OPENING UP THE IVORY TOWER

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Preface

You will now read this thesis named “opening up the ivory tower”, which describes the process of knowledge transfer in the Netherlands. The term ivory tower has been used to describe an environment of intellectual pursuit, disconnected form the practical concerns of life. By opening up the ivory tower, the knowledge hoarded within the tower will be distributed among society. It has been written so I can graduate from the University Utrecht with a master title in Science and Business Management. I was engaged in researching and writing this thesis from May to September 2016.

The project was undertaken in co-operation with IDfuse, where I did an internship. The research question was formulated during the course of the internship and a lot of research was conducted before I knew the direction this study would be going. But an informative thesis is the result.

I would like to thank my supervisor Paul Tuinenburg and his colleague Tijmen Altena at IDfuse for the great time I had with them. They were great discussion partners and were crucial in the creative process that eventually led to this thesis. Furthermore, I would like to thank Toine van Hoof, my University Utrecht supervisor, who kept me writing with his monthly deadlines.

Also special thanks for all participants in this study, both the interviewees as people who provided their proposals. I enjoyed reading these small parts of your research and I am quite interested in the results of your studies!

I hope you enjoy the reading

Joris Koenders

Utrecht, September 2016

Summary

There are multiple terms in use for describing the process of the transfer of knowledge from scientific research to society like valorization, knowledge utilization and impact. This knowledge can be economical, cultural or societal. To stimulate knowledge utilization in The Netherlands, the Dutch government created several mechanisms to enhance knowledge transfer. One of these mechanisms is the knowledge utilization paragraph in the 'Vernieuwingsimpuls' program of the NWO. In this paragraph, scientists have to explain the potential of their study and how they will transfer the knowledge to society (which activities they undertake). The aim of this study was to see how a policy focus on knowledge utilization (the paragraph) influences scientists (how they write the paragraph). To test this, the effectiveness of the focus on the writing of the paragraph, the unintended side-effects of the focus and the focus' effect on different groups were measured. Additional information was acquired through interviews with laureates from the program.

To study the effectiveness of the knowledge utilization paragraphs, the paragraphs were analyzed and scored on the knowledge transfer activities, readability, specificity, terminology and use of active voice. These parameters were also used to differentiate between the NWO disciplines and between the Veni- and Vidi candidates. Unintended side-effects of the focus on the paragraph were also speculated upon, and possible effects might be an increase in entrepreneurial activity and reduced time for academic work due to increase time spend on knowledge utilization.

Results show an increase in knowledge utilization promises in 2015, compared to 2013 and 2014. Other parameters did not show any significant difference. No increase in entrepreneurial activity could be seen when looking at the proposals and it became clear from the interviews that time spend on research was not hindered by knowledge utilization. When comparing the disciplines: the applicants in the Societal- and Behavioral Sciences promised more activities compared to the applicants in Earth and Life Sciences, Exact Sciences and Physics. The applicants of technology foundation STW were more specific than the average of all groups. Applicants in Chemical Sciences and Physics used more scientific terminology compared to the average of all groups, whereas the applicants for Societal- and Behavior Sciences used less scientific terminology. Also, when looking at what was promised, differences can be seen. With some disciplines that promise more economic activities (Technology Foundation STW, ZonMw, Exact Sciences and Physics), whereas other disciplines promise more societal activities (Humanities, Societal- and Behavior Sciences). Also the difference between the Veni candidates and Vidi candidates was measured. And it appeared that Vidi scientists are more specific in their paragraphs than Veni scientists, which suggests a better understanding of the paragraph by senior scientists. This exploratory study provided a lot of insights in knowledge utilization in the knowledge utilization paragraphs, but further studies have to be conducted to get a complete overview of how knowledge utilization is perceived in The Netherlands, and in the world.

Laymen's summary

Er zijn meerdere termen die het proces beschrijven van het overdragen van kennis naar de maatschappij, vanuit wetenschappelijk onderzoek, zoals valorisatie, kennisbenutting en impact. Deze kennisoverdracht kan zowel economisch, cultureel of maatschappelijk zijn. Omdat er veel van het Nederlandse belastinggeld naar wetenschappelijk onderzoek gaat is het in het belang van de overheid om deze kennisoverdracht te stimuleren en te reguleren. Dit doet ze onder andere met de kennisbenuttingsparagraaf in de Vernieuwingsimpuls, een programma waar wetenschappers een beurs kunnen aanvragen voor hun onderzoek. In deze kennisbenuttingsparagraaf moeten wetenschappers aangeven wat het belang van het onderzoek is en hoe ze de kennis de maatschappij in willen krijgen. Het doel van dit onderzoek was om in kaart te brengen wat het effect van de focus op deze paragraaf was op het schrijven van de wetenschappers. Om dit te testen is gekeken naar de effectiviteit van de paragraaf, de onbedoelde effecten van de paragraaf, en de verschillen in de paragraaf tussen de NWO disciplines en de verschillen tussen de Veni- en Vidi laureaten.

Om de effectiviteit te bestuderen, zijn de kennisbenuttingsparagrafen geanalyseerd en gescoord op de beloofde activiteiten, de leesbaarheid, specificiteit, het gebruik van wetenschappelijke termen en het gebruik van actieve taal. Deze parameters zijn ook gebruikt om de verschillen tussen de disciplines en tussen de Veni- en Vidi kandidaten aan te tonen. Er is gespeculeerd over onbedoelde effecten: meer activiteiten die met ondernemerschap te maken en minder tijd voor academisch werk door de toegenomen tijd besteed aan valorisatie.

De resultaten laten zien dat er meer kennisoverdracht activiteiten worden beloofd over de jaren, maar de rest van de parameters lieten geen verschil zien. Ook werden er geen onbedoelde effecten gezien in dit onderzoek. Veel verschillen tussen de disciplines waren er ook niet, maar als er gekeken werd naar de inhoud van de beloftes was er wel verschil te zien. Sommige disciplines beloofden meer economisch activiteiten, terwijl andere disciplines meer maatschappelijke activiteiten beloofden. Er was ook een verschil te zien tussen de Veni- en Vidi kandidaten. Met meer specifiekere paragrafen van Vidi wetenschappers, wat suggereert dat zij een beter begrip hebben van de paragraaf. Veel inzicht in valorisatie in de kennisbenuttingsparagraaf is gekomen door deze studie, maar veel onderzoek moet nog gedaan worden om te zien hoe valorisatie wordt bekeken in Nederland, en in de wereld.

Contents

List of abbreviations

ALW:	Aard- en Levenswetenschappen (Earth- and Life Sciences)
ArC:	Area crossing Sciences
CW:	Chemische Wetenschappen (Chemical Sciences)
EW:	Exacte wetenschappen (Exact Sciences)
GW:	Geesteswetenschappen (Humanities)
KNAW:	Koninklijke Nederlandse Academie voor de Wetenschappen (Royal Dutch Academy for Sciences)
KU:	Knowledge Utilization
MGW:	Maatschappij- en gedragswetenschappen (Societal- and behavior studies)
N:	Natuurkunde (Physics)
NWO:	De Nederlandse Organisatie voor Wetenschappelijk Onderzoek (Dutch Organisation for Scientific Research)
R&D	Research and development
SEP	Standard Evaluation Protocol
VSNU:	Vereniging van Universiteiten (Society of Universities)

Chapter 1 IDfuse

This study is conducted at IDfuse, a consultancy company founded in 2012 by Paul Tuinenburg and Tijmen Altena. It is a start-up located in Utrecht and it specializes in the design and support of the process that brings academic knowledge to fruition. Their main activities are:

- Grant writing: assisting scientists in the writing of utilization paragraphs and being involved in the execution of the promises in that paragraph.
- Entrepreneurship programs: IDfuse has developed programs in collaboration with UtrechtInc to attract scientists to entrepreneurship. These programs are aimed at finding a role best suited to a scientist in the business sector.
- Impact workshops: teaching scientists about knowledge utilization and training them to write more convincing paragraphs.

