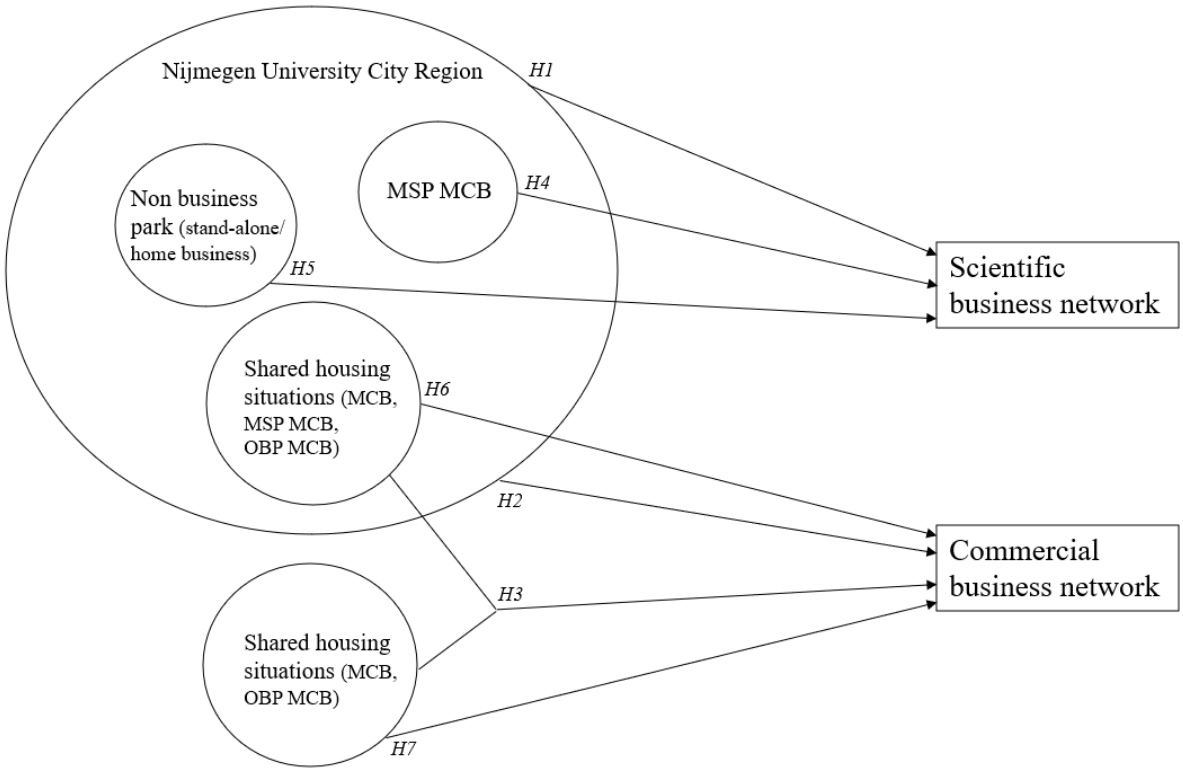

Figure 2: Conceptual model. MSP = Mercator science park. OBP = ordinary business park. MCB = multi-company building.

§3 Methodology

In this chapter, the methodological choices of this research will be explained. The research methodology choice (qualitative or quantitative) and the research unit (population and observation-unit) will be explained. Furthermore, the theoretical concepts will be operationalised, the validity and reliability will be discussed and finally the method of analysis and the ethics will shortly be explained.

§3.1 Research Methodology

In scientific research, a distinction is made between qualitative or quantitative research. Qualitative research is about gathering and interpreting spoken and/or written words to come to conclusions about a social phenomenon. Quantitative research is aimed at collecting figures, for example resulting from a survey (Bleijenbergh, 2015). To answer the research question of this research: '*What is the effect of clustering on different spatial scale levels on the development of the scientific- and commercial business network of USOs?'* a quantitative study will be performed, through the use of a survey, because a survey is particularly useful to conduct research among a large set of comparable units, and to empirically test all the relations (hypotheses) from the conceptual model (Vennix, 2016, p. 77).

Furthermore, a scientific research can be theoretically or practically oriented. This research will be theoretically oriented, because it tries to contribute to the scientific knowledge about clustering of firms, USOs in this research, at different spatial scale levels in connection with the scientific and commercial business network development. A practically oriented research would have the goal to enhance the knowledge about a certain situation in an organisation, with the goal to improve it (Bleijenbergh, 2015). This is not the goal of this research, but nonetheless the entrepreneurs in charge of the USOs and the university might find the outcomes of this research useful for the housing policies of USOs.

§3.2 Research Unit

For this research, the data that will be used has already been gathered. The research population are USOs from the Radboud University (companies which are founded by students, graduates and employees from the Radboud University). The observation-unit are the entrepreneurs who are in charge of the USOs. The survey has been sent out to USOs, using a file of addresses of Radboud University USOs known to the management of the Mercator science park. The entrepreneurs have been invited by letter to fill out an online questionnaire. The data that will be used will consist of the gathered data in 2004, 2008 and 2011 (see Appendix 1).

§3.3 Operationalisation

In this paragraph, the different spatial scale levels used in this research will be summed up in a table, to make it more clear what the different locations of USOs can be that are used in this research. Furthermore, the central concepts from the hypotheses will be made empirically testable.

To sum up, next to science parks and ordinary business parks, an entrepreneur can of course also choose to be located elsewhere, or work from his home. Furthermore, the location of the USO may be in the region or outside the region of Nijmegen. This leads to the following possibilities, which will be discussed in more detail in §4 (see Table 1):

<table>
<tr><td colspan="5">I Inside the region of Nijmegen (regional clustering)</td></tr>
<tr><td rowspan="2">1) Science Park multi-company building</td><td rowspan="2">2) Ordinary business park multi-company building</td><td rowspan="2">3) Outside university campus multi-company building</td><td colspan="2">Stand alone</td></tr>
<tr><td>4) Autonomous building</td><td>5) Business at home</td></tr>
<tr><td colspan="5">II Outside the region of Nijmegen (widespread over the Netherlands)</td></tr>
<tr><td colspan="2">6) Ordinary business park</td><td colspan="2">7) Multi-company building</td><td colspan="2">Stand alone</td></tr>
<tr><td colspan="2"></td><td colspan="2"></td><td>8) Autonomous building</td><td>9) Business at home</td></tr>
</table>

Table 1: Different spatial scale levels sub-local clustering

The central concepts from the hypotheses will be made empirically testable in this paragraph (see Table 2).

Variable type	**Variable name**	**Item + question-number**	**Min**	**Max**	**Measurement level**	**Origin**
Dependent	Scientific business network	Importance of knowledge/information source Radboud University / UMC St. Radboud	1	4	Ordinal	Question 13.1e App. 1
		Importance of knowledge/information source other universities or public research institutions	1	4	Ordinal	Question 13.1f. App 1
		Importance of knowledge/information source higher	1	4	Ordinal	Question 13.1g App. 1

		professional education (HBO)				
		Importance of knowledge/information source consultants, commercial laboratories or private R&D-institutions	1	4	Ordinal	Question 13.1h App. 1
	Commercial business network	Importance of knowledge/information source clients	1	4	Ordinal	Question 13.1.b App. 1
Independent[2]	Local clustering	Location relative to Nijmegen	1	4	Nominal	Address data App. 1
	Sub-local clustering	Nine dichotomous variables: Location in Nijmegen on university MCB, OBP, MCB, stand alone or home business, location outside Nijmegen on OBP, MCB, stand alone or home business (see Table 1)	0	1	Nominal	Question 20 & Address data App. 1
Control	Sector	Sector of the USO	1	5	Nominal	Question 3 App. 1

Table 2: Operationalisation

§3.4 Validity and Reliability

Validity and reliability are very important concepts in scientific research. Validity means that the research 'measures what it wants to measure'. Reliability means that the conclusion stays the same if the research would be repeated (Vennix, 2016). A distinction is made between internal and external validity (Vennix, 2016). To ensure the overall validity in this research, the steps taken in this research will be described as detailed as possible. To ensure internal validity, the concepts will be measured as specific as possible, for example a precise measurement of

[2] The independent variables consist of dichotomous variables about the location of the USOs, which will be discussed in more detail in §4.

the housing situation of the USOs and the number of contacts of the entrepreneur with (possible) clients and employees of the scientific knowledge institutions. To ensure external validity, the survey has been as concise as possible (not asking the data that is already known from previous surveys). The reliability is enhanced by using a well-developed and used survey which accurately measures the behaviour and data of the entrepreneur and the USOs (not measuring opinions), and by carefully presenting the methods of analysis and the results, which also leads to an increase in controllability. At the end of this research, the choices made (processing the data, method of analysis, conclusions etc.) will be reflected upon. The influence of the role of the researcher will also be discussed.

§3.5 Method of Analysis and Ethics

To test the hypotheses about to what extent different spatial scale levels of the business environment differentiate regarding their impact upon both the scientific and commercial business network development of Radboud University spin-offs, linear regression will be used, because linear regression enables testing the hypotheses. Linear regression analysis is used to determine to what extent there is a linear relationship between the dependent and the independent variables (Field, 2014).

Ethics are very important in research. To enhance the ethics, the research will be done with transparency. To enhance the transparency, the respondents have been informed with the purpose of the research and when the research was finished, have been informed about the outcomes of the research. The previously gathered data from the survey will be handled and processed with strict confidentiality. It will not be possible to derive the data from individual companies out of the results of this research.

§4 Results

Now that the research question has been formed, the theory has been discussed and the methodology has been explained, this chapter will discuss the results of the survey. Firstly, the response to the survey and the construction of variables will be discussed. Thereafter, a univariate, bivariate and multivariate analysis will be performed, leading to the testing of the hypothesis. At the end of this chapter, a short summary of the results will be given.

§4.1 Response

For this research, a combination of the data of the surveys performed in 2004, 2008 and 2011 will be used, as stated in the methodology chapter. The data list consists of 332 respondents (USOs) (N=332), which will be used for performing the univariate, bivariate and multivariate analysis. Some respondents have participated in one, two or all three the survey. This leads to the fact that for some variables an average will be calculated and used. In Table 3, an overview of the distribution between the sectors of the USOs is given.

Sector	**Frequency**
Industry	9
Trade	29
R&D work	39
ICT	25
Service, training, health and wellness	221
Missing	9
Total	332

Table 3: Distribution sectors of USOs

§4.2 Construction of Variables

In this paragraph, the construction of the variables that will be used in the analysis will be discussed. Firstly, the construction of the dependent variables will be discussed, where after the construction of the independent variables will be discussed. Lastly, the construction of the control variables will be discussed.

§4.2.1 Construction dependent variables

The dependent variables consist of the development (and mean use) of the scientific business network and the development (and mean use) of the commercial business network.

Development (and mean use) of scientific business network

The mean use of the scientific business network is calculated and composed by the use of four sub-questions: v11e, v11f, v11g and v11h (see blue coding Appendix 1). The answers to these questions led to four values for each sub-question: ‘1=source not used’, ‘2=somewhat important’, ‘3=important’, ‘4=very important’. The average of these four variables led to the variable of the scientific business network ‘v11efgh’. The variable that will be used to indicate

the development of the scientific business network is constructed using the mean of the use of the scientific business network through the years of the USOs. To get the variable that indicates the development of the scientific business network over time, a variable named v11efgh_growth is made, which calculates the development of the scientific business network of USOs over the years they have filled in the survey.

Development (and mean use) of commercial business network

The variable that will be used to indicate the mean use of the commercial business network is constructed using variable v11b (see blue coding Appendix 1). The answers to the sub-question v11b also led to four values: '1=source not used', '2=somewhat important', '3=important', '4=very important'. To then get the variable that indicates the development of the commercial business network over time, a variable named v11b_growth is made, which calculates the development of the commercial business network of USOs over the years they have filled in the survey[3].

§4.2.2 Construction independent variables

The independent variables consist of local clustering and sub-local clustering.

Local clustering

The variable about local clustering is constructed out of a variable named 'cluster' that can take four values: '1: elsewhere in the Netherlands', '2: in the suburban ring around Nijmegen (<25km)', '3: elsewhere in Nijmegen', '4: on the terrain of the university'. These four values are used to construct a new variable, which takes the value 1 if the USO is located 'elsewhere in Nijmegen' or 'on the terrain of the university', and the value 0 if the USO is located 'elsewhere in the Netherlands' or 'in the suburban ring around Nijmegen'. The local clustering variable thus indicates if a spinoff is located inside or outside Nijmegen.

Sub-local clustering

There are a number of dichotomous variables (nine), which indicate if a company is located in Nijmegen on a science park MCB (UT_MCB), an ordinary business park (Nijm_CBP), MCB outside university campus (Nijm_MCB), stand-alone building (Nijm_SO) or home business (Nijm_HM). Adding to that, there are dichotomous variables which indicate if a company is

[3] For the commercial business network, there were sixteen cases in which companies filled in the highest value of '4' in consecutive years. This leads to the fact that for those companies, the questionnaire did not allow growth, because these USOs were already at the highest value of this variable. To account for this effect, the first time the company scored '4' is set on missing. USOs, who scored '4' in consecutive years, are thus not taken into the construction of the growth variable for the commercial business network.

located outside of Nijmegen on an ordinary business park (Ned_CBP), in a MCB (Ned_MCB), stand-alone building (Ned_SO) or home business (Ned_HM). Out of these dichotomous variables, five overarching variables are made, which make the testing of hypothesis 3-7 possible. These variables are: 'spinoffs located on MCB', 'located on university grounds in a MCB', 'spinoffs located in the city of Nijmegen but not on a business park', 'spinoffs located on MCB in Nijmegen' and 'Netherlands MCB'. The values these variables take can be found in Table 4. For clarification; the variable 'spinoffs located on MCB' takes the value 1 if the spinoff is located on a MCB (UT_MCB, Nijm_MCB, Ned_MCB), and the value 0 if the spinoff is located elsewhere.

	Spinoffs located on MCB	Located on university grounds in a MCB	Spinoffs located in the city of Nijmegen but not on a business park	Spinoffs located on MCB in Nijmegen	Netherlands MCB
UT_MCB	1	1	-	1	-
Nijm_CBP	0	0	-	0	-
Nijm_MCB	1	0	1	1	-
Nijm_SO	0	0	1	0	0
Nijm_HM	0	0	1	0	-
Ned_CBP	0	0	0	0	-
Ned_MCB	1	0	0	0	1
Ned_SO	0	0	0	0	-
Ned_HM	0	0	0	0	-

Table 4: Variables sub-local clustering

§4.2.2 Construction control variables

The sector of the USOs will function as a control variable in this research.

Sector

The variable 'sector' is constructed from question 3 of the survey (see Appendix 1). The variable can take on five values, '1: Industry, '2: Trade', '3: R&D work', '4: ICT', '5: Service, training, health and wellness' (see Table 3).

§4.3 Univariate analysis

In this paragraph, an overview will be given about the variables that are used in the analysis, which will include the mean, median, mode, standard deviation, min. and max., skewness and kurtosis (see Table 5).

Dependent variables	Mean	Median	Mode	Standard deviation	Min.	Max.	Skewness	Kurtosis
Development of scientific business network	,31	,00	0	0,86	-2,5	3	,17	,60
Mean use of scientific business network	1,77	1,67	1	,77	1	4	,68	-,46
Development of commercial business network	-,08	,00	0	1,31	-3	3	-,20	,08
Mean use of commercial business network	2,77	3,00	3	,95	1	4	-,43	-,71

Table 5: Descriptive statistics

In this research, four dependent variables will be used. The two main dependent variables are: 'the development of the scientific business network' and 'the development of the commercial business network'. For further grip on and understanding of the data and the development of the scientific and commercial business network, it is also helpful to look at the mean use of the scientific and commercial business network of the USOs. The mean use of the scientific and commercial business network will thus also be used as dependent variables. The skewness and kurtosis of the dependent variables fit the criteria of needing to be between -3 and 3 (Hair, Black, Babin, & Anderson, 2014).

One of the independent variables which will be used is the variable about the 'location of the USOs regarding Nijmegen', which can take four values: '1=elsewhere in the Netherlands', '2=in the suburban ring around Nijmegen (<25km)', '3=elsewhere in Nijmegen', '4=on the terrain of the university'. As discussed in the paragraph about the construction of the variables, this variable is used to construct the variable 'local clustering'. This way, USOs located outside Nijmegen will be the reference category for this variable, enabling them to be compared to USOs located inside Nijmegen. The variables that will be used for the sub-local clustering are the five overarching variables formed out of the nine dichotomous variables (see Table 4). For an overview of the distribution of USOs over the independent variables, see Table 6.

Local clustering	
Location of USOs regarding Nijmegen	Number of USOs
Elsewhere in the Netherlands	101
In the suburban ring around Nijmegen (<25km)	60
Elsewhere in Nijmegen	125

On the terrain of the university	45
Total:	331
Missing:	1
Sub-local clustering	
University MCB (UT_MCB)	42
Conventional business park Nijmegen (Nijm_CBP)	8
Nijmegen outside university campus MCB (Nijm_MCB)	19
Nijmegen stand alone company (Nijm_SO)	20
Nijmegen home business (Nijm_HM)	25
Netherlands outside Nijmegen on business park (Ned_CBP)	8
Netherlands outside Nijmegen in MCB (Ned_MCB)	16
Netherlands outside Nijmegen stand alone (Ned_SO)	13
Netherlands outside Nijmegen home business (Ned_HM)	58

Table 6: Distribution of location of USOs

The control variable 'sector', which can take on five values: '1=Industry', '2=Trade', '3=R&D work', '4=ICT' and '5=Service, training, health and wellness' has been discussed in the previous paragraph (see Table 3).

§4.4 Bivariate analysis

In this paragraph, the results of the bivariate analysis will be discussed. The sample size of 332 is large enough to perform the linear regression analysis, according to the rule of thumb of 10 cases of data for each predictor in the model (Field, 2014). Furthermore, there are no problems with the normality of the data, concluded from the values of the skewness and kurtosis in the univariate analysis.

Now, the focus will be on to what extent multicollinearity exists. To calculate the correlations between the variables, a Pearson correlation matrix has been made (see Table 7, p. 32). According to Field (2014), values higher than .10 show a small effect, values higher than .30 show a medium effect and values higher than .50 show a large effect. Normally, the independent variables should correlate with the dependent variables, but not with each other. In this research, the independent variables consist of categorical variables, some of which are combinations of them, so correlations between those categorical variables are unavoidable.

The Pearson correlation matrix can also be used to already look at the effects between the independent and the dependent variables before they finally will be tested in the multivariate analysis.

The first two hypotheses test the effects of local clustering. The first hypothesis expects that the closer USOs are located near the city of Nijmegen, the stronger the development of their scientific business network. The table does not show a significant (positive) effect. The second hypothesis expects that the closer USOs are located near the city of Nijmegen, the stronger the development of their commercial business network. The table shows a significant positive effect between a spinoff located in Nijmegen and the development of the commercial business network, with a small effect of .24. This is in accordance with the second hypothesis and will further be analysed and discussed in the multivariate analysis.

The third hypothesis tests the effect of sub-local clustering. The third hypothesis expects that USOs located in a MCB (shared housing situations) develop a larger commercial business network, compared to other spin-offs. The table does not show a significant (positive) effect.

The fourth to seventh hypotheses test the effects of combinations between local- and sub-local clustering. The fourth hypothesis expects that USOs in shared housing situations on a science park develop a larger scientific business network, compared to other USOs. The table does not show a significant result of this effect. However, the table does show a significant positive effect of being located on a university MCB on the mean use of the scientific business network, with a small effect of .26. The fifth hypothesis expects that USOs located in the city of Nijmegen, but not on a business park, develop a larger scientific business network, compared to USOs outside of the city of Nijmegen. The table does not show a significant result of this effect. The sixth hypothesis expects that USOs in a multi-company building in Nijmegen develop a larger commercial business network, compared to other USOs. The table shows a significant positive effect of being located in a multi-company building in Nijmegen on the development of the commercial business network, with a small effect of .27., which is in accordance with the hypothesis. The seventh hypothesis expects that USOs in a multi-company building outside Nijmegen develop a smaller commercial business network, compared to stand-alone USOs in Nijmegen. The table shows a significant negative effect of being located in a multi-company building outside Nijmegen (compared to stand-alone USOs in Nijmegen) on the development of the commercial business network, with a medium effect of .47. This is in accordance with the hypothesis. There are also differences in the sectors of the USOs, in which the trade sector shows a significant positive effect with the development of the commercial business network, with a small effect of .22. The sectors industry and trade show a significant

positive effect on the mean use of the scientific business network, with small effects of .17 and .18 respectively. The sector service, training, health and wellness has a significant negative effect on the mean use of the scientific business network, with a small effect of .18.