IDfuse collaborates with the majority of the Dutch universities and has ties with NWO and other companies involved in science and innovation.

Through their experience with knowledge utilization paragraphs, IDfuse has been able to develop a tool that can analyze paragraphs. This tool scans texts for words, but also uses text mining software to analyze a proposal. These text mining parameters have been used in this study.

Chapter 2 Introduction

Great amounts of knowledge are acquired by research. A substantial part of the research and development (R&D) in The Netherlands is performed by the 14 publicly funded universities in the Netherlands. The Dutch government wants to stimulate the knowledge generation and wants to regulate the usage of knowledge within these universities, to enable the transfer of the knowledge to the society. Terms used for this transfer are valorization, knowledge utilization (KU) and impact, in the rest of the thesis KU will be used. Since 2004 this knowledge transfer activity became the third core task of universities. (De Jong, 2015) And although it has been emphasized by the government, the actual transfer of knowledge to the society remains a difficult process. This is illustrated by a dilemma posed by a juvenile court magistrate on a congress in The Netherlands: "Sometimes I see juvenile delinquents for the tenth time. What should I do with these repeat juvenile offenders? Keep imprisoning them or try to correct them in another way?" Not five minutes after her presentation, a scientist entered the stage who mentioned that this dilemma was solved years ago, and the research he was doing now was of much more importance. Somehow this knowledge was available, but was not distributed among the interested parties. And this is just one of many examples of inefficient knowledge transfer that happen on a daily base throughout all disciplines on all universities in The Netherlands.

To prevent these kind of inefficient knowledge transfers a few control mechanisms have been introduced to regulate knowledge transfer. Some of these control mechanisms are specifically for research groups, like the Standard Evaluation Protocol (SEP), where knowledge transfer (and other things) are measured by an independent jury. Other mechanisms are specifically for universities, like the valorization indicators from the VSNU (society of Dutch universities), which provided a framework of indicators which the universities could use to measure their knowledge transfer. Later chapters will elaborate on this. Another control mechanism is on an individual scientist level: the KU paragraph in the NWO (Dutch Organization for Scientific Research) programs. In these programs scientists can apply for a grant. Their proposal is scored on the quality of the proposed research, the curriculum of the scientist and on KU. In the KU paragraph applicants have to state the potential of their research and the contribution of their research to society. In this thesis an exploratory study will be conducted to answer the main question: how does a policy focus on KU (paragraphs) influences how the KU paragraphs are written? Within the framework for analyzing public policies three sub-questions have been formulated: (1) what is the effect of the increased policy focus on way scientists write the paragraph, (2) what are unintended effects of the policy focus and (3) what are the effects of this policy on different groups (comparison of all NWO disciplines and comparison between Veni- and Vidi laureates)?

In this study, interviews have been conducted, proposals from the greatest Dutch subsidiary program have been analyzed from 2013, 2014 and 2015, referee and committee feedback on the paragraphs has been reviewed and text mining exercises have been conducted on the paragraphs. These activities have been used to test the hypotheses formulated for each sub-questions. Two chapters to provide background information will follow this introduction, with chapter 3 touching upon the subject of KU and the control mechanisms that exist in the

Netherlands, like the SEP and VSNU indicators. This chapter will also focus on the KU paragraph in the Vernieuwingsimpuls program. Chapter 4 will provide background information on R&D, the scope of R&D worldwide. How R&D is conducted in the Netherlands, how the funding structure is organized and which part of the funding goes to universities. The theoretical framework will be explained in chapter 5; the hypotheses to answer the sub questions are introduced and explained. The following will explain the methods used to conduct this study (chapter 6), the data acquired from the interviews, proposal analysis and text mining analysis (chapter 7). And the final chapters will be dedicated to discussion of the acquired data (chapter 8), conclusions and recommendations (chapter 9).

Chapter 3 Knowledge utilization

3.1 Knowledge utilization

There are many synonyms that describe the same process of knowledge transfer. The NWO uses knowledge utilization, the Dutch government uses valorization and in other countries, people talk about impact: societal/economic/scientific impact. Since 2009 the Dutch government defines valorization as: the process of creating value from knowledge by making it suitable and/or available for economic and/or societal use and translating it into products, services, processes and entrepreneurial activity. (De Jong, 2015) The NWO also uses this definition, but handles the term KU. KU is a continuous process of translating knowledge into something valuable. This value is not only expressed in money, but everything benefiting society. KU is therefore a process that comes in many forms and executions within multiple disciplines. (Van Drooge and De Jong, 2016) Although valorization and KU are interchangeable, the rest of this study will use the term KU, for clarity. Figure 1 illustrates how (economical) KU might be achieved. Both the acquired knowledge from the research executed as well as the skill sets of the researchers can contribute to knowledge transfer activities. The knowledge transfer activities might vary greatly and the activities depicted are but a few of many possibilities. These activities might result in economic activity, with companies using the knowledge provided to develop new products or services, providing an economic impact.

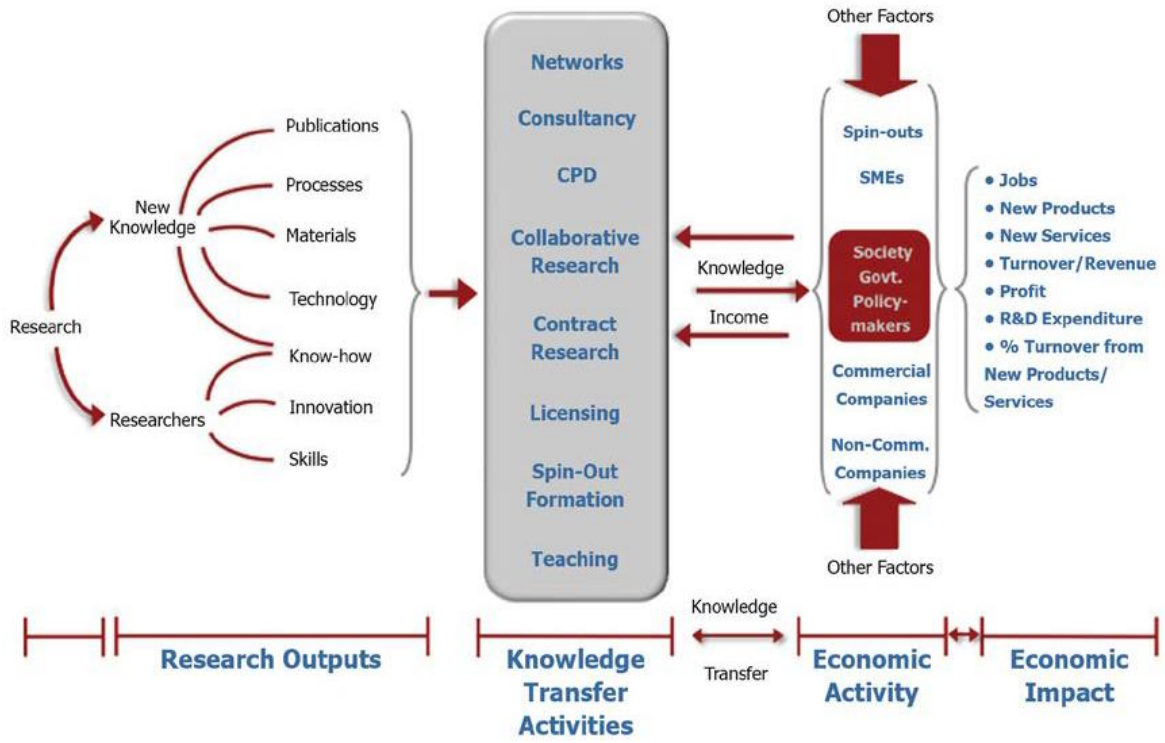

***Figure 1**: How research outputs can impact the economy. A varied set of research outputs contributes to knowledge transfer activities. Which will lead to economic activity and therefore impact. Other forms of impacts are also possible.*

(Finne et al., 2011) A similar figure can be developed to illustrate knowledge transfer activities with regard to societal or cultural KU. KU activities can be very diverse and abstract. An exhibition in a museum does have a societal impact but is hard to quantify and qualify. How to measure KU has been a focus of many studies in the previous years.

The Dutch government considers KU a very important aspect of research. In 2004 the Dutch government announced that the third core task of universities will be knowledge utilization. This indicates its importance besides the first core task education and the second core task research. In the law on Higher Education and Scientific Research this was already mentioned (the transfer of knowledge to benefit society), but no clear interpretation of the law was given. In a letter to the executive boards of the universities in 2005, this law was explained and elaborated upon. Universities were expected to incorporate KU in their strategic plan and explain in their accountability rapport what they had done. Some indicators for KU were given in the letter. Which included:

(1) delivering high educated people to society.
(2) Research co-operation with private companies and societal parties.
(3) Completing research assignments for societal parties.
(4) Collaboration with the business sector in training and education.
(5) Publishing research results.
(6) Informal knowledge exchange during conferences and in professional networks and board of directors.
(7) Science and technique communications.
(8) Guarding intellectual property, supporting scientist in the acquisition of patents or licenses and how to deal with rights of the author etc. and
(9) stimulate spin-offs and entrepreneurship. (Van Der Hoeve and Rutte, 2015)

Universities are supposed to spend a part of their budget on knowledge utilization. The focus on knowledge utilization in 2004 was the first step in regulating KU. Other steps were the focus on knowledge utilization in the standard evaluation protocol (SEP) and the KU indicators by the VSNU.

3.2 Standard Evaluation Protocol

The SEP was brought to life to evaluate research in research groups. All the research units within universities, academic medical centers, NWO institutes and KNAW institutes are being evaluated following the protocol. Every six years, research units are being evaluated and scored on different criteria by an external party. KU is one of these criteria, the others being: quality, and vitality and feasibility. The aim of the SEP is to increase the quality of research and to account for the spending of public means to the board of the university, the financers, the government and the society. (Van Drooge et al., 2013) In the most recent SEP (2015-2021) the criterion productivity has been merged with the criterion quality. Putting the emphasis on quality above quantity, and allowing for more focus on societal relevance. (KNAW, VSNU and NWO, 2014; interview Van Drooge, 2016) Although it remains hard to measure societal

relevance, with the SEP outreach activities and knowledge transfer activities are measured and universities can be scored on their KU.

3.3 Valorization indicators VSNU

The valorization indicators drafted by the VSNU are another control mechanism. The aim of these indicators is to create a structured way to measure KU and to create transparency and visibility regarding knowledge utilization. Furthermore, it creates a uniform way to measure KU. They were drafted by the VSNU in response to performance agreements between the government and universities. In this performance agreements other strategies to increase knowledge utilization were also mentioned (the SEP, but also the existence of technology transfer offices on a university). (VSNU, 2012) It is not intended to give a definite answer to the question on how to quantify and qualify KU, but it will provide some structure. The indicators were created following examples of indicators for knowledge utilization worldwide. (Finne et al., 2011; VSNU raamwerk, 2013) An overview of indicators is given in table 1. (VSNU keuzemenu, 2013; Finne et al., 2011) The indicators are divided into three categories: People, Results and Co-operation. In the category 'people' all mentioned indicators can be ascribed to the activities of people. In this category four main groups transfer knowledge to society: (1) Students graduating from universities, (2) researchers following training courses outside academia and returning to a university or public research organization afterwards, (3) researchers inside academia getting jobs within another sector and (4) individuals who have a part-time job outside of their sector (professor serving on the board of a corporation or an industrialist holding an adjunct professorship). Within results the most important activities are the patenting and licensing of IP and contributions to the private sector. These contributions can be consultancy, founding of a new company and contribution to new products or services. The final category is co-operation, which include all the collaboration from universities and public research organization with other sectors. Contract research and consultancy can also be considered to belong to this category So although categories have been more clearly defined, ambiguity remains, with indicators that can belong in multiple categories. (Finne et al., 2013) Universities in the Netherland had the freedom to choose their own indicators that fit their own ambitions and their own profile, and contribute own indicators (VSNU indicators were more guidelines than prescriptions). Between 2013 and 2015 these indicators were tested and in 2016 these indicators were published.

3.4 Vernieuwingsimpuls

Research grants enable researchers to conduct research project with clearly defined topics and durations. Grant proposals are submitted to funding agencies, who decide if they fund the project. The greatest funding agency in The Netherlands is The NWO. The NWO aims to improve the quality and innovation in the Dutch scientific world. There are 23 institutes, organizations and other agencies that are part of the NWO. These parts control 232 funding instruments within 197 programs. The Vernieuwingsimpuls program is one of the most prestigious programs in The Netherlands. It translates as innovation impulse and challenges scientists to come up with innovative research. Excellent researchers apply for this program and deliver high quality research proposals. The admittance rate is around 15% (see figure 2), and due to the strong selection the KU paragraph also has to be very good. (NWO, 2006-2015) Aditionally, the Vernieuwingsimpuls emphasizes the KU part, with 20% of the score attributed

to KU (all NWO programs have KU in their application). Therefore, the proposals from this program have been used in this study.