Concluding, some expected effects of the hypothesis were (partly) visible in the Pearson correlation matrix, while others were not. In the next paragraph, it will be made clear which hypothesis will be accepted and which will be rejected, by performing the multivariate analysis.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Development of use scientific business network	1														
2. Mean use of scientific business network	,09	1													
3. Development of use commercial business network	-,04	-,17	1												
4. Mean use of commercial business network	,07	,14*	-,13	1											
5. Spinoffs located in Nijmegen	-,05	,09	,24*	,06	1										
6. Spinoffs located on MCB	-,14	,24**	,07	,06	,39**	1									
7. University MCB	-,06	,26**	,30**	,11	,47**	,65**	1								
8. Spinoffs located in the city of Nijmegen, not on BP	,01	,00	,12	,11	1,00**	,11	.c	1							
9. Spinoffs located on MCB in Nijmegen	-,06	,16*	,27**	,04	,60**	,84**	,78**	,44**	1						
10. Netherlands MCB (0=Nijm_SO)	-,15	,36*	-,47*	-,20	-1,00**	1,00**	.c	-1,00**	.c	1					
11. Industry	,16	,17**	-,04	,06	-,00	,14*	,07	-,10	,04	,28	1				
12. Trade	-,08	-,07	,22*	,05	,00	-,18*	-,12	,03	-,13	-,35*	-,05	1			
13. R&D work	-,10	,18**	,13	-,07	,08	,27**	,37**	-,09	,32**	,04	-,06	-,12*	1		
14. ICT	-,03	,05	-,05	,05	,17**	,21**	,18*	,19*	,23**	-,13	-,05	-,09	-,11	1	
15. Service, training, health and wellness	,09	-,18**	-,18	-,03	-,15**	-,26**	-,32**	-,03	-,29**	,19	-,25**	-,46**	-,55**	-,43**	1

Table 7: Bivariate Analysis. $^{**}p < .01$; $^{*}p < .05$; .c = cannot be computed because at least one of the variables is constant.

Dependent variables: 1-4

Independent variable local clustering: 5

Independent variable sub-local clustering: 6

Independent variables combination of local- and sub-local clustering: 7-10

Control variables: 11-15

§4.5 Multivariate analysis

In this paragraph, the hypotheses of this research will be tested by performing a multivariate analysis. Linear regression analysis will be used to test the hypotheses. The multivariate analysis will be structured according to the hypotheses about local clustering, sub-local clustering and the combination between local- and sub-local clustering.

§4.5.1. Local clustering

In this paragraph, the hypotheses about local clustering will be tested, which consist of the first two hypotheses.

The first hypothesis that will be tested is: *H1: The closer USOs are located near the city of Nijmegen, the stronger the development of their scientific business network.* Firstly, the assumptions of linearity, homoscedasticity, independent errors and normally distributed errors will be checked for both the analysis of the mean use of the scientific business network, and the development (see Appendix 2). The scatterplots do not show a clear pattern, which means the models can be seen as linear. The residuals in the scatterplots also do not show a clear pattern, so the models are homoscedastic. To check for independence of the errors, the mean and the standard deviation of the 'standardized predicted value' is used, which are .000 and 1.000, which means that the errors do not significantly correlate with the independent variables. The errors are normally distributed, as can be seen in the P-P plots and histograms (see Appendix 2). So, the regression analysis for the first hypothesis can be performed, because there are no problems with the assumptions for both models.

For the variable indicating local clustering, spinoffs located outside of Nijmegen form the reference category. The sector R&D work is the reference category of the control variable. The results of the linear regression of the first hypothesis can be found in Table 8. Firstly, the model with the development of the scientific business network as dependent variable will be discussed. The F-value is not significant, which means that the independent variables in the model do not significantly predict the dependent variable. The only significant coefficient is the sector industry, which means that the sector industry, relative to R&D work, will increase the development of the scientific business network by 1.13 units ($b = 1.13$, $p < .05$).

Now, the model with the mean use of the scientific business network as dependent variable will be discussed, because while there maybe no significant results for the development, looking at the mean use of the scientific business network can enhance the understanding of the data and has theoretical relevance. The F-value is significant, which means that the independent variables in the model do significantly predict the dependent variable. The

value of R^2 is .04, which means that 4% of the variance is explained by the predictors in the model. The independent variable however is not significant, so spinoffs located inside Nijmegen do not significantly differ in the mean use of the scientific business network, compared to spinoffs outside Nijmegen. The sectors trade (b = -.54, p < .01) and service, training, health and wellness (b = -.46, p < .01) both have a significantly negative effect on the mean use of the scientific business network, compared to R&D work. Finally, there is no collinearity within the data, as the VIF values are below 10 and the tolerance values are above .02 (see Appendix 2).

As a conclusion, the model of the regression analysis was not significant for hypothesis 1: *The closer USOs are located near the city of Nijmegen, the stronger the development of their scientific business network.* The first hypothesis is thus rejected.

		Scientific business network	
		Development	**Mean use**
Control Variables		b (SE)	b (SE)
1.	Sector_Industry	1,13 (,56) **	,35 (,29)
2.	Sector_Trade	,07 (,35)	-,54 (,19) ***
3.	Sector_ICT	,16 (,41)	-,27 (,20)
4.	Sector_ServiceTrainingHealthWellness	,33 (,28)	-,46 (,13) ***
5.	Sector_R&Dwork	Ref.	Ref.
Independent Variables			
6.	Spinoffs inside Nijmegen	,03 (,16)	,09 (,09)
7.	Spinoffs outside Nijmegen	Ref.	Ref.
Model Statistics			
F-value		1,05	4,65***
F-change		1,05	4,65***
R^2		,04	,07
R^2 change		,04	,07
N		120	310
Explanation:	* p < ,1; ** p < ,05; *** p < ,01		

Table 8: Results linear regression hypothesis 1

The second hypothesis that will be tested is: *H2: The closer USOs are located near the city of Nijmegen, the stronger the development of their commercial business network.* Before discussing the results of the linear regression for this hypothesis, the assumptions of linearity, homoscedasticity, independent errors and normally distributed errors will be checked for both

models (see Appendix 2). The scatterplots do not show a clear pattern, which means the models can be seen as linear. The residuals in the scatterplots also do not show a clear pattern, so the models are homoscedastic. The errors do not significantly correlate with the independent variables, as checked with the 'standardized predicted value'. The errors are normally distributed, as can be seen in the P-P plots and histograms (see Appendix 2). So, the regression analysis for the second hypothesis can be performed, because there are no problems with the assumptions for both models.

For the variable indicating local clustering, spinoffs located outside of Nijmegen form the reference category. The sector R&D work is the reference category of the control variable. The results of the linear regression of the second hypothesis can be found in Table 9. Firstly, the model with the development of the commercial business network as dependent variable will be discussed. The F-value is significant, which means that the independent variables do significantly predict the dependent variable in this model. The value of R^2 is .11, which means that 11% of the variance is explained by the predictors in the model. Compared to USOs located outside Nijmegen, USOs located inside Nijmegen show significantly more development of the commercial business network ($b = .54$, $p < .05$).

The model with the mean use of the commercial business network as dependent variable does not show significant results for both the full model and the independent variables, which means those results can not be interpreted. Finally, there is no collinearity within the data, as the VIF values are below 10 and the tolerance values are above .02 (see Appendix 2).

As a conclusion, the spinoffs located inside Nijmegen show significantly more development of the commercial business network, compared to spinoffs located outside Nijmegen for hypothesis 2: *The closer USOs are located near the city of Nijmegen, the stronger the development of their commercial business network.* The second hypothesis is thus accepted.

		Commercial business network	
		Development	**Mean use**
Control Variables		b (SE)	b (SE)
1.	Sector_Industry	-,68 (,86)	,41 (,37)
2.	Sector_Trade	,26 (,60)	,33 (,24)
3.	Sector_ICT	-1,04 (,69)	,32 (,25)
4.	Sector_ServiceTrainingHealthWellness	-,63 (,47)	,16 (,17)
5.	Sector_R&Dwork	Ref.	Ref.
Independent Variables			

6.	Spinoffs inside Nijmegen	,54 (,26) **	,07 (,11)
7.	Spinoffs outside Nijmegen	Ref.	Ref.
Model Statistics			
	F-value	2,41**	,70
	F-change	2,41**	,70
	R^2	,11	,01
	R^2 change	,11	,01
	N	103	310
Explanation:	* p < ,1; ** p < ,05; *** p < ,01		

Table 9: Results linear regression hypothesis 2

§4.5.1. Sub-local clustering

In this paragraph, the hypothesis about sub-local clustering will be tested, which consist of the third hypothesis.

The third hypothesis that will be tested is: *H3: USOs in shared housing situations develop a larger commercial business network, compared to other spin-offs.* Before discussing the results of the linear regression for this hypothesis, the assumptions of linearity, homoscedasticity, independent errors and normally distributed errors will be checked for both models (see Appendix 2). The scatterplots can be seen as linear because they do not show a clear pattern. The models are homoscedastic because the residuals in the scatterplots do not show a clear pattern. The errors do not significantly correlate with the independent variables, as checked with the 'standardized predicted value'. The errors are normally distributed, as can be seen in the P-P plots and histograms (see Appendix 2). So, the regression analysis for the third hypothesis can be performed, because there are no problems with the assumptions.

USOs located in a MCB (either on a University MCB, an MCB in Nijmegen or an MCB in the Netherlands) is the independent variable, those USOs can be compared to USO's which are not located in a MCB. The sector R&D work is the reference category of the control variable. The results of the linear regression of the third hypothesis can be found in Table 10. For both models, the F-value is not significant, which means that the independent variables in the models do not significantly predict the dependent variable. The independent variable is also not significant for both models, which means that USOs located on an MCB do not significantly differ in the development and the mean use of the commercial business network, compared to USOs located elsewhere. Finally, there is no collinearity within the data, as the VIF values are below 10 and the tolerance values are above .02 (see Appendix 2).

As a conclusion, the model of the regression analysis and the independent variable were

not significant for hypothesis 3: *USOs in shared housing situations develop a larger commercial business network, compared to other spin-offs.* The third hypothesis is thus rejected.

		Commercial business network	
		Development	**Mean use**
Control Variables		b (SE)	b (SE)
1.	Sector_Industry	-,96 (,89)	,43 (,44)
2.	Sector_Trade	,47 (,64)	,20 (,29)
3.	Sector_ICT	-,79 (,71)	,33 (,30)
4.	Sector_ServiceTrainingHealthWellness	-,54 (,51)	-,01 (,20)
5.	Sector_R&Dwork	Ref.	Ref.
Independent Variables			
6.	Spinoffs located on MCB (UT_MCB, Nijm_MCB, Ned_MCB)	,33 (,33)	,05 (,15)
7.	Spinoffs located elsewhere	Ref.	Ref.
Model Statistics			
	F-value	1,54	,74
	F-change	1,354	,74
	R^2	,08	,02
	R^2 change	,08	,02
	N	96	191
Explanation:	* p < ,1; ** p < ,05; *** p < ,01		

Table 10: Results linear regression hypothesis 3

§4.5.1. Local and sub-local clustering combined

In this paragraph, the hypotheses about the combination between local- and sub-local clustering will be tested, which consist of the fourth to seventh hypotheses.

The fourth hypothesis that will be tested is: *H4: USOs in shared housing situations on a science park develop a larger scientific business network, compared to other USOs.* Before discussing the results of the linear regression for this hypothesis, the assumptions of linearity, homoscedasticity, independent errors and normally distributed errors will be checked for both models (see Appendix 2). The scatterplots do not show a clear pattern, which means the models can be seen as linear. The residuals in the scatterplot also do not show a clear pattern, so the models are homoscedastic. The errors do not significantly correlate with the independent variables, as checked with the 'standardized predicted value'. The errors are normally distributed, as can be seen in the P-P plots and histograms (see Appendix 2). So, the regression

analysis for the fourth hypothesis can be performed, because there are no problems with the assumptions.

USOs located on a university MCB are taken as independent variable, those USOs can be compared to USO's which are not located on a university MCB. The sector R&D work is the reference category of the control variable. The results of the linear regression of the fourth hypothesis can be found in Table 11. Firstly, the model with the development of the scientific business network as dependent variable will be discussed. The independent variables do not significantly predict the dependent variable, because the F-value is not significant. The effects of the independent variables are also not significant. USOs located on a university MCB do not significantly differ from USOs that are not located on a university MCB, in terms of the development of the scientific business network.

While there are no significant results for the development of the scientific business network in this model, there are significant results for the model which has the mean use of the scientific business network as dependent variable, which was already visible in the bivariate analysis table. The F-value is significant, which means that the independent variables do significantly predict the dependent variable in this model. The value of R^2 is .13, which means that 13% of the variance is explained by the predictors in the model. The results of the linear regression of the effect of being located on a university MCB on the mean use of the scientific business network show that, compared to USOs located elsewhere, USOs located on a university MCB show significantly more mean use of the scientific business network ($b = .30$, $p < .05$). For the control variable, the sector service, training, health and wellness shows significantly less mean use of the scientific business network ($b = -.35$, $p < .05$), compared to the R&D sector. Finally, there is no collinearity within the data, as the VIF values are below 10 and the tolerance values are above .02 (see Appendix 2).

As a conclusion, the model of the regression analysis and the independent variable were not significant for hypothesis 4: *USOs in shared housing situations on a science park develop a larger scientific business network, compared to other USOs*. The fourth hypothesis is thus rejected. USOs located on a university MCB did however show more mean use of the scientific business network, compared to USOs located elsewhere.

		Scientific business network	
		Development	**Mean use**
Control Variables		b (SE)	b (SE)
1.	Sector_Industry	1,11 (,57)*	,56 (,35)
2.	Sector_Trade	,01 (,38)	-,42 (,23)*
3.	Sector_ICT	,15 (,42)	-,01 (,24)
4.	Sector_ServiceTrainingHealthWellness	,29 (,31)	-,35 (,17)**
5.	Sector_R&Dwork	Ref.	Ref.
Independent Variables			
6.	Located on university grounds in a MCB	-,13 (,31)	,30 (,14)**
7.	Spinoffs located elsewhere	Ref.	Ref.
Model Statistics			
	F-value	1,08	5,36***
	F-change	1,08	5,36***
	R^2	,05	,13
	R^2 change	,05	,13
	N	111	192
Explanation:	* p < ,1; ** p < ,05; *** p < ,01		

Table 11: Results linear regression hypothesis 4

The fifth hypothesis that will be tested is: *H5: USOs located in the city of Nijmegen, but not on a business park, develop a larger scientific business network, compared to USOs outside of the city of Nijmegen.* Before discussing the results of the linear regression for this hypothesis, the assumptions of linearity, homoscedasticity, independent errors and normally distributed errors will be checked for both models (see Appendix 2). The scatterplots do not show a clear pattern, which means the models can be seen as linear. The residuals in the scatterplot also do not show a clear pattern, so the models are homoscedastic. The errors do not significantly correlate with the independent variables, as checked with the 'standardized predicted value'. The errors are normally distributed, as can be seen in the P-P plots and histograms (see Appendix 2). So, the regression analysis for the fifth hypothesis can be performed, because there are no problems with the assumptions.

USOs located in the city of Nijmegen (except USOs located on a business park) are taken as independent variable. USOs located outside the city of Nijmegen are the reference category. The sector R&D work is the reference category of the control variable. The results of the linear regression of the fifth hypothesis can be found in Table 12. Firstly, the model with

the development of the scientific business network as dependent variable will be discussed. The independent variables do not significantly predict the dependent variable, because the F-value is not significant. The effects of the independent variables are also not significant. USOs located in the city of Nijmegen (except USOs located on a business park) do not significantly differ from USOs located outside the city of Nijmegen in the development of the scientific business network.

The model with the mean use of the scientific business network as the dependent variable shows no significant results, except one sector of the control variable. Compared to the sector R&D work, the trade sector shows significantly less mean use of the scientific business network ($b = -.63$, $p < .05$). Finally, there is no collinearity within the data, as the VIF values are below 10 and the tolerance values are above .02 (see Appendix 2).

As a conclusion, the model of the regression analysis and the independent variable were not significant for hypothesis 5: *USOs located in the city of Nijmegen, but not on a business park, develop a larger scientific business network, compared to USOs outside of the city of Nijmegen*. The fifth hypothesis is thus rejected.

		Scientific business network	
		Development	**Mean use**
Control Variables		b (SE)	b (SE)
1.	Sector_Industry	,55 (,74)	-,17 (,55)
2.	Sector_Trade	-,56 (,48)	-,63 (,30) **
3.	Sector_ICT	-,20 (,60)	,01 (,40)
4.	Sector_ServiceTrainingHealthWellness	-,10 (,41)	-,30 (,24)
5.	Sector_R&Dwork	Ref.	Ref.
Independent Variables			
6.	Spinoffs located in the city of Nijmegen (Nijm_MCB, Nijm_SO, Nijm_HM), but not in a business park	,12 (,19)	,02 (,13)
7.	Spinoffs located outside city of Nijmegen (Ned_CPB, Ned_MCB, Ned_SO, Ned_HM)	Ref.	Ref.
Model Statistics			
	F-value	,81	1,19
	F-change	,81	1,19
	R^2	,04	,04
	R^2 change	,04	,04

N		94	136
Explanation:	* p < ,1; ** p < ,05; *** p < ,01		

Table 12: Results linear regression hypothesis 5

The sixth hypothesis that will be tested is: *H6: USOs in a multi-company building in Nijmegen develop a larger commercial business network, compared to other USOs.* Before discussing the results of the linear regression for this hypothesis, the assumptions of linearity, homoscedasticity, independent errors and normally distributed errors will be checked for both models (see Appendix 2). The scatterplots do not show a clear pattern, which means the models can be seen as linear. The residuals in the scatterplot also do not show a clear pattern, so the models are homoscedastic. The errors do not significantly correlate with the independent variables, as checked with the 'standardized predicted value'. The errors are normally distributed, as can be seen in the P-P plots and histograms (see Appendix 2). So, the regression analysis for the sixth hypothesis can be performed, because there are no problems with the assumptions.

USOs located on a MCB in Nijmegen (university MCB and Nijmegen MCB) are taken as independent variable, which means that those USOs can be compared to USOs which are not located on a MCB in Nijmegen. The sector R&D work is the reference category of the control variable. The results of the linear regression of the sixth hypothesis can be found in Table 13. Firstly, the model with the development of the commercial business network as dependent variable will be discussed. The F-value is significant, which means that the independent variables do significantly predict the dependent variable in this model. The value of R^2 is .14, which means that 14% of the variance is explained by the predictors in the model. USOs located on a MCB in Nijmegen showed significantly more development of the commercial business network ($b = .94$, $p < .01$), compared to USOs which are not located on a MCB in Nijmegen.

The F-value of the model with the mean use of the commercial business network as dependent variable is not significant, which means the independent variables do not significantly predict the dependent variable. The independent variables are also not significant, so these results are not interpretable. Finally, there is no collinearity within the data, as the VIF values are below 10 and the tolerance values are above .02 (see Appendix 2).

So, as a conclusion, USOs located on a MCB in Nijmegen showed significantly more development of the commercial business network, compared to USOs not located on a MCB in Nijmegen for hypothesis 6: *USOs in a multi-company building in Nijmegen develop a larger commercial business network, compared to other USOs.* The sixth hypothesis is thus accepted.