This program has three forms of finance: The Veni, Vidi and Vici. With Veni providing grants up to €250,000, the Vidi providing grants up to €850,000, and the Vici providing grants up to €1,500,000. (NWO website, 2016) Furthermore, the Vernieuwingsimpuls is one of the most prestigious programs with a strong selection and admittance rate around 15%, which is quite low (see figure 2). (NWO, 2006-2015)

Applications can be submitted within eight different disciplines:

- Earth and Life Sciences (Aard- en Levenswetenschappen: ALW), which cover all aspects of life and of the earth (five themes: water and climate; agro- and horticulture; living in health; durable energy and materials (solutions to scarcity)). (NWO ALW, 2015)
- Chemical Sciences (Chemische Wetenschappen: CW), which encompasses the themes chemistry of life, chemistry of materials and chemical conversion. (NWO CW, 2016)
- Exact Sciences (Exacte Wetenschappen: EW), which includes astronomy, mathematics and informatics.
- Humanities (Geesteswetenschappen: GW), which include historical sciences, language studies, literature studies, culture studies, theology, philosophy and media sciences.[11]
- Societal- and behavioral sciences (Maatschappij- en gedragswetenschappen: MGW), which include the themes economics and business; behavior and education; law and governance; and social sciences.
- Physics (Natuurkunde: N), which encompasses all studies into physics.
- Technology foundation STW (STW), which stimulates the development of new technology in top sectors.
- Medical Sciences (ZonMw), which encompasses all studies into medicine, and other medical studies.
- Area crossing (ArC), all proposals that span several disciplines can be submitted with the area crossing panel. (NWO onderdelen, 2016)

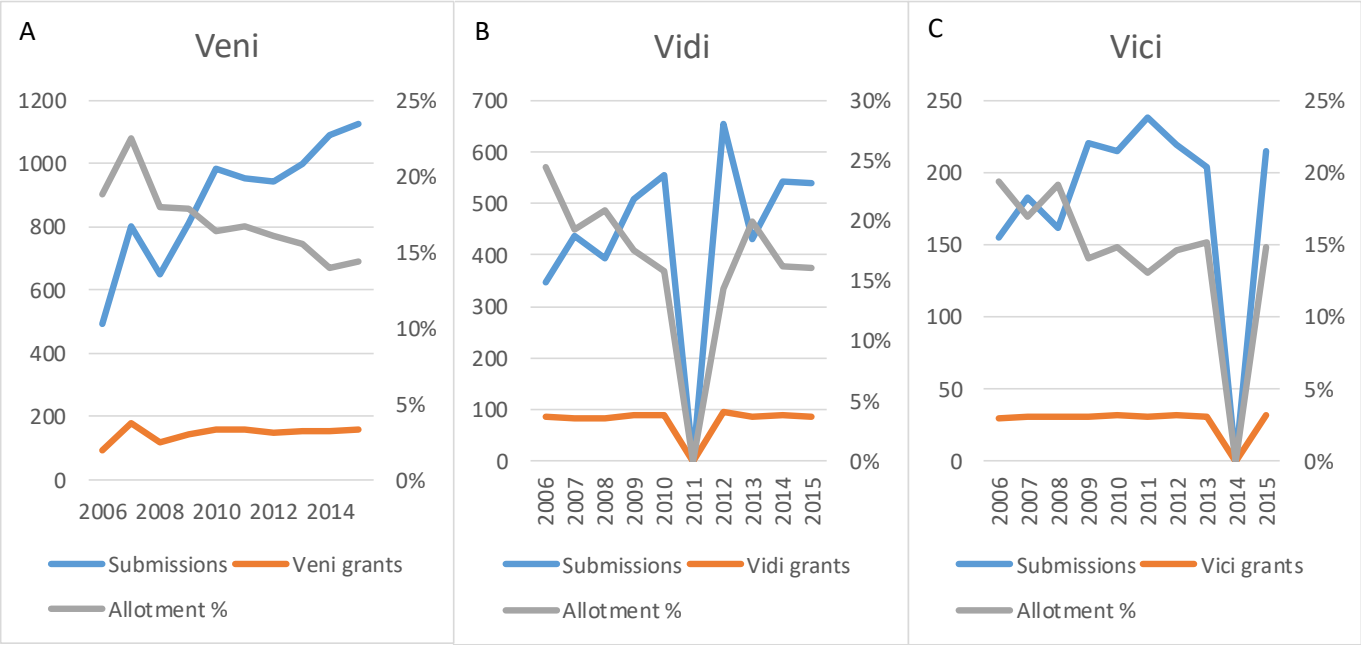

***Figure 2**: The amount (lef axis) submissions (blue) and grants (red) and the percentage (right axis) of allotted grants (grey). In figure 2A the Veni submission are depicted, in 2007 were two submission rounds. Figure 2B depicts the Vidi, in 2011 no Vidis were granted, this was moved to 2012. In figure 2C the Vicis are depicted, in 2014 no Vicis were allotted, these were moved to 2015. (NWO, 2006-2015)*

Table 1: An overview of all indicators for KU. Universities choose their own subset of indicators to show their societal impact. (VSNU keuzemenu, 2013)

People	**How to measure?**
Entrepreneurship	# technology transfer officers (TTO); education in entrepreneurship for students and employees; availability instruments that stimulate entrepreneurship in students and employees
Interaction	# employees with a part-time job outside higher education; # public/private mobility
Life-long learning	% of labor force (25-64) following education on university level; revenue from extra education given to labor force; # courses/trainings for business sector and public sector
Scientists to companies	# highly educated people employed in the business sector
Results	
Licences	# new licences; total revenue from licences, private contracts, patented products, life-long learning activities; # copyrights and other IP forms
Co-operation	# products/services/consultations for the public sector; # consultations for business sector; income from products/services for the public sector; # use guidelines and protocols public sector; # participations in conferences and fairs
Entrepreneurship	# new spin-offs; revenue from spin-offs; average number of new startups in the past three years per 1000 full-time equivalent (FTE) scientific personnel; # usage products/services by common public
Patents	# submitted patent requests related to the amount of FTE scientific personnel; # granted patents; # invention disclosures; # patent requests from the higher education institute itself
Co-operation	
Contracts	# research contracts in co-operation with public partners/business sector; # consultancy assignments with companies or other users; # policy/governance/law etc. studies
Funds	Financial contribution by business sector per year; presence holding; # R&D and innovation grants; total funding in grants in different programs per FTE; distributed or acquired pre-seed and seed funds; revenue from R&D contracts with companies and other users; % of first funding flow spend on KU
Co-operation	# companies collaborating with the university; # shared use of high tech equipment of research rooms; # prizes/awards given by the business sector/public sector; # consortia with companies or non-academic organization; # memberships in advisory committees; # paid function outside higher education; # editorships; # memberships social organizations; presence incubator/TTO-office/center of entrepreneurship/Science Park/knowledge portal; # partnerships dual learning; # temporarily exchanges; # participations of the public in research; # taken knowledge vouchers SMCs; # participations in funds project outside of research; # projects executed with societal factors
Publications	# common publication related to the total # publications; # publications in collaboration with business sector compared to total # publications; # meetings organized for business sector and public sector; # contributions to exhibitions; # fora/congresses; # references in journals; # PR plans; # web publications; # references in newspapers, radio and television; # publications; # articles and interviews in the media; revenue out of products/services; share in Open Access publications

Chapter 4 Research and development

4.1 Overview R&D

As mentioned before great amounts of money are invested in R&D worldwide. The 34 OECD countries[1] (The Organization for Economic Co-operation and Development) spent around 1,100,000 million dollars in 2014 on R&D and this accounts for the majority of all expenditure on R&D worldwide. Research is conducted in multiple sectors: the business enterprise sector, the government sector, the higher education sector and the private non-profit sector. Among the business enterprise sector are all the firms, organizations and institutions that sell goods or services to the general public. (OECD, 2002) The government sector consists of departments, offices and other bodies that administer to the needs of the community that cannot be conveniently or economically provide by other institutions. (OECD, 2002) All universities and other post-secondary education institutes are part of the higher education sector. All facilities under the direct control of or administered by higher education institutes are also included. (OECD, 2002) The last sector is the private non-profit sector, which encompasses all non-market, non-profit institutes (NPI) that serve households (charities,