		Commercial business network	
		Development	**Mean use**
Control Variables		b (SE)	b (SE)
1.	Sector_Industry	-,68 (,86)	,44 (,44)
2.	Sector_Trade	,68 (,62)	,18 (,29)
3.	Sector_ICT	-,83 (,68)	,33 (,30)
4.	Sector_ServiceTrainingHealthWellness	-,33 (,49)	-,02 (,21)
5.	Sector_R&Dwork	Ref.	Ref.
Independent Variables			
6.	Spinoffs located on MCB in Nijmegen (UT_MCB, Nijm_MCB)	,94 (,35)***	,02 (,16)
7.	Spinoffs located elsewhere	Ref.	Ref.
Model Statistics			
F-value		2,84**	,72
F-change		2,84**	,72
R^2		,14	,02
R^2 change		,14	,02
N		96	191
Explanation:	* p < ,1; ** p < ,05; *** p < ,01		

Table 13: Results linear regression hypothesis 6

The seventh and last hypothesis that will be tested is: *H7: USOs in a multi-company building outside Nijmegen develop a smaller commercial business network, compared to stand-alone USOs located in Nijmegen.* Before discussing the results of the linear regression for this hypothesis, the assumptions of linearity, homoscedasticity, independent errors and normally distributed errors will be checked for both models (see Appendix 2). The scatterplots do not show a clear pattern, which means the models can be seen as linear. The residuals in the scatterplot also do not show a clear pattern, so the models are homoscedastic. The errors do not significantly correlate with the independent variables, as checked with the 'standardized predicted value'. The errors are normally distributed, as can be seen in the P-P plots and histograms (see Appendix 2). So, the regression analysis for the seventh hypothesis can be performed, because there are no problems with the assumptions.

USOs located in a MCB outside Nijmegen are taken as independent variable. USOs located as stand-alone in Nijmegen are the reference category. The sector R&D work is the reference category of the control variable. The results of the linear regression of the seventh hypothesis can be found in Table 14. For both models, the F-value is not significant, which

means that the independent variables in the models do not significantly predict the dependent variable. The independent variable is also not significant for both models, which means that USOs located in a MCB outside Nijmegen do not significantly differ from USOs located as a stand-alone in Nijmegen in the development and the mean use of the commercial business network. Finally, there is no collinearity within the data, as the VIF values are below 10 and the tolerance values are above .02 (see Appendix 2).

As a conclusion, the model of the regression analysis and the independent variable were not significant for hypothesis 7: *USOs in a multi-company building outside Nijmegen develop a smaller commercial business network, compared to stand-alone USOs located in Nijmegen.* The seventh hypothesis is thus rejected.

		Commercial business network	
		Development	**Mean use**
Control Variables		b (SE)	b (SE)
1.	Sector_Industry	-2,00 (1,16)	-,10 (,76)
2.	Sector_Trade	-1,78 (1,19)	-,45 (,64)
3.	Sector_ICT	-2,02 (1,28)	-,11 (,68)
4.	Sector_ServiceTrainingHealthWellness	-2,17 (1,03)*	-,59 (,55)
5.	Sector_R&Dwork	Ref.	Ref.
Independent Variables			
6.	Netherlands MCB	-1,02 (,53)*	-,30 (,30)
7.	Stand-alone Nijmegen spin-offs	Ref.	Ref.
Model Statistics			
	F-value	1,92	,74
	F-change	1,92	,74
	R^2	,38	,12
	R^2 change	,38	,12
	N	22	33
Explanation:	* p < ,1; ** p < ,05; *** p < ,01		

Table 14: Results linear regression hypothesis 7

§4.6 Summary of results

This chapter has focused on the results. The univariate, bivariate and multivariate analysis have been performed, which has led to either accepting or rejecting of the seven hypotheses (see Table 15).

Hypothesis	Status
H1: The closer USOs are located near the city of Nijmegen, the stronger the development of their scientific business network.	Rejected
H2: The closer USOs are located near the city of Nijmegen, the stronger the development of their commercial business network.	Accepted
H3: USOs in shared housing situations develop a larger commercial business network, compared to other spin-offs.	Rejected
H4: USOs in shared housing situations on a science park develop a larger scientific business network, compared to other USOs.	Rejected
H5: USOs located in the city of Nijmegen, but not on a business park, develop a larger scientific business network, compared to USOs outside of the city of Nijmegen.	Rejected
H6: USOs in a multi-company building in Nijmegen develop a larger commercial business network, compared to other USOs.	Accepted
H7: USOs in a multi-company building outside Nijmegen develop a smaller commercial business network, compared to stand-alone USOs located in Nijmegen.	Rejected

Table 15: Summary of results

§5 Discussion

This chapter will begin with a short summary of the thesis. Then, the conclusion will be drawn and the research question will be answered. Furthermore, the reflection, recommendations and limitations will be discussed.

§5.1 Summary

This research focused on the business network development of USOs. USOs were defined as ‘’firms whose products or services develop out of technology-based ideas or scientific / technical know-how generated in a university setting by a member of faculty, staff or student who founded (or co-founded with others) the firm’’ (Rappert et al., 1999, p. 874). A broader interpretation of this definition was used in this research, because companies were also seen as USOs if the entrepreneurs used (academic) skills learned at the Radboud University. USOs were seen as companies that provide employment, with a larger than average growth potential (Czarnitzki et al., 2014).

A distinction has been made between the scientific (number of employees of a scientific knowledge institution with which a USO maintains personal contact) and commercial (number of (possible) clients with which a USO maintains personal contact) business networks. It has been discussed that clustering of USOs aimed to enhance the development of the business network of those USOs. The two problem contexts; ‘conflicting views on the scientific business network development of USOs’ and ‘mismatched perspectives on the commercial business network development of USOs’, together with the research gap of a simultaneous analysis of the effect of clustering on local and sub-local level on the business network development of USOs led to the following objective of this research:

To gain more information about the effect of clustering on different spatial scale levels on the development of the scientific- and commercial business network of USOs. To contribute to the scientific knowledge about business network (development) of spin-offs and their business environment, to stimulate balanced networking of Radboud University spin-offs.

The research question was:

What is the effect of clustering on different spatial scale levels on the development of the scientific- and commercial business network of USOs?

A general principle guiding clustering and network development has been discussed. The effect of geographic location on knowledge flow was important, because ‘’the difficult of transmitting

knowledge between individuals in organizations increases with geographic distance, or conversely, decreases with proximity'' (Bell & Zaheer, 2007, p. 957). Spatial proximity was also of importance to the knowledge flow, where spatial proximity to knowledge institutions provided scientific business networking opportunities and spatial proximity to other companies provided commercial business networking opportunities (Huggins & Johnston, 2010). Furthermore, the effect of clustering on business parks and in multi-company buildings on the business network development have been discussed. A distinction was made between local clustering, sub-local clustering and the combination of local and sub-local clustering in the discussion about the effects of those types of clustering on the business network development of USOs, which has led to seven hypotheses.

§5.2 Conclusion

In this paragraph, the conclusion will be formed. The conclusion will be structured according to the three sub-questions in this research.

§5.2.1 Local clustering

The first sub-question of this research related to local clustering: *To what extent is the development of the scientific- and commercial business network of USOs of the RU influenced by local clustering?* Two hypothesis were made for this sub-question: **H1: The closer USOs are located near the city of Nijmegen, the stronger the development of their scientific business network** and **H2: The closer USOs are located near the city of Nijmegen, the stronger the development of their commercial business network.** The first hypothesis is rejected, the second hypothesis is accepted.

The first hypothesis is about the expectation that the closer USOs are located near the city of Nijmegen, the stronger the development of their scientific business network. The results of the linear regression were not significant for the independent variables, which means they are not interpretable. The control variable sector industry was significant, which means that, compared to the sector R&D work, the scientific business network development increases with 1.12 units ($b = 1.12$, $p < .05$). The second hypothesis is about the expectation that the closer USOs are located near the city of Nijmegen, the stronger the development of their commercial business network. The results of the linear regression were significant for the independent variables and showed that the spinoffs located inside Nijmegen show significantly more development of the commercial business network, compared to spinoffs located outside Nijmegen ($b = .54$, $p < .05$).

As a conclusion, this research did not find significant results for the effect of being

located inside Nijmegen on the scientific business network development, relative to being located outside Nijmegen. However, this research did find that being located inside Nijmegen leads to more development of the commercial business network, relative to being located outside Nijmegen.

§5.2.2 Sub-local clustering

The second sub-question of this research related to sub-local clustering in multi-company buildings: *To what extent is the development of the scientific- and commercial business network of USOs of the RU influenced by sub-local clustering?* The hypothesis for this sub-question was: **H3: USOs in shared housing situations develop a larger commercial business network, compared to other spin-offs.** The third hypothesis is rejected.

The third hypothesis is about the expectation that USOs in shared housing situations develop a larger commercial business network, compared to other spin-offs. The results of the linear regression analysis were not significant for both the independent and the control variables, which means that they are not interpretable.

As a conclusion, this research did not find significant results of sub-local clustering / clustering in a multi-company building of USOs on the development of the commercial business network, compared to other spin-offs.

§5.2.3 Local and sub-local clustering combined

The third sub-question of this research related to a combination of local and sub-local clustering: *To what extent is the development of the scientific- and commercial business network of USOs of the RU influenced by combinations from local- and sub-local clustering?* Four hypotheses were made for this sub-question: **H4: USOs in shared housing situations on a science park develop a larger scientific business network, compared to other USOs**, **H5: USOs located in the city of Nijmegen, but not on a business park, develop a larger scientific business network, compared to USOs outside of the city of Nijmegen**, **H6: USOs in a multi-company building in Nijmegen develop a larger commercial business network, compared to other USOs** and **H7: USOs in a multi-company building outside Nijmegen develop a smaller commercial business network, compared to stand-alone USOs located in Nijmegen.** The fourth, fifth and seventh hypotheses were rejected, the sixth hypothesis was accepted.

The fourth hypothesis is about the expectation that USOs in shared housing situations on a science park develop a larger scientific business network, compared to other USOs. The results of the linear regression analysis were not significant for both the independent and the

control variables, which means that they are not interpretable. USOs located in shared housing situations on a science park did however show more mean use of the scientific business network, compared to other USOs. The fifth hypothesis is about the expectation that USOs located in the city of Nijmegen, but not on a business park, develop a larger scientific business network, compared to USOs outside of the city of Nijmegen. The results of the linear regression analysis were not significant for both the independent and the control variables, which means that they are not interpretable. The sixth hypothesis is about the expectation that USOs in a multi-company building in Nijmegen develop a larger commercial business network, compared to other USOs. The results of the linear regression analysis showed a positive significant result for USOs located in an MCB in Nijmegen on the development of the commercial business network, compared to other USOs, which means the hypothesis is accepted. The seventh hypothesis is about the expectation that USOs in a multi-company building outside Nijmegen develop a smaller commercial business network, compared to stand-alone USOs located in Nijmegen. The results of the linear regression analysis were not significant for both the independent and the control variables, which means that they are not interpretable.

As a conclusion, this research did not find significant results for the combination of local and sub-local clustering for the expected effect that USOs in shared housing situations on a science park would develop a larger scientific business network, compared to other USOs. No significant result was also found for the expected effect that USOs located in the city of Nijmegen, but not on a business park, would develop a larger scientific business network, compared to USOs outside the city of Nijmegen. Furthermore, there was no significant result for the expected effect that USOs in a MCB outside Nijmegen would develop a smaller commercial business network, compared to stand-alone USOs located in Nijmegen. This research did however find a significant positive result for the expected effect that USOs in a MCB in Nijmegen would develop a larger commercial business network, compared to other USOs.

§5.2.4 Answer research question

Now the three sub-questions are answered, the conclusion will be finalised by answering the research question of this research: *What is the effect of clustering on different spatial scale levels on the development of the scientific- and commercial business network of USOs?*

As a conclusion, this research did not find significant results for the effect local-clustering on the scientific business network development, but did find significant results for the effect of local-clustering on the commercial business network development, where being

located inside Nijmegen led to significantly more development of the commercial business network, compared to being located outside Nijmegen. Furthermore, this research did not find significant results for the effect of sub-local clustering on the commercial business network development. Finally, this research did not find significant results for the effect of the combination of local- and sub-local clustering on the business network development for three out of the four expected effects, but did find a significant positive result for the expected effect that USOs in a MCB in Nijmegen would develop a larger commercial business network, compared to other USOs.

§5.3 Reflection

This paragraph will consist of a reflection on the theory, more specific the way the outcomes of this research relate to the theoretical part. The analysis shows that the expected positive effects on the development of the scientific business network on the conditions of the closer USOs are located near the city of Nijmegen (H1), USOs in shared housing situations on a science park (compared to other USOs, H4) and USOs located in the city of Nijmegen but not on a business park (compared to USOs outside of the city of Nijmegen, H5) were not supported, but were expected out of the theory. For the fourth hypothesis, it was however found that USOs located in shared housing situations on a science park show more mean use of the scientific business network, compared to being located elsewhere. This may be caused by the problem context of conflicting views, which is discussed in the introduction. USOs who already have an extensive scientific business network might choose to locate on a science park, because they already have a lot of contact with the knowledge institution. Based on multiple theories of spatial proximity to knowledge institutions and an active university in the region (Simard & West, 2006; Huggins et al., 2008; Huggins & Johnston, 2010), the three hypothesis about the development of the scientific business network were formed. Reasons that the analysis did not show the expected result might be explained by the problem context of conflicting views. USOs with frequent contact to knowledge institutions might choose to locate on a science park because of the frequent contact, those USOs might not choose to locate on a certain location to enhance the scientific business network development. The globalisation and enhanced communication effects might also have an influence that geographic location does not play as big of a role as expected anymore.

The analysis shows that the expected positive effect on the development of the commercial business network for USOs in shared housing situations (compared to other USOs, H3) was not supported, but was expected out of the theory, based on multiple theories (Huggins

& Johnston, 2010; Bøllingtoft & Ulhøi, 2005; Cooper et al., 2012; Speldekamp et al., 2020). Furthermore, the expected negative effects on the development of the commercial business network of USOs in a MCB outside Nijmegen (compared to stand-alone USOs located in Nijmegen, H7) was also not supported. Reasons that the analysis did not show the expected results might be the same as the reasons explained above, where the geographic location might not play as big of a role as expected anymore for those effects

However, the analysis for the second and sixth hypotheses were supported and expected out of the theory, where USOs inside Nijmegen (compared to USOs outside Nijmegen, H2) and where USOs in a MCB in Nijmegen (compared to USOs located elsewhere, H6) would develop a larger commercial business network. The positive effects of physical proximity of USOs in local clustering and in a combination of local and sub-local clustering for the development of the commercial business network did thus lead to stronger development of the commercial business network, compared to other USOs, which was expected from the theory (Cooper et al., 2012).

This research has contributed to the scientific knowledge, by gaining more information about the effect of clustering on different spatial scale levels on the development of the scientific and commercial business network of USOs. While only two hypotheses that were formed out of the theory were accepted, the hypotheses that were not accepted also lead to more insights, because the effect of location on the development of the business network might not be so significant as expected. This research did find that the location can have an influence on the mean use of the scientific business network, and on the development of the commercial business network. Furthermore, there are also managerial contributions of this research. Entrepreneurs of USOs can use this research to better be able to decide where they want to locate their USO and that the location can have implications for the business network (development). Further research is however necessary, which will be discussed in the recommendations paragraph.

§5.4 Limitations

This paragraph will discuss the most important limitations of this research. The literature about the effect of clustering on the business networks of companies was available, from which the theory chapter is formed, but there was a lack of specific simultaneous researches about the effect of different spatial scale levels on scientific and commercial business network development of USOs. Therefore, the theory chapter could have been more specific and extensive if those researches were available.

COVID-19 influences the whole world, and so also this research. Due to the crisis, new data could not be gathered, which caused this research to be adapted to the old data that was previously gathered. Not all of the original hypotheses could be tested and the survey-questions could also not be formed to fully fit the content of this research, which of course has some influences on the validity and the methodology of the research.

The last limitation is that this research focuses on USOs from the Radboud University in Nijmegen, which might lead to the fact that the results are less generalizable, because spin-offs from a technical university (for example the Eindhoven University of Technology) might show other results for the effect of clustering on different spatial scale levels on the development of the business network.

§5.5 Recommendations

In this paragraph, the recommendations for further research will be discussed.

The first recommendation for future research is a qualitative research focussing on the choices of location of the entrepreneurs in charge of the USOs and what for effect this has on the business network development. Why did the entrepreneurs choose the specific location for their USO? What are the main reasons and in what way does the location impact the business network development of USOs? Are the entrepreneurs aware that the location of their USO can have an influence on their company and the business network development?

Furthermore, a research into the effect of different spatial scale levels on the business network development of USOs from another university might lead to different results and more insights, for example the Eindhoven University of Technology. USOs from the Eindhoven University of Technology might differ in the effect of clustering on different spatial scale levels on the scientific and commercial business network development, compared to USOs from the Radboud University in Nijmegen.

The last recommendation is a research that delves more in the results of this research. What is the reason that some hypotheses were not accepted? Were there factors that were not taken into account or does the location of a USO simply not play as big of a role as expected?

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respnr respnr v1_00 v0a

Spin-offs
Radboud Universiteit Nijmegen
Universitair
Medisch Centrum St. Radboud

(ex) studenten en (ex) medewerkers
met een eigen bedrijf

Uw naam en voorletters: vvoorlet vvoorlet ____ v0b .....

Naam van uw bedrijf: ..... vbedrnaa vbedrnaa v2 v0c .....

Straat en huisnummer: ..... vstraat vstraat v3 v0d .....

Postcode cijfers Postcode letters Plaats

Plaats: vpostcij vpostcij v3 vpostlet vpostlet ____ vplaats vplaats v7 v0e .....

e-mail: .....

Dit onderzoek vindt plaats in opdracht van:

Stichting Gelder-Kennis / UBC / Mercator Incubator Nijmegen

Coördinatie: ITS Nijmegen
Bezoekadres: Toernooiveld 5, Nijmegen
Postadres: Postbus 9048,
6500 KJ Nijmegen

Toelichting

Doel van het onderzoek
Voor u ligt een vragenlijst voor ondernemers die als student, afgestudeerde of (ex)medewerker van de Radboud Universiteit Nijmegen/UMC St. Radboud betrokken zijn/waren bij de oprichting van een bedrijf of praktijk. Deze bedrijven worden spin offs genoemd. De opdrachtgever voor dit onderzoek is de spin off-stimuleringsorganisatie Stichting Gelder-Kennis/UBC/Mercator Incubator Nijmegen. Daarin werken de Nijmeegse universiteit en het UMC St. Radboud samen met de Hogeschool van Arnhem en Nijmegen, de gemeente Nijmegen en regionale organisaties van overheid en bedrijfsleven. De opdrachtgever wil met een regelmatige monitoring van spin offs meer inzicht krijgen in hun bedrijfsontwikkeling, de knelpunten waar zij mee te maken hebben en relevante ondersteuningsmogelijkheden.

Tegenprestatie
Wij stellen uw deelname aan het onderzoek zeer op prijs. Als tegenprestatie voor het invullen van de vragenlijst ontvangt u de samenvattingen van het voorgaande onderzoek, en van dit nieuwe onderzoek, nadat wij de door u ingevulde vragenlijst hebben ontvangen en verwerkt. Ook wordt u geïnformeerd over nieuwe activiteiten en science-to-business-netwerken die voor uw bedrijf van belang kunnen zijn.

De individuele ondernemer telt!!
Spin off-bedrijven maken vanaf de start meerdere groeifasen door. De visies en ervaringen daarbij van de oprichters en ondernemers staan centraal in dit onderzoek. De vragenlijst is daarom gericht aan de grondleggers en directie van een bedrijf. In het geval een bedrijf door meerdere personen is opgericht kunnen zij ook ieder afzonderlijk een exemplaar ontvangen, invullen en aan ons terugsturen.

Tijdsduur
Het invullen van de vragenlijst duurt naar schatting 15 à 20 minuten.

Vertrouwelijkheid
De verzamelde gegevens worden strikt vertrouwelijk behandeld en gegevens van individuele bedrijven zullen niet uit de rapportage kunnen worden afgeleid.