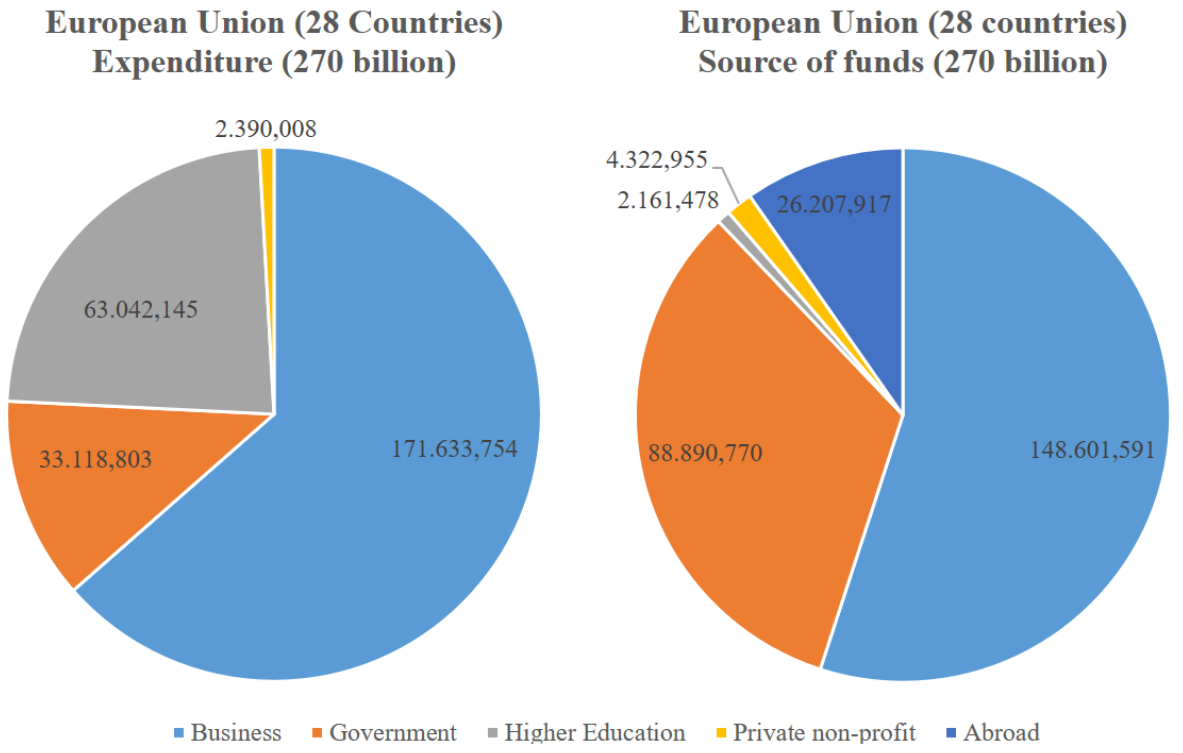

***Figure 3**: The expediture- and source of R&D funds in the EU. A substantial difference in the expenditure and the source can be seen in the Government sector and Higher Education sector.*[2]

trade unions, etc.). All NPIs that are funded, or controlled by another sector, belong to that other sector. E.g. lower education is non-profit, but funded by the government sector and therefore a part of the government sector. The three countries that spend the most on R&D (in 2012) were the United States of America (USA) with 353 billion euro, Japan with 155 billion

[1] *OECD member countries are: Australia, Austria, Belgium, Canada, Chile, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Korea, Luxembourg, Mexico, The Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States*

euro and China (without Hong Kong) with 127 billion euro. In 2012 the European Union[2] (EU) spent 270 billion euro on R&D. (Eurostat, 2014) An overview of the expenditure in the EU is given in figure 3. In the figure the source of funds is also depicted. This indicates what amount of the spent funds is originating from which sector.

As can be seen in figure 3, a substantial part of the funding is done by the government sector. The average percentage of funding in the 34 OECD countries by the government sector is 28%. (Van Steen, 2012) This funding is used to support fundamental research, which lacks other sources of finance (companies are reluctant to invest in research that does not provide an immediate solution or product). But also for the maintenance of the knowledge infrastructure in areas important to the government (weather, national health, policies). This part goes to the funding of institutes affiliated with the government. The government sector also funds companies, which stimulates research indirectly. Research funding (fundamental or applied) is for a set time, budget and content and is highly competitive. Only the best research proposals get funding. (Van Steen, 2012) An overview of the Dutch funding model is shown in figure 4, as an example. The government, assisted by advisory bodies drafts the policy regarding R&D. Ministries then divide the funds among R&D funding agencies in accordance with the countries policy. Part of these funds is used to maintain institutes governed by these agencies, the rest is available for researchers, who can apply for a grant. Money invested in the EU can also be used for R&D, via international funding organizations (like Horizon2020), who also provision grants. (Van Steen, 2012)

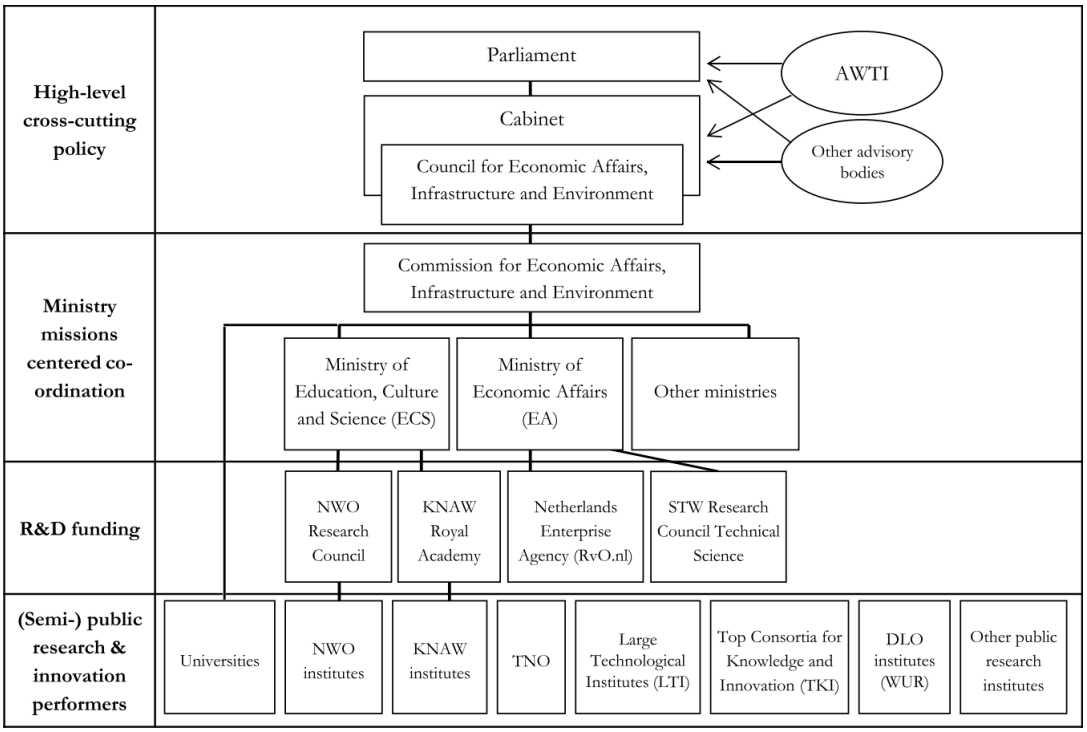

***Figure 4**: An overview of the funding system. The hierarchy of the flow of funds is depicted. From the government (top) to the research institutes (bottom). (Van Steen, 2016)*