Opsturen
We verzoeken u vriendelijk de ingevulde vragenlijst binnen 10 dagen te retourneren in de bijgevoegde antwoordenveloppe, of in een enveloppe zonder postzegel naar:

Dr. P. Vaessen
Radboud Universiteit Nijmegen,
p/a ITS Nijmegen
Antwoordnummer 193
6500 WC Nijmegen
e-mail: P.Vaessen@fm.ru.nl
Tel.nr.: 024-3611266

Voor eventuele vragen en opmerkingen kunt u contact opnemen met de heer Peter Vaessen.

Bij voorbaat hartelijk dank voor uw medewerking.

Jan Heijink
Senior onderzoeker
ITS Nijmegen.

Hein van der Pasch
Directeur Stichting Gelder-Kennis/
UBC/Mercator Incubator Nijmegen.

Peter Vaessen
Onderzoeker RU, Faculteit der
Managementwetenschappen.

1. De start

1a. Bent u oprichter of betrokken geweest bij de oprichting van het op het voorblad ingevulde bedrijf?

v1a

1 nee

2 ja, en ik was enige oprichter v1a

V2_5 - v2_6 3 ja, samen met nog ..... andere oprichters (aantal)

v1a

v1b ___ V2_1 V1b

1b. In welk jaar is het bedrijf opgericht? ..... oprichtingsjaar

1c. Staat het bedrijf ingeschreven in het handelsregister van de Kamers van Koophandel?

v1c

v1

v1_3

1 nee

2 ja v1c_2 v1b ___ ___ ..... vul hier het kamer van koophandelnummer in a.u.b.

2. Fulltime of parttime ondernemer

v2a

2a. Bent u in uw eigen bedrijf fulltime werkzaam of parttime?

v2a

v1_4

v2a

1 fulltime ⟶ *ga door naar vraag 3*

2 parttime

2b. Bent u naast uw eigen bedrijf of praktijk ook nog werkzaam in loondienst bij een andere organisatie, en zo ja gedurende hoeveel uur per week?

v2b

v2b

v1_61

v2c

1 nee

2 ja v2b v2b v1_62 v2c ..... aantal uren per week in loondienst

3. De activiteiten en aard van het bedrijf

3a. Betreft uw bedrijf een:

v3a

v1_1

v3a

1 bedrijf of onderneming

2 praktijk in het kader van de vrije beroepsbeoefening, zoals (huis)artsen, advocaten, notarissen, psychotherapeuten e.a.

3 anders, namelijk: ..... v3aand ___ v1_1a v3a_1 .....

3b. Wilt u de kernactiviteit(en) van uw bedrijf hieronder zo concreet mogelijk omschrijven?

v3b ___ v1_2 v3b

4. Financiering

4a. Hoeveel euro bedroeg het aanvankelijk vereiste kapitaal van dit bedrijf?

v4a ___ ___ v4a

< 10.000	10.000 - 25.000	25.000 - 50.000	50.000 - 100.000	100.000
1	2	3	4	5

4b. Door wie is het vereiste kapitaal van dit bedrijf gefinancierd? *(meerdere antwoorden mogelijk)*

v4b1 ___ ___ v4b_1 [1] de oprichter(s)

v4b2 ___ ___ ___ [2] externe financiers, nl.: → [1] bank v4b_2_1 ___ ___ v4b_2

v4b3 ___ ___ v4b_6 [3] geen vreemd kapitaal *(ga door naar vraag 5)* [2] participatie-/venturefonds v4b_2_2 ___ ___ v4b_3

[3] familie/kennissen v4b_2_3 ___ ___ v4b_4

[4] anders v4b_2_4 ___ ___ v4b_5

		in zeer geringe mate	in geringe mate	in grote mate	in zeer grote mate
v4c __ v4e_1	4c. In welke mate heeft u het bijeenbrengen van voldoende kapitaal als een probleem ervaren bij de start van uw bedrijf?	1	2	3	4
v4d __ __ __	4d. In welke mate zou een eenvoudiger beschikbaarstelling van voldoende kapitaal de start van uw bedrijf hebben versneld?	1	2	3	4

5. Groeiplannen

v5
v3
___
v22

Hoe groot is het streven van uw bedrijf om in de komende jaren te groeien? *(kruis het meest toepasselijke antwoord aan)*

[1] ons streven is om de grootste speler te worden
[2] ons streven is omstarkte groeien
[3] ons streven is groei
[4] ons streven is een gezonde bedrijfsvoering, even veel met groei
[5] we streven niet naar groei

6. Klanten

v6a v4a __ v6a

	1 - 2	3 - 5	6- 10	11 - 20	> 20	n.v.t. (nog) geen afzet
6a. Aan hoeveel klanten heb u in het afgelopen jaar ongeveer geleverd?	1	2	3	4	5	6

v6b v4b __ v6b

	< 25%	25 - 50%	51 - 75%	76 - 90%	> 90%	n.v.t. (nog) geen afzet
6b. Welk deel van de omzet komt van uw grootste klanten?	1	2	3	4	5	6

7. Hoe belangrijk zijn de volgende vernieuwingsactiviteiten in uw bedrijf?

(Geef met een score van 1 tot 5 de volgorde van belangrijkheid aan: 1 is het belangrijkst; gebruik elke score slechts één keer)

investeren in R&D voor ontwikkeling van nieuwe of verbeterde producten/diensten	investeren in technologie (IT)/machines/ apparatuur	marketing vernieuwingen (m.b.t. verkoop, distributie, verpakking, ontwerp)	vernieuwen werkprocessen of organisatiestructuur	investeren in motivatie, flexibiliteit en ontwikkeling (b.v. scholing) van medewerkers (uzelf inclusief)
v7a v5a ___ ___	v7b v5b __ ___	v7c v5c ___ ___	v7d v5d ___ ___	v7e v5e ___ ___

8. Nieuwe en/of verbeterde producten/diensten

Heeft uw bedrijf in de periode 2005-2007 nieuwe of verbeterde producten of diensten op de markt gebracht?

v8_1 v6_1 __ v10

[1] nee → *ga door naar vraag 9*

[2] ja → Die vernieuwingen/verbeteringen werden:

v8_2 v6_2 __ v10

[1] grotendeels door uw eigen bedrijf ontwikkeld

[2] door zowel uw bedrijf als derde(n) ontwikkeld

[3] grotendeels door derde(n) ontwikkeld

8a. Welk gedeelte van de gemiddelde jaaromzet in de periode 2005-2007 wordt gevormd door duidelijk verbeterde of geheel nieuwe producten of diensten?

v8a v6a __ v12a

..... % van de omzet uit nieuwe of verbeterde producten

8b. Heeft uw bedrijf in de periode 2005-2007 producten/diensten verkocht die voor uw **afzetmarkt** nieuw of duidelijk verbeterd waren?
(d.w.z. niet eerder door concurrenten op de markt gebracht!)

v8b v6b —— ——

[1] nee

[2] ja → [1] het aandeel van déze producten als percentage van uw totale omzet is: ..... %

v8b_2 v6b_2 —— ——

[2] ook met een grove schatting is dit % niet te geven

v8b_2b v6b_2b —— v12b

9. Nieuwe processen

Procesinnovatie is de toepassing van een voor uw bedrijf nieuw of sterk verbeterd productieproces, distributiemethode of ondersteunende activiteit voor uw goederen of diensten. Puur organisatorische innovaties vallen hier niet onder

Heeft uw bedrijf 2005-2007 nieuwe of sterk verbeterde methoden in gebruik genomen:	**nee**	**ja,** ontwikkeld door: voornamelijk ons eigen bedrijf	ons bedrijf samen met andere bedrijven of instellingen	voornamelijk andere bedrijven of instellingen		
v9a v7a —— —— a. voor de productie van goederen of diensten	[1]	[2]	[3]	[4]	v9a2	v7a2 ——
v9b v7b —— —— b. voor de logistiek (verwerving of distributie) van uw inputs of outputs (goederen of diensten)	[1]	[2]	[3]	[4]	v9b	v7b ——
v9c v7c —— —— c. voor ondersteunende activiteiten voor uw bedrijfsprocessen, zoals onderhoudssystemen, aankoop, boekhoudkundige of calculatiemethoden	[1]	[2]	[3]	[4]	v9c	v7c ——

v10

10. Organisatorische vernieuwingen en marketinginnovaties

*Een organisatorische innovatie is een vernieuwing van of een **ingrijpende** verandering in de bedrijfsstructuur of managementmethoden met als doel de benutting van kennis en daardoor de efficiency van het bedrijfsproces en/of de kwaliteit van uw goederen en diensten te verbeteren*

*Een marketinginnovatie is de implementatie van **nieuwe of sterk verbeterde** productontwerpen (bijv. vormgeving), -uitvoeringen of verkoopmethoden om uw goederen en diensten aantrekkelijker te maken of om nieuwe markten te veroveren*

	Heeft uw bedrijf in de periode 2005-2007 de volgende innovaties geïntroduceerd?	**nee**	**ja**	
v10a v8a __ __	a. nieuwe of sterk verbeterde kennismanagementsystemen om informatie, kennis en vaardigheden binnen uw bedrijf beter te benutten	1	2	Organisatorische innovaties
v10b v8b __ __	b. een grote verandering in de organisatie van uw bedrijf, zoals veranderingen in de managementstructuur, of de samenvoeging van verschillende afdelingen of activiteiten	1	2	
v10c v8c __ __	c. nieuwe of ingrijpende veranderingen in uw relaties met andere bedrijven of instellingen, bijvoorbeeld via samenwerkingsverbanden of uitbesteding	1	2	
v10d v8d __ __	d. ingrijpende veranderingen in het productontwerp of de verpakking van goederen of diensten, anders dan gebruikelijke veranderingen	1	2	Marketinginnovaties
v10e v8e __ __	e. nieuwe of ingrijpend veranderde verkoop- of distributiemethoden, zoals internetverkoop, franchising of distributielicenties.	1	2	

11. Flexibel personeelsbeleid

(indien u de enige medewerker bent van het bedrijf doorgaan naar vraag 12)

		heel onbelangrijk	onbelangrijk	neutraal	belangrijk	zeer belangrijk
v11a v9a __ __	a. hoe belangrijk voor de komende twee jaar vindt u het om te kunnen inspelen op wensen, capaciteiten en diversiteit van het eigen personeel	1	2	3	4	5

	Voor het verhogen van de flexibiliteit sturen wij op:	niet aan de orde	enigszins aan de orde	sterk aan de orde	zeer sterk aan de orde
v11b v9b __ __	b. mogelijkheden om individuele kennis en vaardigheden up-to-date te houden, onder andere door het bieden van uitdagend werk	1	2	3	4
v11c v9c __ __	c. betrokkenheid van werknemers bij besluitvorming	1	2	3	4
v11d v9d __ __	d. ruimte voor individuele wensen in werktijden *(deeltijdarbeid, verlofregelingen, variabele begin- en eindtijden, thuiswerken)*	1	2	3	4
v11e v9e __ __	e. ruimte voor combinatie van werk en privé	1	2	3	4

12. Flexibele organisatie

	In welke mate maakt uw bedrijf gebruik van:	In zeer geringe mate	In geringe mate	In grote mate	In zeer grote mate
v12a v10a __ __	a oproep-, nuluren- of freelancekrachten	1	2	3	4
v12b v10b __ __	b. uitzendkrachten of andere gedetacheerden	1	2	3	4
v12c v10c __ __	c. in welke mate maakt uw bedrijf bij de voortbrenging van uw producten of diensten gebruik van samenwerkingspartners en uitbesteding?	1	2	3	4

13 Informatie-/kennisbronnen en samenwerking

13.1 Hoe belangrijk waren de volgende informatie-/kennis-bronnen in de periode 2005-2007 voor de innovatie-activiteiten van uw bedrijf?

		bron gebruikt en was:			*bron niet gebruikt*
		enigszins belangrijk	belangrijk	zeer belangrijk	
V13a V11a — V13a	a. interne bronnen binnen uw bedrijf of concern	1	2	3	4
V13b V11b — V13b	b. afnemers	1	2	3	4
V13c V11c — V13c	c. leveranciers van apparatuur, materialen, componenten of software	1	2	3	4
V13d V11d — V13d	d. concurrent of andere bedrijven in uw bedrijfstak	1	2	3	4
V13e V11e — V13e	e. Radboud Universiteit Nijmegen/UMC ST Radboud	1	2	3	4
V13f V11f — V13f	f. andere universiteiten of openbare onderzoeksinstellingen	1	2	3	4
V13g V11g — —	g. hbo-instellingen	1	2	3	4
V13h V11h — V13h	h. consultants, commerciële laboratoria of particuliere R&D-instituten	1	2	3	4
V13i V11i — V13i	i. conferenties, beurzen of exposities	1	2	3	4
V13j V11j — V13i	j. wetenschappelijke tijdschriften en vak-/technische publicaties	1	2	3	4
V13k V11k — V13g	k. beroeps- en brancheverenigingen	1	2	3	4
V13l V11l — —	l. internet	1	2	3	4

13.2 Heeft uw bedrijf in de periode 2005-2007 bij innovatie-activiteiten samengewerkt met andere bedrijven of instellingen?

Bedoeld wordt: het actief samenwerken met andere bedrijven of niet-commerciële instellingen op het gebied van innovatie-activiteiten. Deze vraag heeft geen betrekking op uitbesteding van werkzaamheden zonder actieve samenwerking

V13_2 V11_2 — V14a

1 nee → *ga door naar vraag 14*

2 ja →

	partner gevestigd in *(meerdere opties mogelijk)*:			
	Nederland binnen een straal van 50 km	elders in Nederland	ander Europees land	overige landen
	V13_2a1 V11_2a1	V13_2a2 V11_2a2	V13_2a3 V11_2a3	V13_2a4 V11_2a4
A. leveranciers van apparatuur, materialen, componenten of software	1	2	3	4
	V13_2b1 V11_2b1	V13_2b2 V11_2b2	V13_2b3 V11_2b3	V13_2b4 V11_2b4
B. afnemers	1	2	3	4
	V13_2c1 V11_2c1	V13_2c2 V11_2c2	V13_2c3 V11_2c3	V13_2c4 V11_2c4
C. concurrenten of andere bedrijven in uw bedrijfstak	1	2	3	4
	V13_2d1 V11_2d1	V13_2d2 V11_2d2	V13_2d3 V11_2d3	V13_2d4 V11_2d4
D. commerciële laboratoria of particuliere R&D-instituten	1	2	3	4
	V13_2e1 V11_2e1	V13_2e2 V11_2e2	V13_2e3 V11_2e3	V13_2e4 V11_2e4
E Radboud Universiteit Nijmegen/UMC St. Radboud	1	2		
	V13_2f1 V11_2f1	V13_2f2 V11_2d2	V13_2f3 V11_2f3	V13_2f4 V11_2f4
F. andere Universiteiten of instellingen van hoger onderwijs	1	2	3	4
	V13_2g1 V11_2g1	V13_2g2 V11_2g2	V13_2g3 V11_2g3	V13_2g4 V11_2g4
G. overheids- of andere openbare onderzoeksinstellingen	1	2	3	4

13.3 Welke van deze samenwerkingspartners (A - G) vindt u het meest waardevol voor de innovatie-activiteiten van uw bedrijf *(slechts één hokje aankruisen)*?

V13_3 V11_3

A	B	C	D	E	F	G
1	2	3	4	5	6	7

14. Overige aspecten van vernieuwing

14a. Zijn in uw bedrijf bepaalde medewerkers (uzelf incluis) specifiek belast met het ontwikkelen van nieuwe of het verbeteren van bestaande producten en processen (R&D)?

V14a
V12a
—
V14b

1 nee
2 ja → Indien ja, hoeveel arbeidsjaren* zijn daarmee gemoeid?

aantal R&D-arbeidsjaren*
V14a2 V12a2 — ——
.....

een voltijdmedewerker die alle werktijd besteedt aan R&D telt voor één arbeidsjaar. Een medewerker die in deeltijd werkt of niet alle werktijd besteedt aan R&D slechts meetellen voor een gedeelte van een arbeidsjaar. Bijvoorbeeld een medewerker die twee dagen per week besteedt aan R&D telt voor 0,4 arbeidsjaar.

14b. Zijn er medewerkers (uzelf incluis) die in 2007 op kosten van het bedrijf cursussen of trainingen hebben gevolgd?

V14b
V12b
—
V14c

1 nee
2 ja → Indien ja, hoeveel medewerkers hebben in 2007 aan cursussen/ trainingen deelgenomen?

V14b2 V12b2 — —
.....

V14c V12c — v14d

14c. Welk deel van de medewerkers van uw bedrijf (uzelf incluis) heeft onderwijs op HBO of WO-niveau genoten ..... % van het totaal aantal medewerkers

14d. Beschikte uw bedrijf per 1 januari 2008 over één of meerdere geregistreerde octrooien (incl. lopende octrooiaanvragen)?

V14d
V12d
—
V14e

1 nee
2 ja

15. Belemmeringen

15.1 In welke mate hebben in de periode 2005 – 2007 de volgende factoren een belemmering gevormd voor uw innovatie-activiteiten of –projecten of hebben zij de beslissing om niet te innoveren beïnvloed?

		Belemmering waargenomen en was:			
		Sterk belemmer end	Belemmer end	Zwak belemmer end	*Niet waarge-nomen*
V15a V13a — —	a. gebrek aan financiële middelen in het bedrijf	1	2	3	4
V15b V13b — —	b. gebrek aan externe financiële middelen	1	2	3	4
V15c V13c — —	c. gebrek aan informatie over technologie	1	2	3	4
V15d V13d — —	d. gebrek aan marktinformatie	1	2	3	4

15.2 In welke mate is een geringe behoefte aan/belang bij (eigen) innovaties van betekenis geweest voor het achterwege blijven of vertraagd uitvoeren van innovatie-activiteiten in de periode 2005 – 2007?

V15_2
V13_2
——
——

1 sterke mate
2 redelijke mate
3 geringe mate
4 geringe innovatiebehoefte niet waargenomen in ons bedrijf

16. Contacten met kennisinstellingen

		Hoe vaak is er in de periode 2005-2007 persoonlijk contact* geweest tussen uw bedrijf en:	geen contact	incidenteel	regelmatig	zeer vaak
V16a V14a __ v15a	a	de Radboud Universiteit Nijmegen/UMC St. Radboud?	1	2	3	4
V16b V14b __ v15b	b.	andere universiteiten?	1	2	3	4
V16c V14c __ v15c	c.	andere onderzoeksinstellingen?	1	2	3	4
V16d V14d __ __	d.	instellingen van Hoger Beroepsonderwijs (HBO)	1	2	3	4
V16e V14e __ __	e.	overige onderwijsinstellingen (MBO/ROC e.a.)	1	2	3	4

**'persoonlijk contact' ruim opvatten: lezingen, gebruik faciliteiten, stagiaires, afspraken met medewerkers, in dienst nemen van afgestudeerden, bibliotheekgebruik e.d.*

17. Klantencontact

			gebrekkig	enigszins	redelijk goed	goed	zeer goed
V17a V15a __ __	a.	hoe goed bent u op de hoogte van de problemen waarmee uw klanten te maken hebben?	1	2	3	4	5
V17b V15b __ __	b.	in welke mate heeft u inzicht in de omvang van de koopkrachtige vraag uit de markt?	1	2	3	4	5
V17c V15c __ __	c.	hoe goed kent u de specificaties van de producten van uw concurrenten?	1	2	3	4	5

18. Formele afspraken met ondernemers en medewerkers van <u>ándere organisaties</u>
(Het gaat om formele afspraken, zoals meestal genoteerd in uw agenda).

18a. Hoeveel formele <u>afspraken</u> met ondernemers of medewerkers van andere organisaties heeft u in de werktijd voor uw eigen bedrijf?
Vul het antwoord in dat het meest van toepassing is.

V18a V16a __ __

1 gemiddeld minder dan één *per week*
2 gemiddeld 1 – 2 *per week*
3 gemiddeld 3 – 4 *per week*
4 gemiddeld één <u>per dag</u> V18aand V16aand __ __
5 gemiddeld meer dan één <u>per dag</u>, namelijk: ..... aantal afspraken

18b. Om hoeveel verschillende <u>bedrijven en instanties</u> gaat het daarbij?
Vul het antwoord in dat het meest van toepassing is

V18b V16b __ __

1 gemiddeld minder dan één *per week*
2 gemiddeld 1 – 2 *per week*
3 gemiddeld 3 – 4 *per week*
4 gemiddeld één <u>per dag</u> V18band V16band __ __
5 gemiddeld meer dan één <u>per dag</u>, namelijk: ..... aantal organisaties

V19a V17a __ __ **19. Informele persoonlijke gesprekken met ondernemers en medewerkers van <u>ándere organisaties</u>**
(Het gaat om informele face-to-face gesprekken niet alleen over bedrijfszaken, maar ook over privé-aangelegenheden, hobby, sport e.d.)