[2] *European Union consists of 28 countries, which are: Austria, Belgium, Bulgaria, Croatia, Cyprus Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, The Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, United Kingdom*

4.2 R&D in The Netherlands

In recent years R&D expenditure in The Netherlands increased from 9.8 billion euro in 2005 to 13.1 billion euro in 2014. Around 33% of the funds is provided by the government sector. (Eurostat, 2014) The flow of funds from the government sector is depicted in detail in figure 4. The 'council for economic affairs, infrastructure and environment' create a policy regarding the funding of institutes. They are mainly advised by the Advisory Council for Science, Technology and Innovation (AWTI). These funds are divided among the ministries, with the department of Economic Affairs (EA) and the department of education, culture and science (ECS) being responsible for 90% of the R&D expenditure. (Van Steen, 2016; Janssen and Den Hertog, 2015) The ministries can distribute the funds to funding agencies. The national funding agencies are the NWO, the Royal Dutch Academy of Arts and Sciences (KNAW), the Netherlands Enterprise Agency (RVO) and the technology foundation STW (which belongs to the NWO, but is independently governed). The funds from the government enable these agencies to maintain their own institutes. The rest of the funds is distributed among the 14 research universities, 37 universities of applied science and other research institutes and companies. (Janssen and Den Hertog, 2015) Also universities get direct government funding. Looking at the research universities in The Netherlands: direct government funding provides 43% of the expenditure (first flow of funds). 25% of the funds are acquired by scientists applying for a grant at a research council (second flow of funds) and the remaining 32% is provided by companies and other sources (the third flow of funds). (Rathenau, 2016)

Acquisition of funds by scientists, especially in the higher education sector is a difficult process. Scientists write a proposal to explain and justify their research and might get funded. One of the major factors deciding the allotment of funds is the impact or KU paragraph of a proposal, where the scientist explains the benefit of the research for the society. Especially in the Vernieuwingsimpuls the contribution of this paragraph is substantial (20%). Besides government related institutions, funds can also be received from companies in the private sector.

Chapter 5 Hypotheses

Public policies have the tendency to backfire. With a popular example the minimum wage legislation, which was supposed to help the least skilled segments of the population but which resulted in an elimination of a percentage of the jobs, which led to high unemployment rates among this segment. (Roots, 2004) So a focus on KU by the government, however noble in intention, might have unintended consequences. To study the effects of a public policy, and its success, several dimension have to be taken into account (table 2) (Morestin, 2012).

Table 2: The three dimensions that measure the effects of a public policy. With the accompanying questions.

Effects	Effectiveness	What effects does the policy have on the targeted problem?
	Unintended effects	What are the unintended effects of this policy?
	Equity	What are the effects of this policy on different groups?

An example could be a public policy to counter obesity, that nutrition labeling should be more visible, so it will be clear how healthy or unhealthy a product is. The effectiveness can be measured by the cases of obesity. The unintended effects might be both positive and negative. The policy might raise public awareness for healthy products (intended), producers make their products healthier to meet the demands of the public which is beneficial for the whole society (unintended). Consumers now reject certain types of food (intended), which leads to revenue losses in that sector and unemployment due to downscaling of the production by producers (unintended). The labeling appears to have less effect among the group with less education and lower income, which is an example of equity (or inequity in this case). (Morestin, 2012).

The policy focus in this study is the, since 2012, obligatory KU paragraph 2b in the Vernieuwingsimpuls. The effects of the policy will be measured and the sub questions have been formed on the effectiveness, unintended effects and the equity.

The aim of this study is to see how scientists are influenced by a focus on KU. To answer this question, I will look at the KU paragraph in the Vernieuwingsimpuls program and how they are written. The effects of the public policy can also be measured in other ways, by looking at reports of the SEP or by measuring output by universities (patents, exhibitions). The paragraph was chosen because it encompasses all possible activities and it is a tool specific for individual scientists, who are at the base of all knowledge transfer. In the paragraph scientists make promises and this is a first indicator of the effect of a policy on micro level.

The intended effect of the obligated paragraph was to stimulate knowledge transfer to society. Since knowledge utilization had become the third core task for universities, the government has been busy with knowledge transfer. Universities were encouraged to report their activities in their strategic plans and examples of activities were given. (Van Der Hoeven and Rutte, 2005). With the obligatory KU paragraph, the government also hopes to encourage individual scientists to commit more energy to KU. The priority of the paragraph for scientist would therefore increase and a change (compared to before 2013, when the paragraph became obligatory) in the written paragraphs is expected, with a change in KU promises. (H1) This can be by either increasing the specificity of the promises, naming more partners and having a more concrete plan on knowledge KU or by increasing the KU promises in their proposal (H1.1 and H1.2). These (sub) hypotheses will be tested by comparing the amount of

KU promises over the years, determined by the paragraph analysis. (H1.1) and by comparing the specificity of the proposals over the years, extracted by text mining (H1.2). The amount of KU promises is not expected to correlate with the specificity of the proposals, this will be tested with a Pearsson's correlation test. If the two parameters correlate, only one of these parameters has to be tested.

H1 *Scientists write their knowledge utilization paragraphs differently*

H1.1 *Over time, more knowledge utilization promises can be seen*

H1.2 *Over time, higher specificity in knowledge utilization paragraphs can be seen.*

Besides changes in the KU promises, the manner in which the paragraph is written is also expected to change. Scientists are more aware of their target audience and will change their paragraph to accommodate this audience. The NWO works with multidisciplinary committees who advise the NWO on the quality and priority of application. Although there is a committee for each discipline, the committee members still have to process a lot of applications. If the policy is effective, the readability will be better and less terminology will be used in the proposal, to better accommodate their readers. If the reading is tough and the subject specific terminology is too high, the committee might not be able to correctly assess the KU activities. This will be tested with a text mining analysis on terminology and readability.

H2 *Over time, less scientific terminology and better readability can be seen*

Passive voice is mostly used for expository purposes and active voice is used for more argumentative purposes, to convince. In the KU paragraph scientists have to convince the referees and the committee members of the potential and applications of their research. A more active approach in this paragraph is to be expected compared to the rest of the proposal. The expectation is that scientists will be more convincing in their paragraphs (I will do, instead of will be done).

H3 *Over time, scientists will become more convincing in their paragraphs.*

KU is largely understood in terms of economic contributions like patents, licenses, spin-offs and technology transfer. This narrow definition threatens to change the broader definition already mentioned. (Benneworth, 2009). An unintended effect of the policy focus might be that scientists are more inclined to mention entrepreneurial activities in their proposals, because they think that knowledge utilization is about economic knowledge transfer. Referees and committee members might also think about knowledge utilization in economic terms and award more grants to proposals with more entrepreneurial activities. Entrepreneurial activities promised over the years have been scored to test this.

H4 *An increase in entrepreneurial promises can be seen over the years*

KU takes time. Contacts have to be established with industrial or public partners. Activities have to be organized. Communications with the public has to be maintained. The more time scientists spend on these kind of activities, the less time will be left for doing research. If the focus on KU increases, a possible unintended effect might be that scientists spend less time on their research. Through interviews this will be gauged.

H5 *Less time is spent on research due to the focus on knowledge utilization*

The groups that were identified were the different scientific disciplines within NWO, where scientists can apply for funds. These disciplines differ in subject. Although the definition of KU does not change, the interpretation of KU by different disciplines may differ. By comparing the different disciplines to each other on several indicators the different effects the policy focus has on the disciplines will be visible. Proposal analysis and text mining exercises will be used to visualize the difference.