19a. Schat het aantal <u>gesprekken</u> dat er op deze informele manier plaatsvindt met personen van andere organisaties tijdens werktijd voor uw eigen bedrijf.
Vul het antwoord in dat het meest van toepassing is.

1 gemiddeld minder dan één *per week*
2 gemiddeld 1 – 2 *per week*
3 gemiddeld 3 – 4 *per week*
4 gemiddeld één <u>per dag</u> V19aand V17aand __ __
5 gemiddeld meer dan één <u>per dag</u>, namelijk: ..... aantal gesprekken

19b. Om (personen van) hoeveel verschillende <u>bedrijven of instanties</u> gaat het daarbij?
V19b V17b __ __ *Vul het antwoord in dat het meest van toepassing is.*

1 gemiddeld minder dan één *per week*
2 gemiddeld 1 – 2 *per week*
3 gemiddeld 3 – 4 *per week*
4 gemiddeld één <u>per dag</u> V19band V17band __ __
5 gemiddeld meer dan één <u>per dag</u>, namelijk: ..... aantal organisaties

20. Huisvesting

20a. Hoe is uw bedrijf gevestigd?

V20aa V18aa __ __ a. op een bedrijvenpark (industrieterrein, science park of kantorenpark) 1
V20ab V18ab __ __ b. in een bedrijfsverzamelgebouw of business incubator met gemeenschappelijke voorzieningen 2
V20ac V18ac __ __ c. in een (kantoor)gebouw zonder gemeenschappelijke voorzieningen 3
V20ad V18ad __ __ d. In een autonoom bedrijfspand uitsluitend voor uw bedrijf bestemd 4
V20ae V18ae __ __ e. In/aan uw woonhuis zonder gescheiden adres 5

aankruisen wat van toepassing is (*meerdere antwoorden mogelijk!!*)

V20af V18af __ __ f. anders, namelijk: .....
V20afand V18afand __ __
.....

20b Indien uw bedrijf is gevestigd op een bedrijvenpark, wat is de naam van dit park? .....
V20b V18b __ __
.....

20c. Indien uw bedrijf is gevestigd in een bedrijfs-verzamelgebouw/bedrijvencentrum, of business incubator met gemeenschappelijke voorzieningen, wat is de naam van dit bedrijvencentrum? .....
V20c V18c __ __
.....

		nee	ja
V20d V18d __ __	20d biedt de huidige huisvesting voldoende uitbreidingsmogelijkheden, indien noodzakelijk?	1	2
V20e V18e __ __	20e. overweegt u binnen de komende drie jaar verplaatsing van (een deel van) uw bedrijf?	1	2

21. Knelpunten

Geef aan of uw bedrijf ten aanzien van de volgende bedrijfsaspecten knelpunten heeft ervaren in de periode 2005-2007.

	aspect	knelpunt? nee	ja, enigszins	ja, aanzienlijk
V21a V19a __ v16a_1	A. opstellen goed ondernemingsplan	1	2	3
V21b V19b __ v16b_1	B. geschikt contactennetwerk	1	2	3
V21c V19c __ v16c_1	C. verwerven naamsbekendheid/ pr/ communicatie	1	2	3
V21d V19d __ v16d_1	D. inzicht in wensen van (mogelijke) klanten (marktkennis)	1	2	3
V21e V19e __ v16p_1	E. geschiktheid vestigingspunt/bedrijfsruimte	1	2	3
V21f V19f __ v16m_1	F. medewerking van de bank, financiers	1	2	3
V21g V19g __ v16n_1	G. verkrijgen subsidies	1	2	3
V21h V19h __ v16g_1	H. (financiële) administratie	1	2	3
V21h V19h __ v5a	I. veel concurrentie	1	2	3
v21j v19j __ v16r_1	J. aantrekken geschikt personeel	1	2	3
v21k v19k __ v16h_1	K. liquiditeitspositie	1	2	3
v21l v19l __ v16i_1	L. (verbetering) rendement van het bedrijf	1	2	3
v21m v19m __ ____	M. samenwerking tussen medewerkers	1	2	3
v21n v19n __ ____	N. het op tijd afleveren van opdrachten	1	2	3
v21o v19o __ v16l_1	O. regels en wetten (bv. arbeidsregelgeving, milieuwetgeving)	1	2	3
v21p v19p __ V16t_1 - v16v_1	P. ander (enigszins) belangrijk knelpunt..... v21pand v19pand V16t_1 - v16v_1	1	2	3

22. Externe ondersteuning/advies, formeel en informeel

Voor ondersteuning bij het oplossen van knelpunten kunt u al dan niet tegen betaling advies of hulp inroepen van allerlei instanties en adviseurs. Ook kunt u gebruik maken van uw informele netwerk (informele gesprekken met collega-ondernemers en/of hun medewerkers, tips van klanten, vrienden of kennissen).

Noteer van de vijf belangrijkste knelpunten in vraag 21 (A – P) per knelpunt of u:

- **over het knelpunt heeft gesproken in uw *informele netwerk* (kolom I)**
- **hulp/ondersteuning heeft ingeroepen van *formele instanties/adviseurs* (kolom II)**

Knelpunt uit vraag 21 *(letter noteren is voldoende).*	**I** aan de orde gesteld in uw informele externe netwerk? niet/ nauwelijks	ja	**II** hulp ingeroepen van formele instanties/adviseurs? nee	ja
v22a v20a __ __	v22a1 v20a1 1	2	v22a2 v20a2 1	2
v22b v20b __ __	v22b1 v20b1 1	2	v22b2 v20b2 1	2
v22c v20c __ __	v22c1 v20c1 1	2	v22c2 v20c2 1	2
v22d v20d __ __	v22d1 v20d1 1	2	v22d2 v20d2 1	2
v22e v20d __ __	v22e1 v20e1 1	2	v22e2 v20e2 1	2

Ruimte voor toelichting

.....

v22r v20r __ __

.....

23. Inkoop in 2007

Wat is de waarde van de ingekochte diensten, onderdelen en materialen (exclusief btw)?
(naar keuze in te vullen in Euro's of in procenten van de omzet).

Euro's		% van de omzet
€	v23a v21a _ ___	% ..... v23b v21b _ ___

24. Omzet

Geef aan hoeveel de totale omzet van uw bedrijf bedroeg over de jaren 2005, 2006 en 2007 (exclusief btw).

*vult u **n.v.t.** in als u in het betreffende jaar nog geen omzet had*	jaar 2005	jaar 2006	jaar 2007	jaar 2003	jaar 2002	jaar 1999
	v24a v22a _ _ €	v24b v22b _ _ €	v24c v22c _ _ €	_ _ _ v21a_1 €	_ _ _ v21a_2 €	_ _ v3_11 _ € .....

25. Bedrijfsresultaat

	2005	2006	2007	2003	2002
a. verlies	v25a 1	v25b 1	v25c 1	_ 1	_ 1
b. break even	v23a 2	v23b 2	v23c 2	_ 2	_ 2
c. winst	_ 3	_ 3	_ 3	_ 3	_ 3
d. n.v.t. *(het bedrijf was nog niet opgericht))*	_ 4	_ 4	_ 4	v21_c1 4	v21_c2 4

26. Medewerkers

Geef het aantal medewerkers in uw bedrijf werkzaam op 31 december van achtereenvolgens het jaar 2005, 2006 en 2007 *(uzelf incluis)*.

	jaar 2005	jaar 2006	jaar 2007	jaar 2003	jaar 2002	jaar 1999
aantal medewerkers absoluut	v28a1 v24a1 _ _	v26b1 v24b1 _ _	v26c1 v24c1 _ _	_ _ _ v21d_1a	_ _ _ v21d_1b	_ _ n3_62 _ .....
aantal medewerkers op basis van fulltime eenheden	.....	.....	.....	.....	.....	.....

*vult u **n.v.t.** in als het bedrijf nog niet was opgericht*

27. Slotvragen

27a. Wat is uw geboortedatum?

27b. Wat is uw geslacht?

1 vrouw
2 man

27c. Bent u student aan de RU Nijmegen/UMC St. Radboud of bent u dat in het verleden geweest?

1 nee
2 ja → 1 afgestudeerd in: ..... jaartal

aan faculteit: ..... (naam)

2 ik studeer nog aan de RU Nijmegen/UMC St. Radboud

aan faculteit: ..... (naam)

27d. Bent u medewerker van de RU Nijmegen/UMC St. Radboud of bent u dat in het verleden geweest?

1 nee
2 ja → 1 in het verleden, tot: ..... (laatste jaar van dienstverband)

aan faculteit of eenheid: ..... (naam)

2 Ik ben nog steeds medewerker van de RU Nijmegen/UMC St. Radboud

aan faculteit of een heid: ..... (naam)

Tenslotte verzoeken wij u hieronder uw telefoonnummer in te vullen en het adres van de website van uw bedrijf

Telefoon/mobiel: .....

website: .....

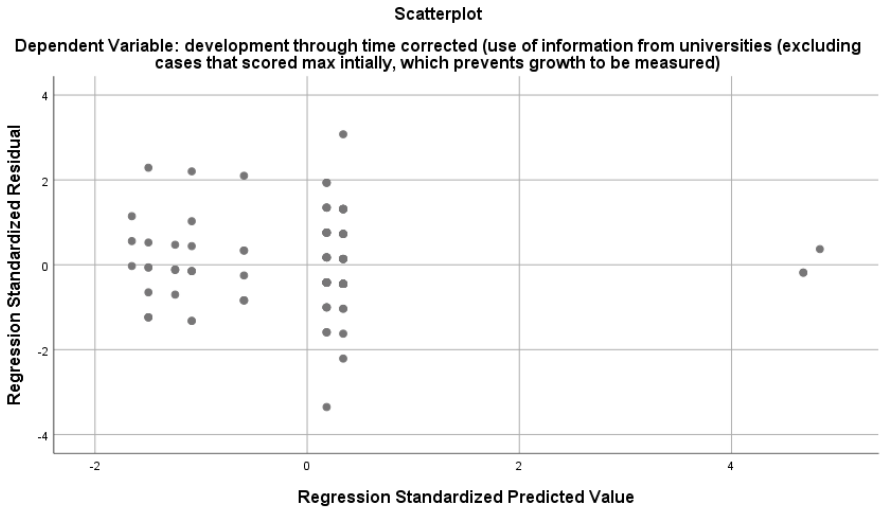
Dit is het einde van de vragenlijst. Hartelijk dank voor uw medewerking

Appendix 2: Multivariate analysis tables

Hypothesis 1:

Development scientific business network as dependent variable:

Linearity and Homoscedasticity:



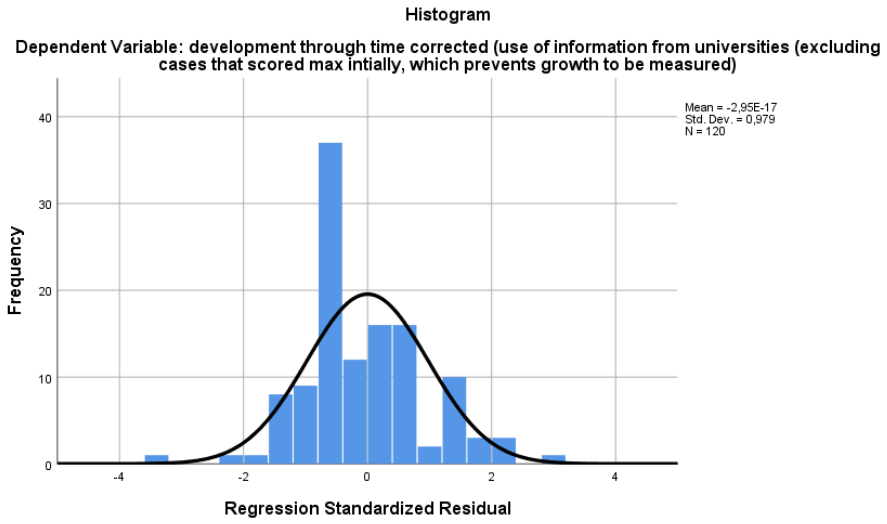
Independent errors:

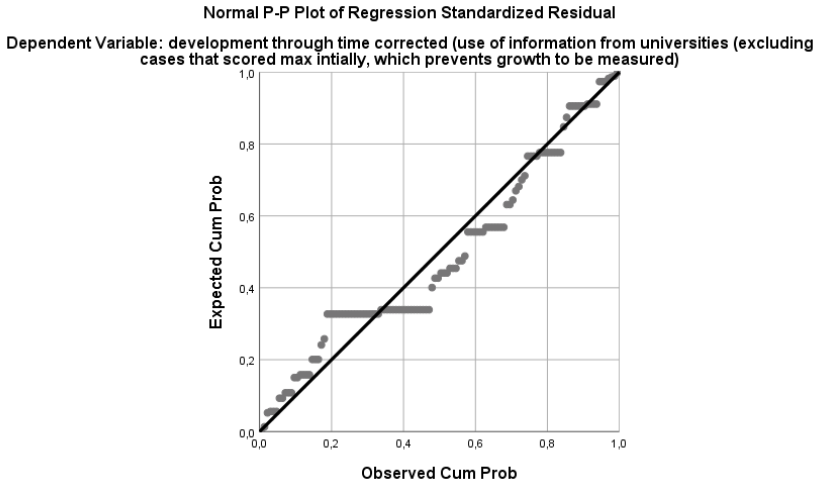
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	,0251	1,1853	,3208	,17888	120
Residual	-2,85360	2,61844	,00000	,83309	120
Std. Predicted Value	-1,653	4,833	,000	1,000	120
Std. Residual	-3,353	3,076	,000	,979	120

a. Dependent Variable: development through time corrected (use of information from universities (excluding cases that scored max intially, which prevents growth to be measured)

Normally distributed errors:



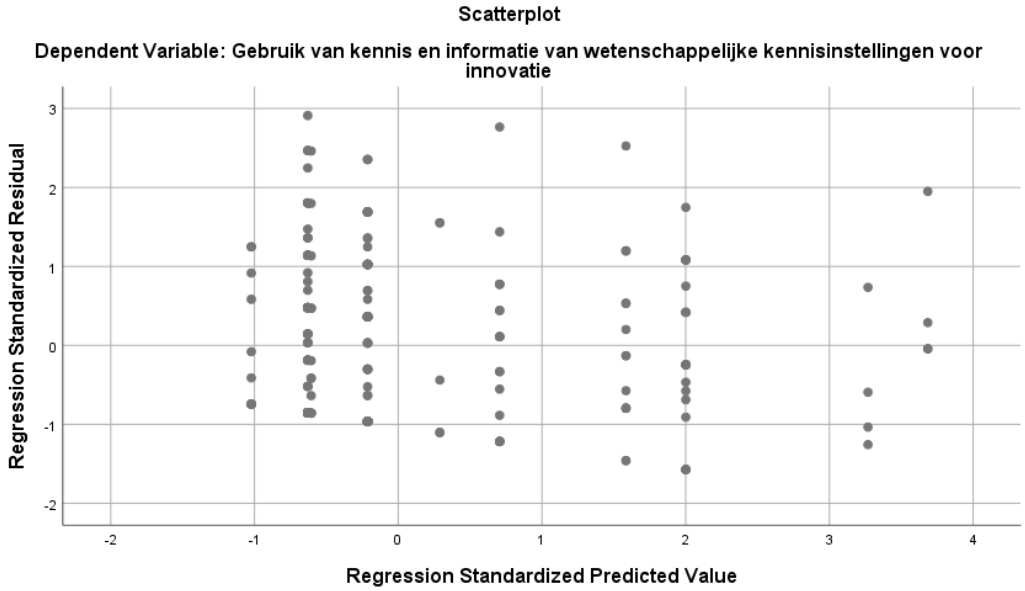


Multicollinearity:

	Tolerance	VIF
Spinoffs inside Nijmegen	,910	1,099
Sector_Industry	,795	1,258
Sector_Trade	,513	1,951
Sector_ICT	,641	1,559
Sector_ServiceTrainingHealthWellness	,390	2,566

Mean use scientific business network as dependent variable:

Linearity and Homoscedasticity:



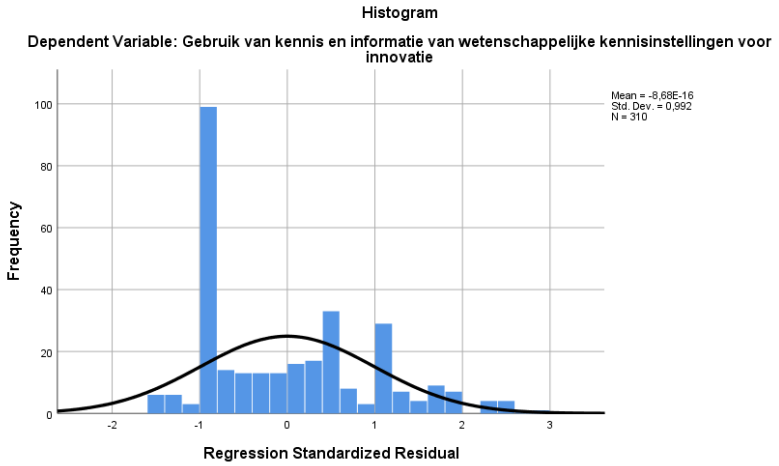
Independent errors:

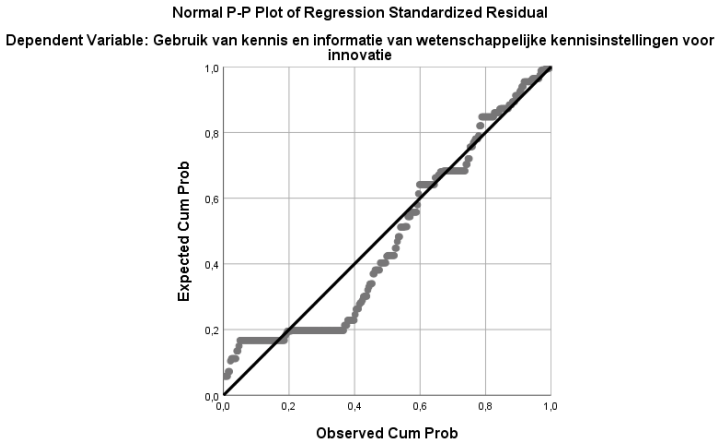
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	1,5603	2,5326	1,7715	,20656	310
Residual	-1,18479	2,19189	,00000	,74681	310
Std. Predicted Value	-1,022	3,685	,000	1,000	310
Std. Residual	-1,574	2,911	,000	,992	310

a. Dependent Variable: Gebruik van kennis en informatie van wetenschappelijke kennisinstellingen voor innovatie

Normally distributed errors:





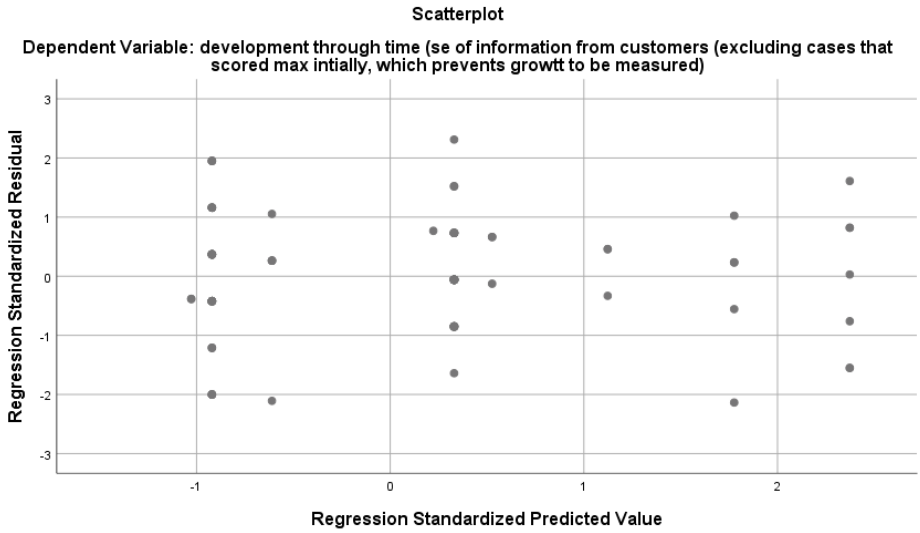
Multicollinearity:

	Tolerance	**VIF**
Spinoffs inside Nijmegen	,964	1,038
Sector_Industry	,851	1,175
Sector_Trade	,646	1,548
Sector_ICT	,667	1,500
Sector_ServiceTrainingHealthWellness	,486	2,056

Hypothesis 2:

Development commercial business network as dependent variable:

Linearity and Homoscedasticity:



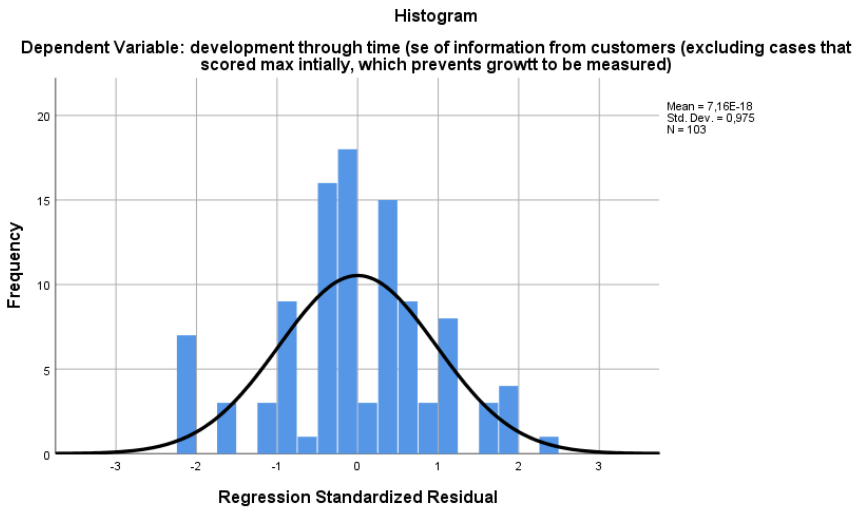
Independent errors:

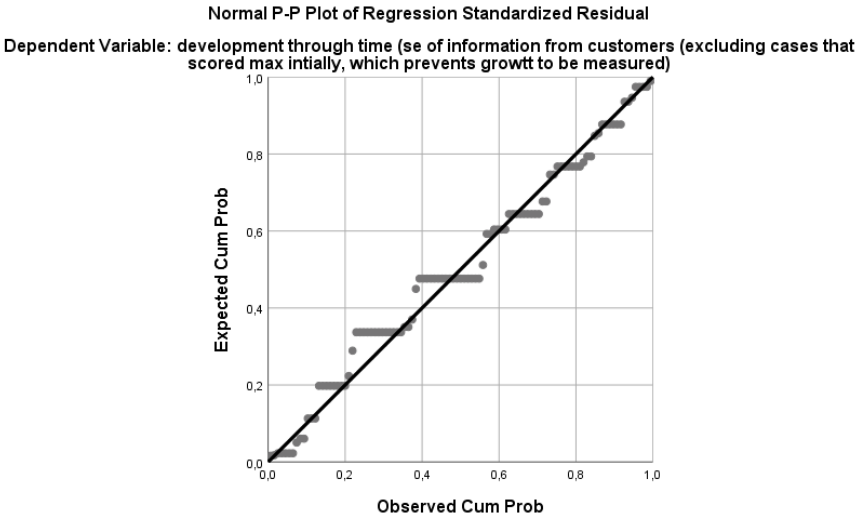
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	-,5144	,9629	-,0680	,43444	103
Residual	-2,70368	2,92466	,00000	1,23381	103
Std. Predicted Value	-1,028	2,373	,000	1,000	103
Std. Residual	-2,137	2,312	,000	,975	103

a. Dependent Variable: development through time (se of information from customers (excluding cases that scored max intially, which prevents growtt to be measured)

Normally distributed errors:



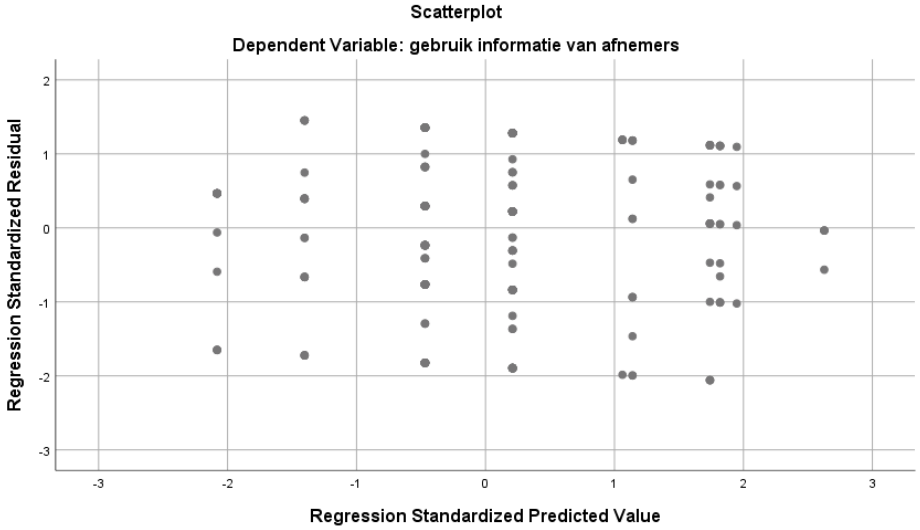


Multicollinearity:

	Tolerance	VIF
Spinoffs inside Nijmegen	,920	1,087
Sector_Industry	,743	1,345
Sector_Trade	,492	2,034
Sector_ICT	,595	1,682
Sector_ServiceTrainingHealthWellness	,361	2,772

Mean use commercial business network as dependent variable:

Linearity and Homoscedasticity:



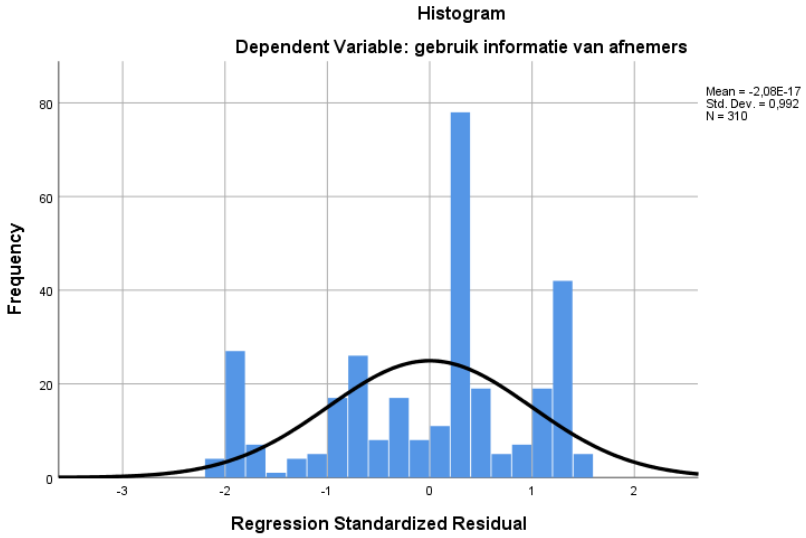
Independent errors:

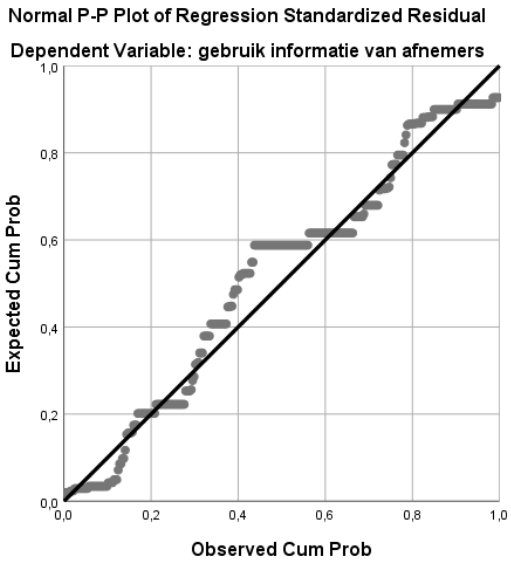
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	2,5595	3,0342	2,7694	,10083	310
Residual	-1,94481	1,37211	,00000	,93718	310
Std. Predicted Value	-2,082	2,627	,000	1,000	310
Std. Residual	-2,058	1,452	,000	,992	310

a. Dependent Variable: gebruik informatie van afnemers

Normally distributed errors:





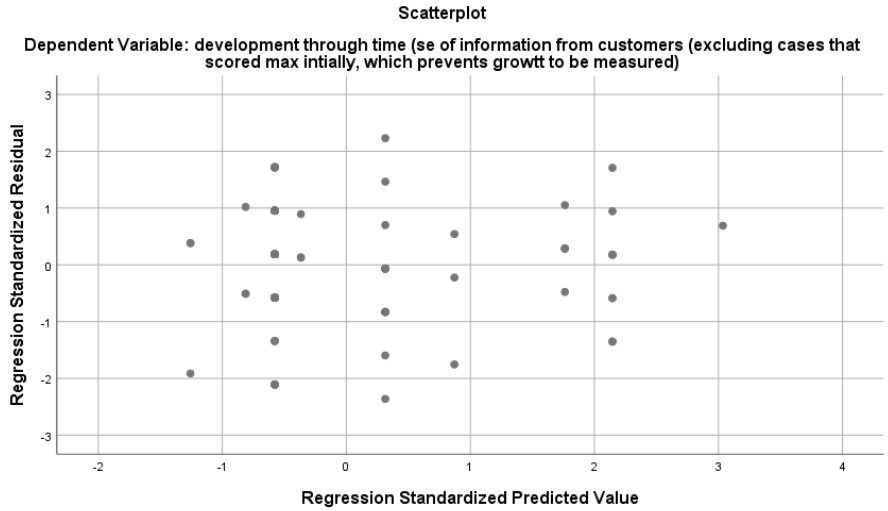
Multicollinearity:

	Tolerance	VIF
Spinoffs inside Nijmegen	,964	1,037
Sector_Industry	,847	1,180
Sector_Trade	,639	1,564
Sector_ICT	,660	1,516
Sector_ServiceTrainingHealthWellness	,479	2,086

Hypothesis 3:

Development commercial business network as dependent variable:

Linearity and Homoscedasticity:



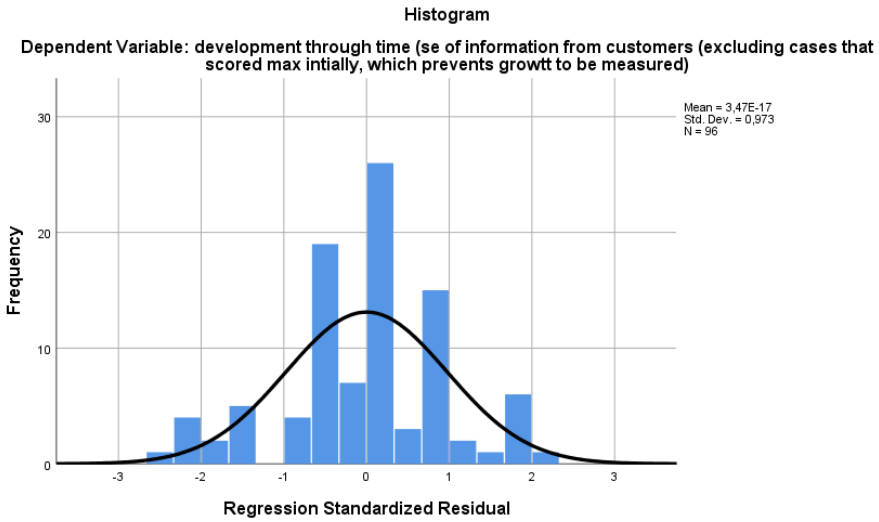
Independent errors:

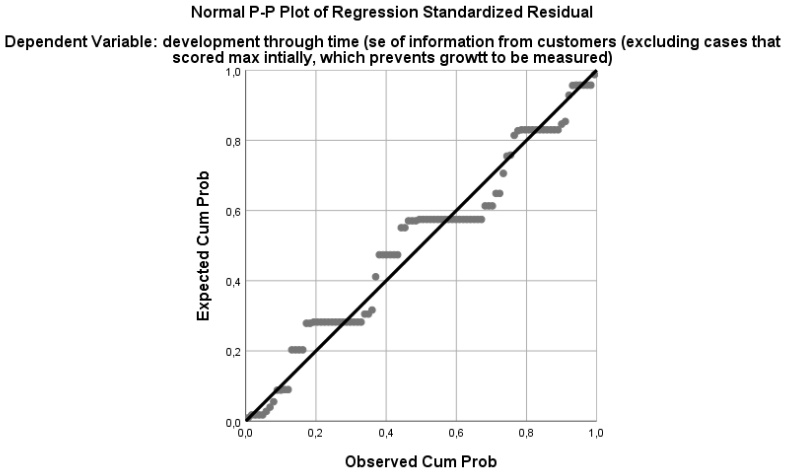
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	-,4991	1,0984	-,0313	,37209	96
Residual	-3,08552	2,91448	,00000	1,27219	96
Std. Predicted Value	-1,257	3,036	,000	1,000	96
Std. Residual	-2,361	2,230	,000	,973	96

a. Dependent Variable: development through time (se of information from customers (excluding cases that scored max intially, which prevents growtt to be measured)

Normally distributed errors:



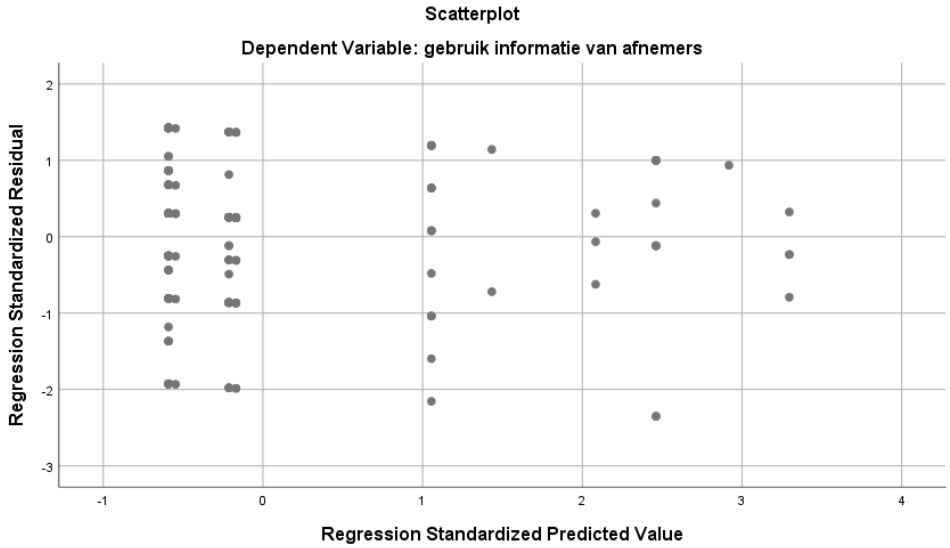


Multicollinearity:

	Tolerance	VIF
Spinoffs located on MCB (UT_MCB, Nijm_MCB, Ned_MCB)	,825	1,212
Sector_Industry	,737	1,358
Sector_Trade	,461	2,170
Sector_ICT	,607	1,646
Sector_ServiceTrainingHealthWellness	,344	2,908

Mean use commercial business network as dependent variable:

Linearity and Homoscedasticity:



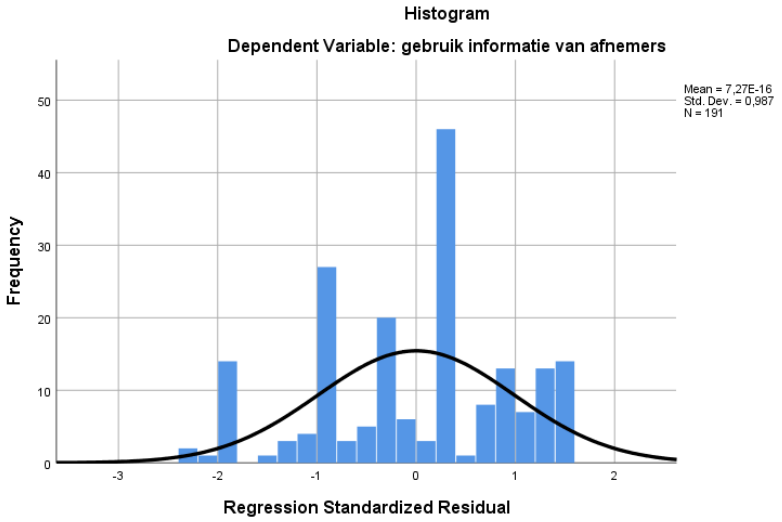
Independent errors:

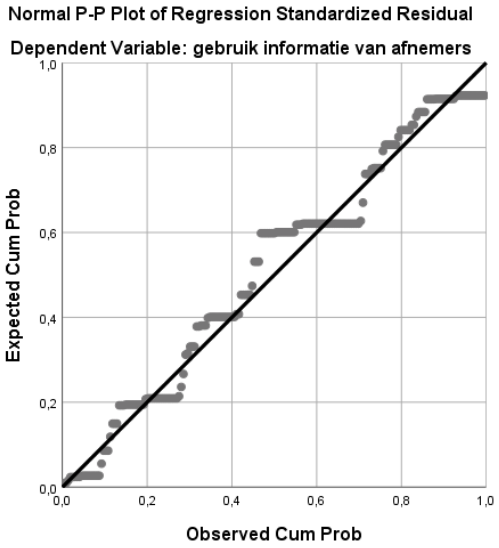
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	2,7246	3,2094	2,7984	,12469	191
Residual	-2,10535	1,27535	,00000	,88351	191
Std. Predicted Value	-,592	3,296	,000	1,000	191
Std. Residual	-2,351	1,424	,000	,987	191

a. Dependent Variable: gebruik informatie van afnemers

Normally distributed errors





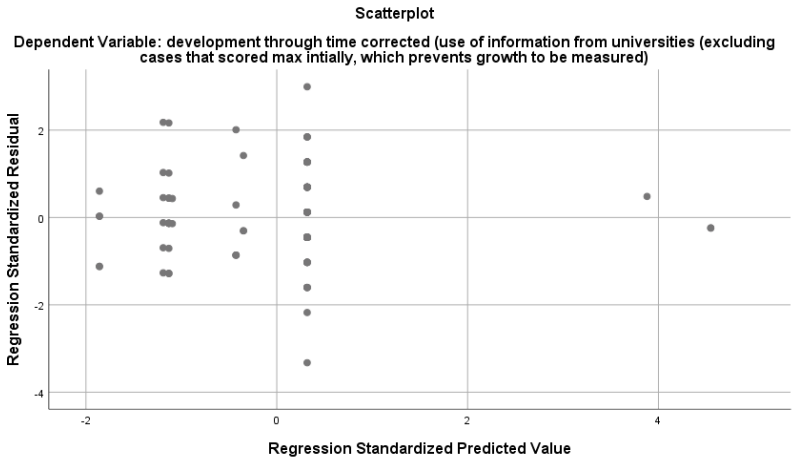
Multicollinearity:

	Tolerance	**VIF**
Spinoffs located on MCB (UT_MCB, Nijm_MCB, Ned_MCB)	,820	1,220
Sector_Industry	,860	1,163
Sector_Trade	,594	1,683
Sector_ICT	,700	1,429
Sector_ServiceTrainingHealthWellness	,467	2,140

Hypothesis 4:

Development scientific business network as dependent variable:

Linearity and Homoscedasticity:



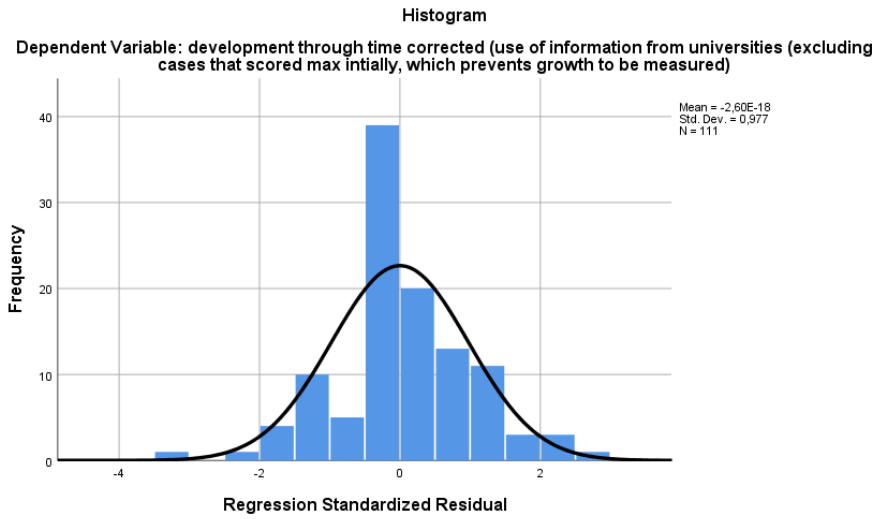
Independent errors:

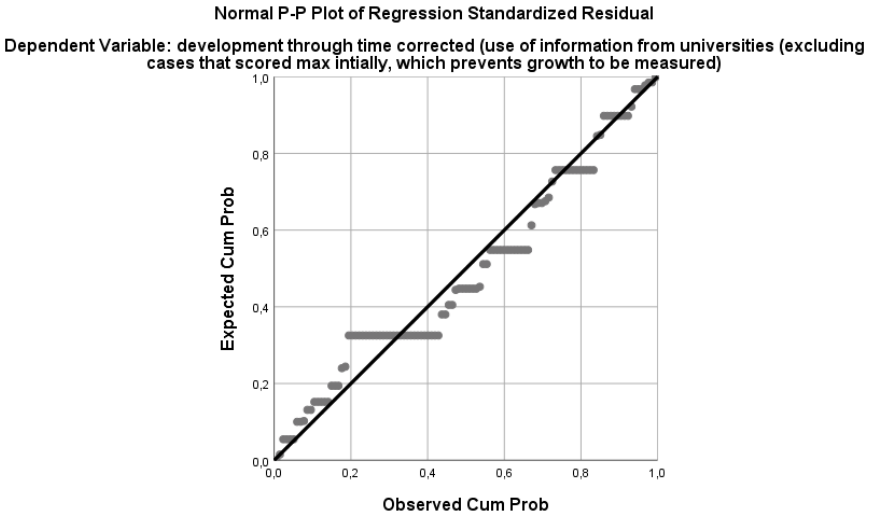
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	-,0247	1,2096	,3333	,19266	111
Residual	-2,89462	2,60538	,00000	,85058	111
Std. Predicted Value	-1,858	4,548	,000	1,000	111
Std. Residual	-3,325	2,993	,000	,977	111

a. Dependent Variable: development through time corrected (use of information from universities (excluding cases that scored max intially, which prevents growth to be measured)

Normally distributed errors:



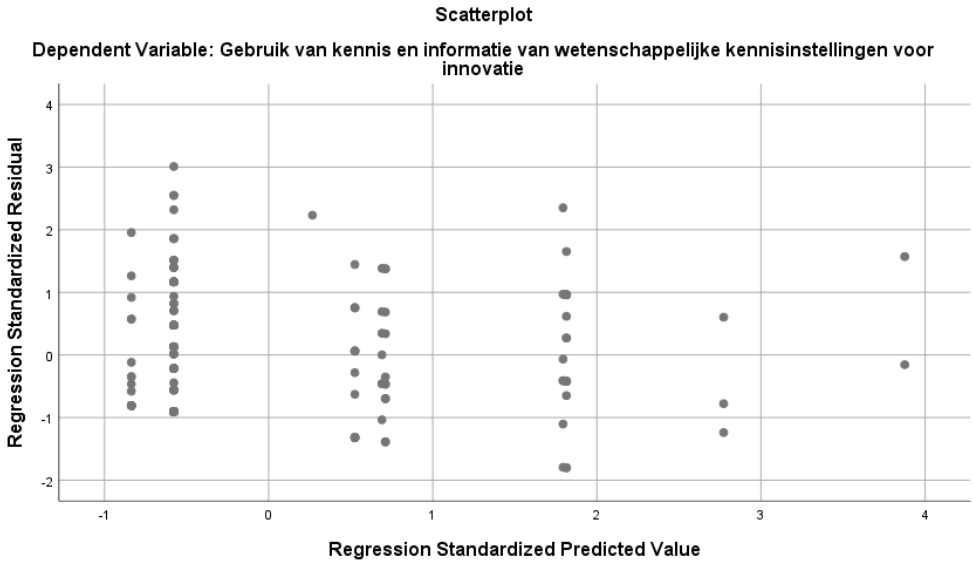


Multicollinearity:

	Tolerance	VIF
Located on university grounds in a MCB	,778	1,286
Sector_Industry	,804	1,244
Sector_Trade	,448	2,234
Sector_ICT	,642	1,557
Sector_ServiceTrainingHealthWellness	,336	2,979

Mean use scientific business network as dependent variable:

Linearity and Homoscedasticity:



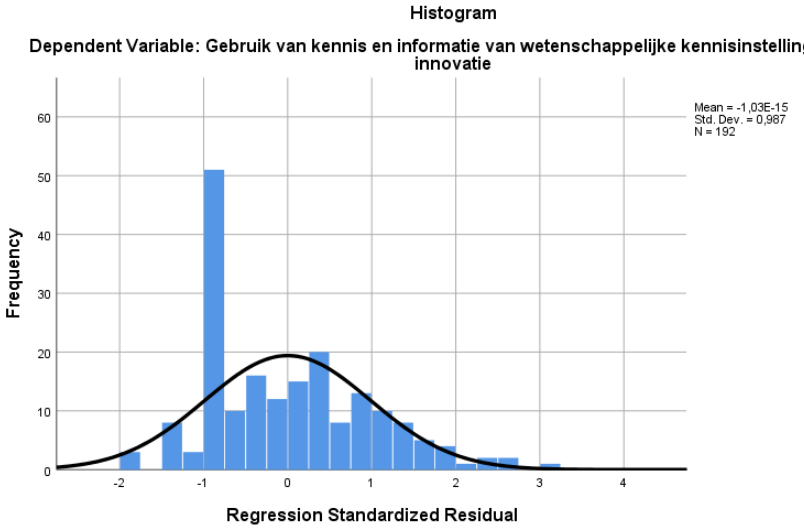
Independent errors:

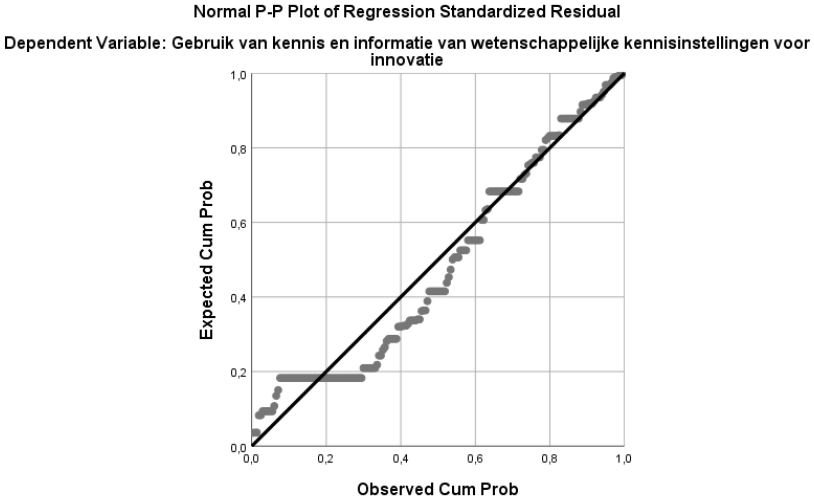
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	1,5852	2,8628	1,8121	,27112	192
Residual	-1,30397	2,17802	,00000	,71429	192
Std. Predicted Value	-,837	3,876	,000	1,000	192
Std. Residual	-1,801	3,009	,000	,987	192

a. Dependent Variable: Gebruik van kennis en informatie van wetenschappelijke kennisinstellingen voor innovatie

Normally distributed errors:





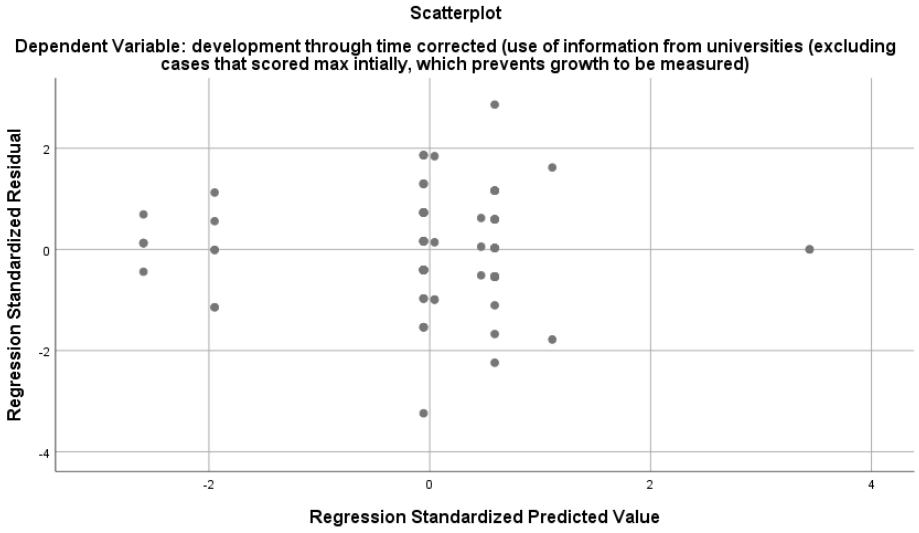
Multicollinearity:

	Tolerance	VIF
Located on university grounds in a MCB	,797	1,254
Sector_Industry	,861	1,161
Sector_Trade	,592	1,690
Sector_ICT	,708	1,412
Sector_ServiceTrainingHealthWellness	,441	2,270

Hypothesis 5:

Development scientific business network as dependent variable:

Linearity and Homoscedasticity:



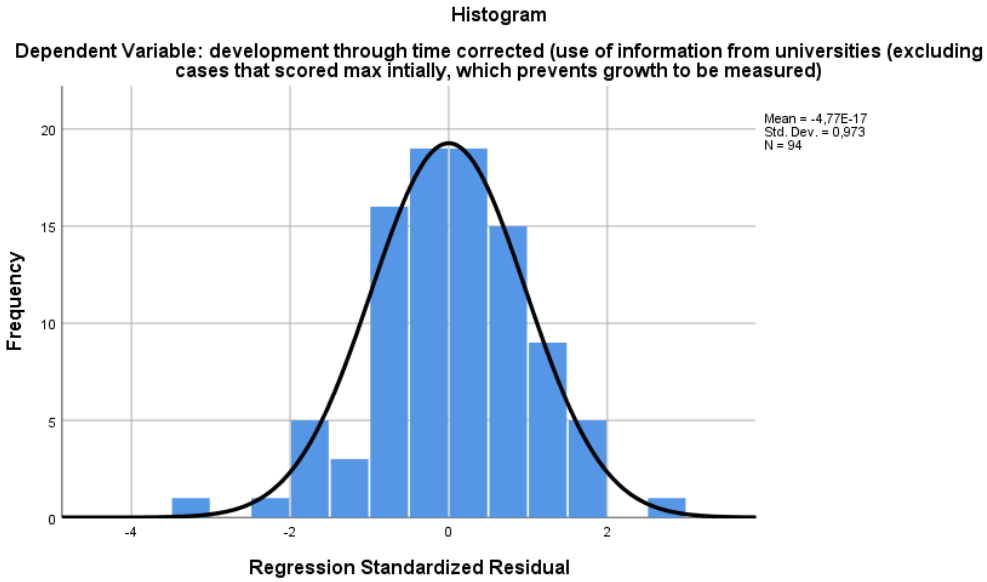
Independent errors:

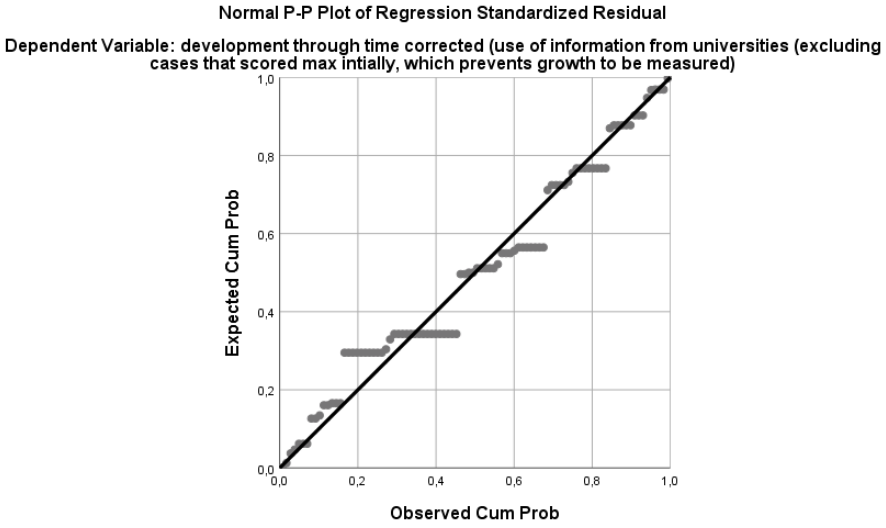
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	-,1101	1,0000	,3670	,18402	94
Residual	-2,85666	2,52475	,00000	,85784	94
Std. Predicted Value	-2,593	3,440	,000	1,000	94
Std. Residual	-3,239	2,863	,000	,973	94

a. Dependent Variable: development through time corrected (use of information from universities (excluding cases that scored max intially, which prevents growth to be measured)

Normally distributed errors:



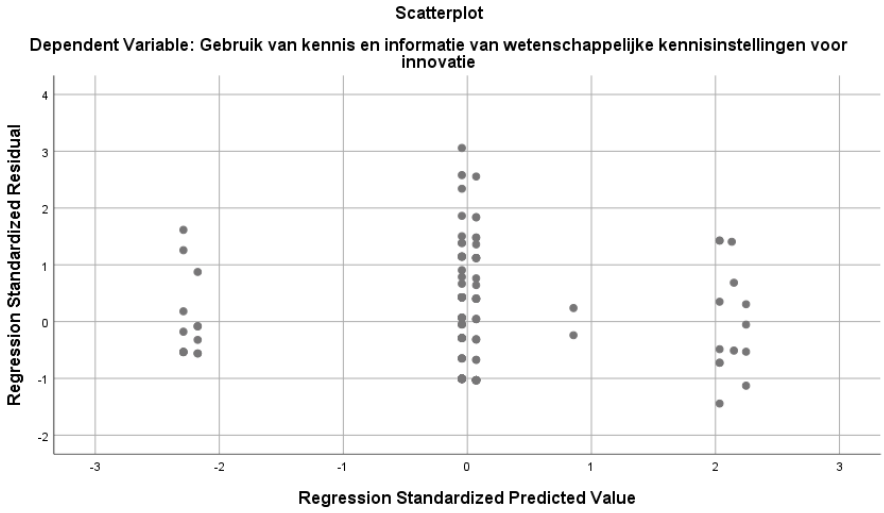


Multicollinearity:

	Tolerance	VIF
Spinoffs located in the city of Nijmegen (Nijm_MCB, Nijm_SO, Nijm_HM), but not in a business park	,916	1,092
Sector_Industry	,722	1,385
Sector_Trade	,353	2,835
Sector_ICT	,559	1,789
Sector_ServiceTrainingHealthWellness	,277	3,604

Mean use scientific business network as dependent variable:

Linearity and Homoscedasticity:



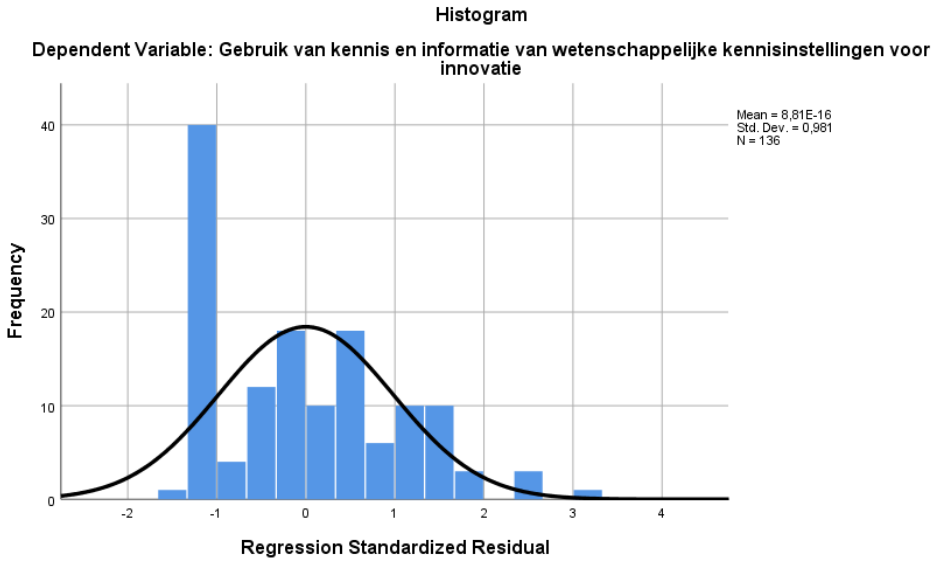
Independent errors:

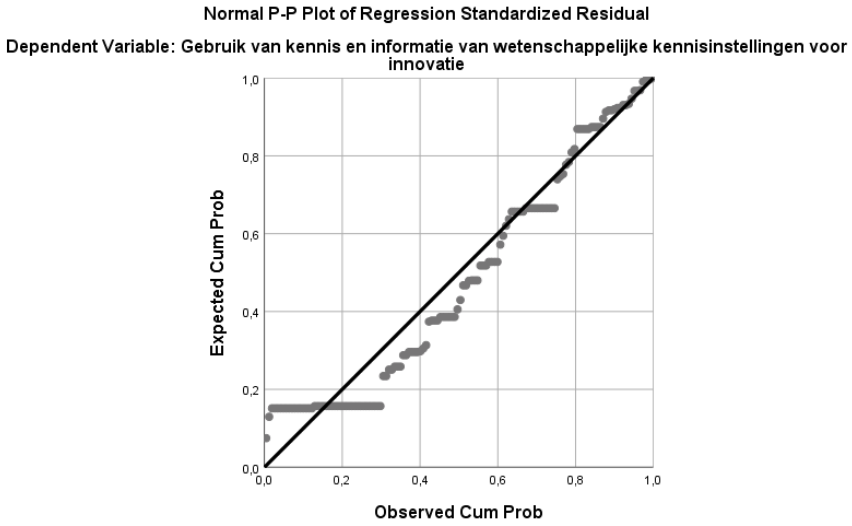
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	1,3737	2,0367	1,7083	,14615	136
Residual	-1,00552	2,13151	,00000	,68406	136
Std. Predicted Value	-2,289	2,247	,000	1,000	136
Std. Residual	-1,442	3,058	,000	,981	136

a. Dependent Variable: Gebruik van kennis en informatie van wetenschappelijke kennisinstellingen voor innovatie