H6 *Rendition of knowledge utilization between disciplines is different*

Vidi scientists have been doing research for a longer time than Veni scientists. During years in research, contacts are established and experience on topics like KU might increase. The seniority of the Vidi candidates would therefore suggest a different (better) rendition of the KU Proposal analysis and text mining exercises will be used to visualize the difference.

H7 *Seniority of an applicant leads to a better rendition of knowledge utilization*

Chapter 6 Methods

This chapter will elaborate on the methods used to conduct the research. Information on KU was acquired through interviews with scientists who were experienced in the writing of the KU paragraph in the 'Vernieuwingsimpuls'. These scientists were also asked for their KU paragraph. Furthermore, scientists who were awarded with the Veni, Vidi or Vici grants in the years 2013, 2014 and 2015 were asked to share their KU paragraph for further analysis. KU strategies were extracted from these paragraphs. These strategies were based on VSNU indicators and IDfuse indicators. And finally text mining exercises were done to get an overview of certain categories.

6.1 Interviews

Interviews were conducted to gain insight in the way scientists view KU. 27 Vidi laureates from 2015 and 4 Vici laureates from 2015 were interviewed. The distribution among the NWO categories is shown in table 1. The KU paragraph from the NWO is subdivided into two sections, the potential and the implementation. These two sections describe the relevance of the research, the target audience of the KU and the steps that will be taken to reach this target audience. Although NWO holds to the interpretation of KU given in chapter 2, individual views on this definition might change the context of the rest of the questions. So, to get an idea of individual interpretation of KU, and to get a frame for the rest of the questions, the first question was:

Table 3: Interviewee's distribution among the NWO categories.

NWO category	**Amount**
Earth- and Lifesciences	7
Chemical Sciences	2
Exact Sciences	2
Humanities	4
Societal- and Behavior Sciences	4
Physics	4
STW	4
ZonMw	4
Total	31

1	What is your definition of knowledge utilization?

The follow up questions were about their view on the increased focus on KU by society and the government and how this influenced their research. How much have been changed since the laws were tightened in 2004/2005 and the paragraph became mandatory in 2013 by the NWO. Expected outcomes on the question are depicted in the rows with an A.

2	What do you think about the increasing focus on KU?			
A	Positive	Negative	Both positive and negative	No opinion
3	How does knowledge utilization/KU influence your research?			
A	Not	A little	A lot	
4	How important do you think the paragraph is in research proposals?			
A	Important	Neutral	Not important	

The NWO departments exact sciences, humanities and the societal- and behavior sciences published a guide on KU. But there are no clear overall guidelines or protocols on KU from the NWO for the Vernieuwingsimpuls. KU is a process that can apply to many different activities; many possible outcomes of the paragraph are possible. The following questions clarified how

scientists prepared for this paragraph and whether it was clear what was expected of them in the paragraph.

5	Is there an information gathering on knowledge utilization in your institute/university?	
A	Yes	No
6	Was it clear what you had to write in your proposal?	
A	Yes	No

Another indicator for the perceived importance of the paragraph is the time spent on KU compared to the rest of the proposal. The KU paragraphs contributes 20% to the final grade of the proposals, which indicates its importance. Expectations would be that from the time spend on the proposal, roughly 20% was dedicated to KU.

7	How much time did you spend on the knowledge utilization paragraph?				
A	0-5%	6-10%	11-15%	16-20%	>21%

In case the interviewee didn't share their KU paragraph, some questions were asked to extract dissemination routes for the work and how the KU plans were going to be implemented. The answers to these questions will be processed in the KU paragraph analysis and will be scored there.

8	What were the major dissemination routes for your work?
9	How are you going to implement your knowledge utilization plans?

To determine what is important in the proposals the participants were asked what kind of feedback they had received. From this, strong points or weaker points in a paragraph can be determined. This will also show how much time the council spent on the paragraph during the interview and if the reviewers knew what to do. The answers to this question will be analyzed separately and will be presented in an overview along with the feedback that was acquired.

10	What kind of feedback did you get on the knowledge utilization paragraph?

6.2 Knowledge Utilization Paragraphs

142 scientist shared their KU paragraph. Table 4 provides an overview of the grants in the Vernieuwingsimpuls that were awarded among the participants in the years 2013, 2014 and 2015. Furthermore, the distribution of the grants among the 9 different NWO categories is depicted in table 2.

Table 4: Distribution of received KU paragraphs among the different NWO categories, the year and the funding program.

	2013		2014		2015		
NWO category	Veni	Vidi	Veni	Vidi	Veni	Vidi	**Total**
Earth- and Lifesciences	7	2	5	3	6	6	29
Chemical Sciences	0	3	1	1	4	2	11
Exact Sciences	1	1	1	1	2	0	6
Humanities	4	2	6	2	10	2	26
Societal- and Behavior Sciences	7	2	12	2	10	1	34
Physics	2	0	2	1	2	2	9
STW	0	0	3	2	0	5	10
ZonMw	3	1	2	1	3	3	13
Area crossing	0	0	1	0	3	0	4
Total	25	11	33	13	40	21	142

The content of the acquired paragraphs was scored in 4 themes subdivided in 25 different categories. These categories are derived from the VSNU indicators drafted for the universities (see chapter 2) modified to be applicable to individual scientists. Because KU on organizational level differs greatly from KU on individual level, the list was completed with indicators extracted from sources[3] and indicators that were already established by IDfuse. These indicators are marked with an asterisk. The 4 themes are: services, co-operation, information sharing, entrepreneurship and other. The KU strategy described in the proposal will be scored in one of the categories. Proposals were also scored on fundamental knowledge acquisition, track record, cultural impact and higher education. These are no activities that can be executed, but say a lot about the proposal or the applicant.

6.2.1 Services

Indicator	**Description**
Advice for public sector	Advice will be given (report, recommendation) to help parties in the public sector (e.g. policy makers, government, public institutions) tackle problems they encounter.
Advice for private sector	Advice will be given (report, recommendation) to help parties in the private sector (entrepreneurs, companies, salesman) tackle problems they encounter.
Guidelines and protocols	New guideline or protocol for a certain procedure will be provided. Or a change in existing guidelines or protocols will be found.
Product or service public sector	All non-profit services and products (this includes: informative books or videos, tours through a lab or museum, etc.)
Intervention/clinical trial/therapy*	The aim of the research is to provide a new intervention, clinical trial or therapy. Or improve existing interventions, clinical trials or therapies.

Lower/middle education	Teaching on primary or middle schools to transfer knowledge.
Teaching public	Providing courses or specific training to the general public. This can include patient care, but also educating public on new techniques or discoveries.
Continued professional development	Training for professionals. E.g. teaching a new method of treatment to doctors.