Normally distributed errors





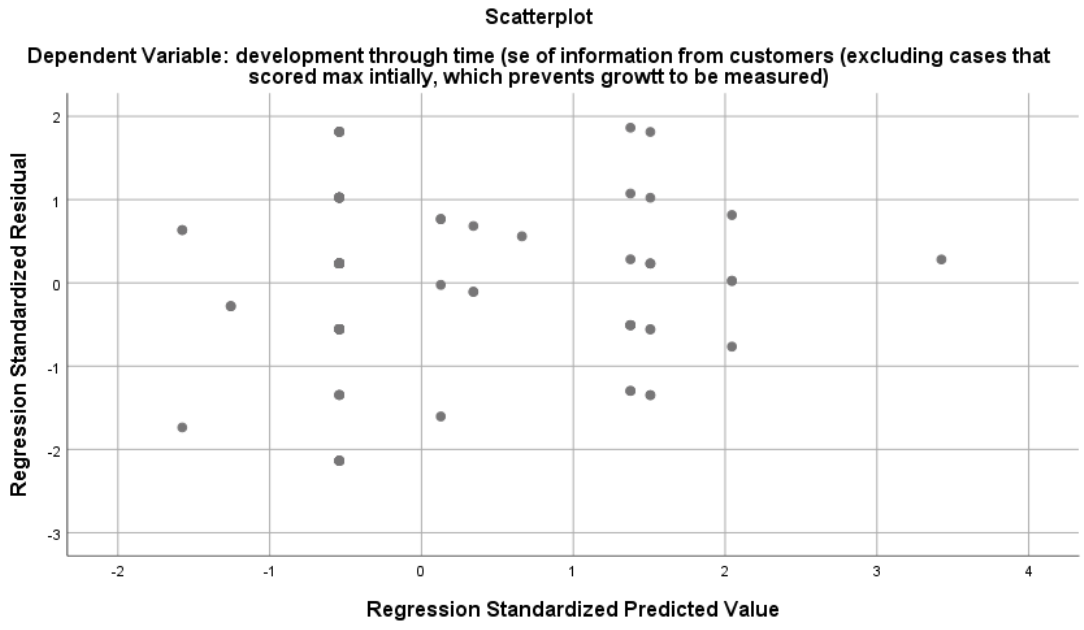
Multicollinearity:

	Tolerance	VIF
Spinoffs located in the city of Nijmegen (Nijm_MCB, Nijm_SO, Nijm_HM), but not in a business park	,956	1,046
Sector_Industry	,828	1,207
Sector_Trade	,433	2,310
Sector_ICT	,645	1,550
Sector_ServiceTrainingHealthWellness	,352	2,839

Hypothesis 6:

Development commercial business network as dependent variable:

Linearity and Homoscedasticity:



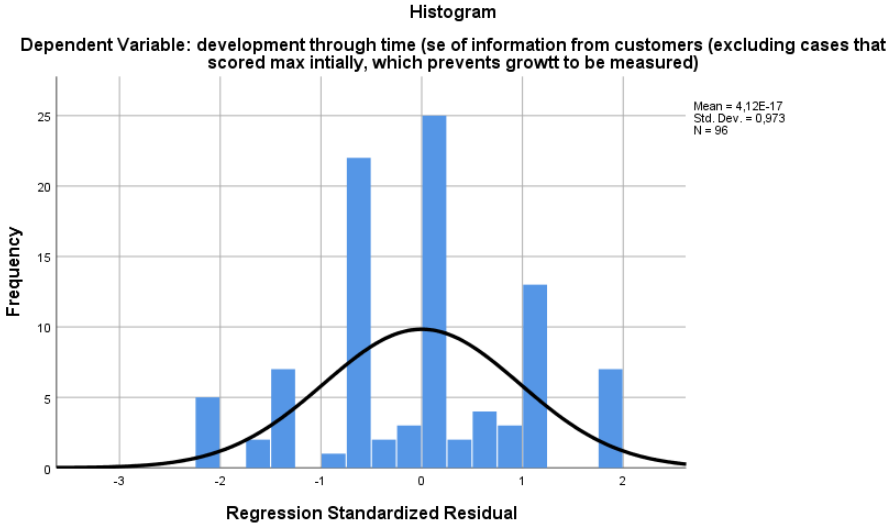
Independent errors:

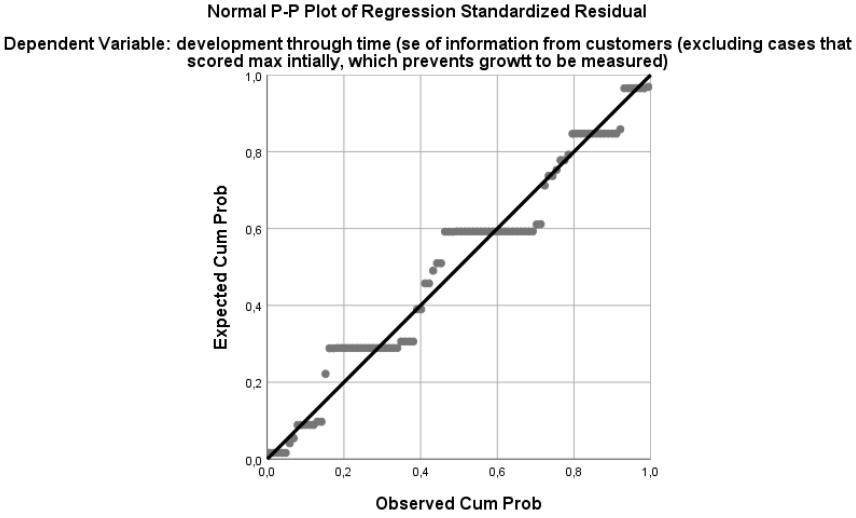
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	-,8025	1,6446	-,0312	,48932	96
Residual	-2,70369	2,35791	,00000	1,23186	96
Std. Predicted Value	-1,576	3,425	,000	1,000	96
Std. Residual	-2,136	1,863	,000	,973	96

a. Dependent Variable: development through time (se of information from customers (excluding cases that scored max intially, which prevents growtt to be measured)

Normally distributed errors:



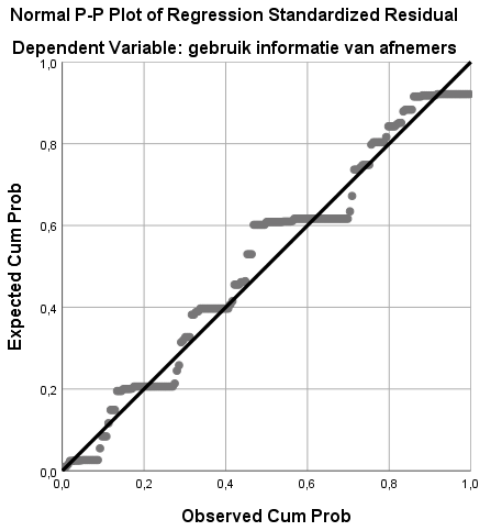


Multicollinearity:

	Tolerance	**VIF**
Spinoffs located on MCB in Nijmegen (UT_MCB, Nijm_MCB)	,882	1,134
Sector_Industry	,747	1,338
Sector_Trade	,470	2,127
Sector_ICT	,610	1,641
Sector_ServiceTrainingHealthWellness	,343	2,913

Mean use commercial business network as dependent variable:

Linearity and Homoscedasticity:



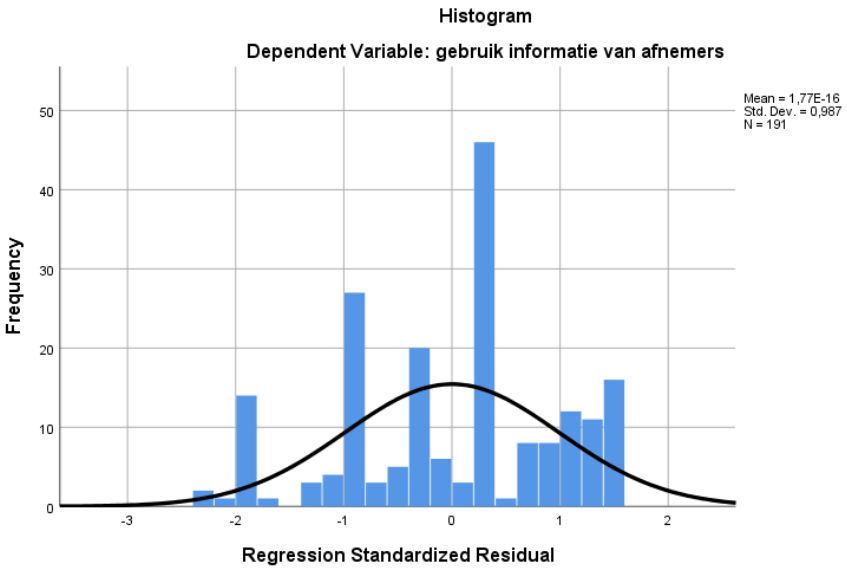
Independent errors:

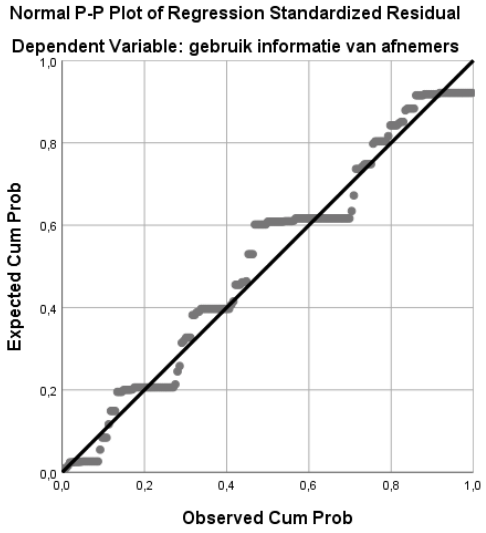
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	2,7344	3,2114	2,7984	,12320	191
Residual	-2,10065	1,26556	,00000	,88372	191
Std. Predicted Value	-,519	3,352	,000	1,000	191
Std. Residual	-2,346	1,413	,000	,987	191

a. Dependent Variable: gebruik informatie van afnemers

Normally distributed errors:





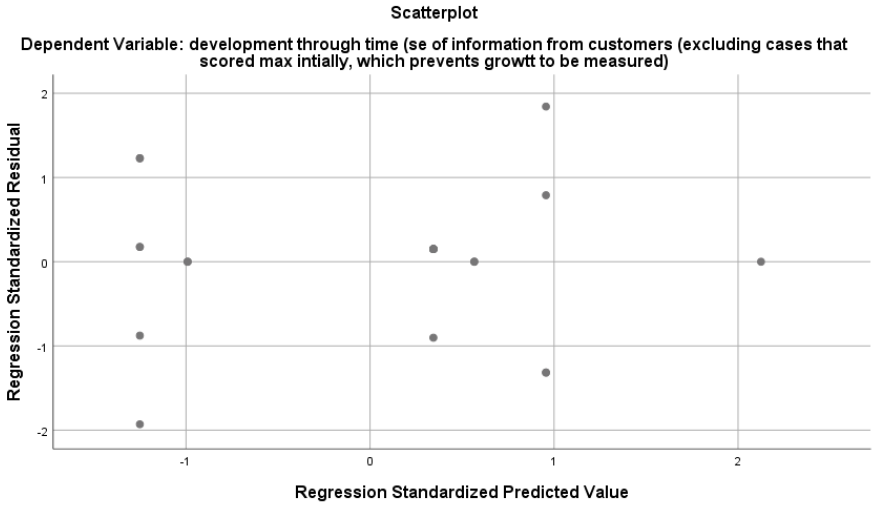
Multicollinearity:

	Tolerance	**VIF**
Spinoffs located on MCB in Nijmegen (UT_MCB, Nijm_MCB)	,811	1,233
Sector_Industry	,854	1,171
Sector_Trade	,595	1,681
Sector_ICT	,701	1,427
Sector_ServiceTrainingHealthWellness	,451	2,218

Hypothesis 7:

Development commercial business network as dependent variable:

Linearity and Homoscedasticity:



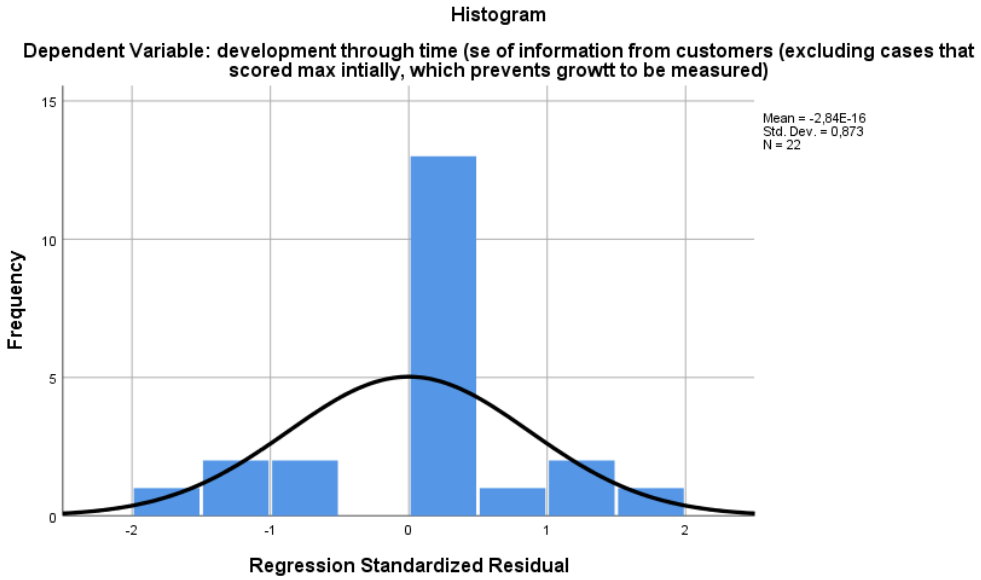
Independent errors:

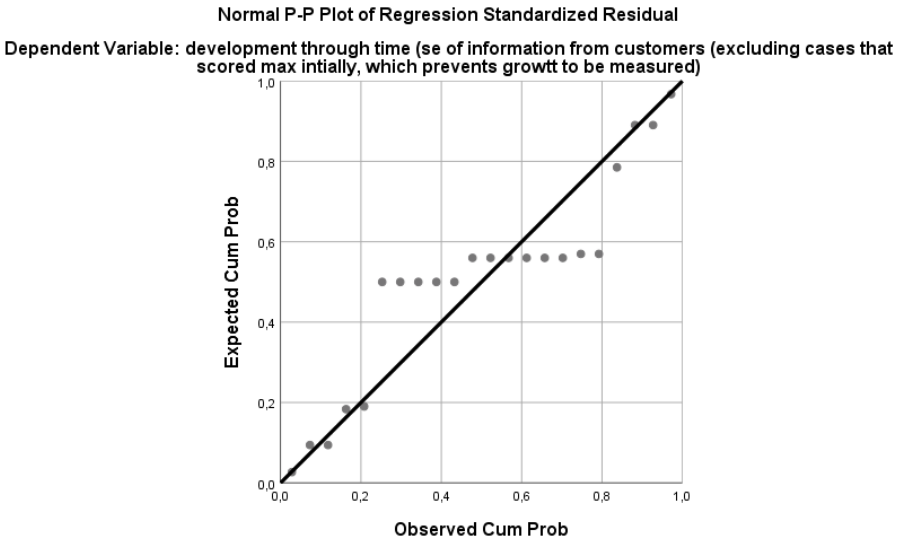
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	-1,1667	1,0000	-,3636	,64181	22
Residual	-1,83333	1,75000	,00000	,82924	22
Std. Predicted Value	-1,251	2,125	,000	1,000	22
Std. Residual	-1,930	1,842	,000	,873	22

a. Dependent Variable: development through time (se of information from customers (excluding cases that scored max intially, which prevents growtt to be measured)

Normally distributed errors:



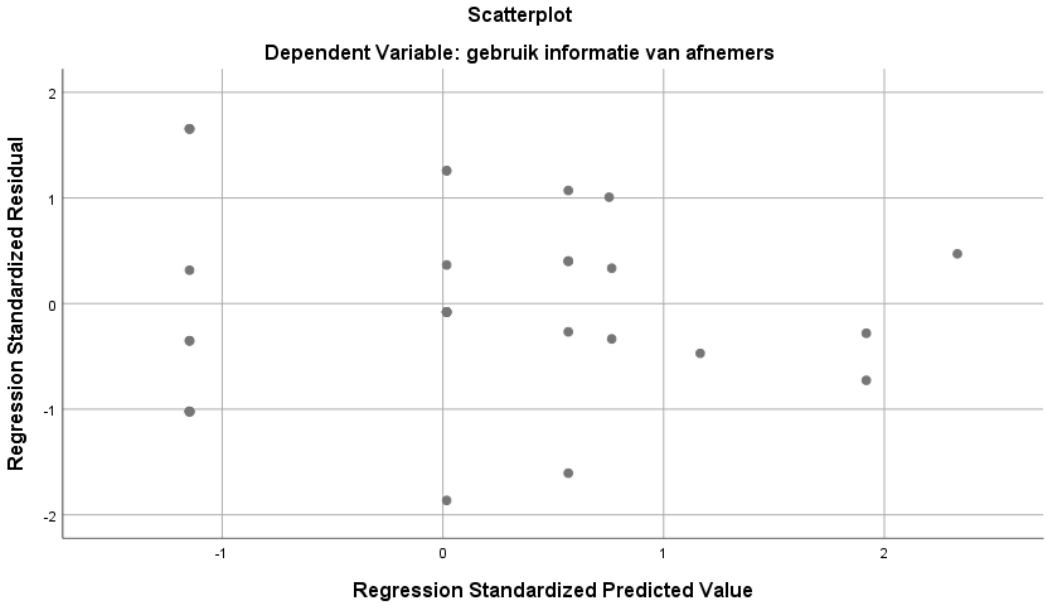


Multicollinearity:

	Tolerance	VIF
Netherlands MCB	,607	1,646
Sector_Industry	,367	2,727
Sector_Trade	,196	5,104
Sector_ICT	,304	3,290
Sector_ServiceTrainingHealthWellness	,161	6,205

Mean use commercial business network as dependent variable:

Linearity and Homoscedasticity:



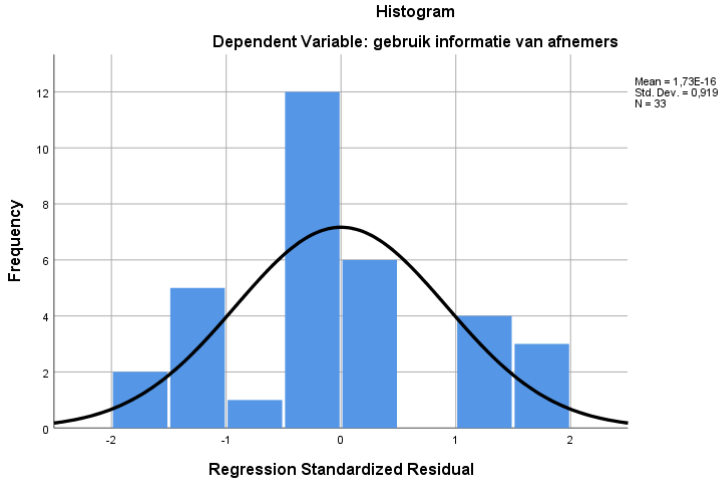
Independent errors:

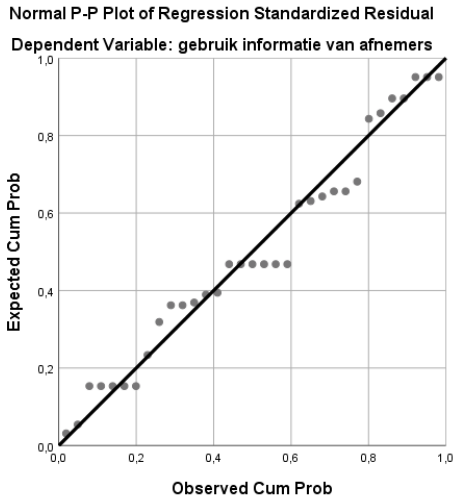
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	2,7637	3,6481	3,0556	,25421	33
Residual	-1,39323	1,23627	,00000	,68648	33
Std. Predicted Value	-1,148	2,331	,000	1,000	33
Std. Residual	-1,864	1,654	,000	,919	33

a. Dependent Variable: gebruik informatie van afnemers

Normally distributed errors:





Multicollinearity:

	Tolerance	**VIF**
Netherlands MCB	,783	1,277
Sector_Industry	,512	1,952
Sector_Trade	,319	3,135
Sector_ICT	,438	2,285
Sector_ServiceTrainingHealthWellness	,239	4,182