6.2.2 Co-operation

Indicator	**Description**
Collaboration (not specified) *	Intended collaboration with public or private sector, but no specified partners or collaborators
Collaboration with private sector	Intended collaboration with companies. This can be in the research phase, but also in a possible development phase. (exchange of knowledge, equipment, manpower)
Collaboration with public sector	Intended collaboration with public institutes, government or other non-profit agencies. (exchange of knowledge, equipment, manpower)
Collaboration with other research disciplines	Intended collaboration with specified scientist from other research disciplines.
Collaboration with professionals in the field	Intended collaboration with a specified professional in the field of research.
User Group	Product of research will be tested and judged by a group of users or by a committee

6.2.3 Information sharing

Indicator	**Description**
Workshops*	Transfer of knowledge through workshops of expert meetings.
Media	Appearance in newspapers, on the television, on the radio, social media and all other forms of publicly available information channels
Mail, newsletter, etc.*	Sharing of knowledge by specific mails, newsletters. Also posts on online platforms or forums are included.
Public lectures	Organization of public seminars or lectures or participation in public seminars or lectures. Also lectures or seminars for students are included.
Conferences and exchanges	Organization of conferences, seminars, exchanges, etc. for a scientific audience. Participation in conferences, seminars, exchanges, etc.
Website, blog, social media	A website will be created with the knowledge acquired by the research or a blog will be kept on the subject. This includes regular posts on social media by researcher
Database*	Information acquired in the project will contribute to an existing database or will be the foundations for a new database.
Network	A way to distribute knowledge to others is through a network. An established network is described and suggested as dissemination.

6.2.4 Entrepreneurship

Indicator	Description
License	A strategy to acquire a license has been described. https://youtu.be/r8cxuslfXQYhttps://youtu.be/r8cxuslfXQYence in an end-product which requires a license.
Copyright, patent, other IP forms	A strategy to acquire a form of intellectual property. Confidence in an end-product which requires protection in the form of a patent or copyright
Product, service, technology	End-goal of research is a product, service or technology that can be commercialized.
Open source product, service or technology	End-goal of research is a product, service or technology, that can be accessed freely.
New company	Start-up, spin-off, spin-out to start commercializing the product might be established

Other

Indicator	Description
Fundamental research*	No concrete executable plans have been described in the paragraph. Possible applications might be too far in the future to describe
Track record*	An indication of previous experiences in the field of KU and knowledge transfer.
Culture*	Not only economical-, and societal impact is enveloped by KU. A clear aim of the research is cultural impact or cultural preservation.
Higher Education*	Although a form of KU, higher Education is not considered as KU by the NWO. Higher education belongs to the second core task of universities.

6.3 Text mining

Proposals were collected in a database and analyzed on different aspects. Because texts and words were extracted automatically, false positives and false negatives may occur.

6.3.1 Readability

Flesch–Kincaid readability tests were used to determine the readability. This test looks at the words per sentence, and the syllables per word to determine a score. With words having few syllables being easier to read. Higher scores mark paragraphs that are easier to read, whereas lower score indicate more difficult reading material. Texts with scores above 90 are very easy to read are on the level of children on primary school. Texts with scores from 60 to 70 are plain English. 30 to 50 are for university students and everything below 30 for graduates from the university. Scores between 30 to 50 would be good for these paragraphs.

The formula used to calculate the score is:

206.835 – 1.015 (total words/total sentences) – 84.6 (total syllables/total words).

6.3.2 Specificity

Spacy's Named Entity Recognition was used to determine the specificity scores. All organization, names and places in the world (GPE) are recognized due to their capital letters, or due to database references. And these were divided by the total number of unspecific terms, that have been added to the text mining tool by IDfuse.

Example:

In collaboration with Paul Tuinenburg at IDfuse this study has been conducted. It is expected to have a benefit for the general public.

Paul Tuinenburg and IDfuse will be recognized as named entities. General public will be recognized as unspecific. The score for specificity will therefore be 1 + 1 / 1 = 2. The global formula is #organization + #persons + #places / # Unspecific target groups.

A score lower than 1 indicated an unspecific proposal, a score higher than 5 indicated a very specific proposal. Scores between 1 and 5 were considered quite specific.

6.3.3 Terminology

The proposals were cross referenced with John Petrie's online database to determine the terminology scores. This database includes scientific terminology throughout several disciplines. The percentage of scientific terms in the text determines the score. So if 3 out of 100 words are scientific words, the terminology score would be 3. Scores below 3 were considered low in terminology, scores above 7 were considered high in terminology. Due to the scientific nature of the proposals everything between 3 and 7 was considered good.

6.3.4 Passive/active voice

Passive phrasing and active phrasing was extracted from the proposals. Spacy's Parts of Speech and dependency tagging were used to determine active/passive voice. The active/passive ratio was calculated. Proposals with scores above 1 are more active, whereas proposals with scores below 1 were more passive. Combinations of words are recognized and marked as passive: "were used" "will be done". The score is determined by dividing the # of passive verbs used by the # of active verbs used. Scores above 1 are therefore more active and were considered good.

6.4 Analysis

The figures were made in Microsoft excel and in Prism. The boxplots depict the average, with the boxes encompassing the 1st quartile to the 3rd quartile. The whiskers encompass all data. Two-way ANOVA was used to compare all disciplines with each other and to see if a significant difference had occurred over the years. The standard T-test was used to compare the Veni laureates with the Vidi laureates. Pearsson's correlation was used to see if the number of activities promised in a proposal correlated with the specificity of the proposal

Chapter 7. Results

This chapter will elaborate on the results acquired by this study.

7.1 Interviews

31 scientists were interviewed to gain insights in their perspective about knowledge utilization. What kind of effect the scientists perceived due to the policy focus. Senior scientists (Vidi and Vici) participated in the interviews. An overview of the results is given in figure 5.

4 scientists were positive about the increasing policy focus on KU, 8 scientists were negative, 14 were both positive and negative and 5 gave neutral answers (5A). Accounting for public funds, making science publicly relevant and forcing scientists to think about more than just their research, were mentioned as positive. On the other hand, people considered the focus as negative due to the short-term thinking of KU (which might affect fundamental research), the risk that "accidental" very important discoveries might occur less and that scientists have less time for research due to activities for society.

KU influenced the research of 22 scientists (5B). Most people think more about KU and try to come up with new outreach activities. 6 out of these 22 scientists are more influenced by KU, with the research taking a different direction to be more relevant for society. The 9 participants who didn't have their research influenced by knowledge utilization were all on the crossroad of science and society and had KU ingrained in their research.

16 participants considered the paragraph to be important (5C). They think it is important to think about the plans for knowledge transfer to society and how it stimulates scientists to contact 3rd parties. However, some think the impact of this paragraph should be less (it is 20% in the Vernieuwingsimpuls now). The 11 participants who considered the paragraph less important were convinced that knowledge would find its way into society anyway, and no separate paragraph is needed. Concerns were also uttered for funding of fundamental research, there are more grants for applied research and if these kinds of programs also focus on applied research, fundamental scientists will not be able to conduct research.

17 participants knew of research offices, workshops or organized meetings which provided assistance with writing the KU paragraph. 3 participants didn't know if there was anything and 11 participants answered not to have heard of assistance. Majority of the participants, even if they knew that there was assistance available, did not participate in these activities. (5D)

Out of 31 interviewees, 12 participants did not exactly know what to write in the KU paragraph. It was not clear how the committee would score the proposals and what they should or should not include. They considered what to write too "open". (5E)

An estimation of the time spend on this paragraph is depicted in 5F. Because the proposals are mostly written when there is time to write it was hard to pinpoint the exact time that was spend on the paragraph. But 11 scientist spend approximately 0-5% of their proposal writing time on the KU paragraph, 13 scientists spend approximately 6-10%, four scientists approximately 11-15%, one scientist approximately 16-20% and two scientists spend more than 20% of their writing time on this paragraph.

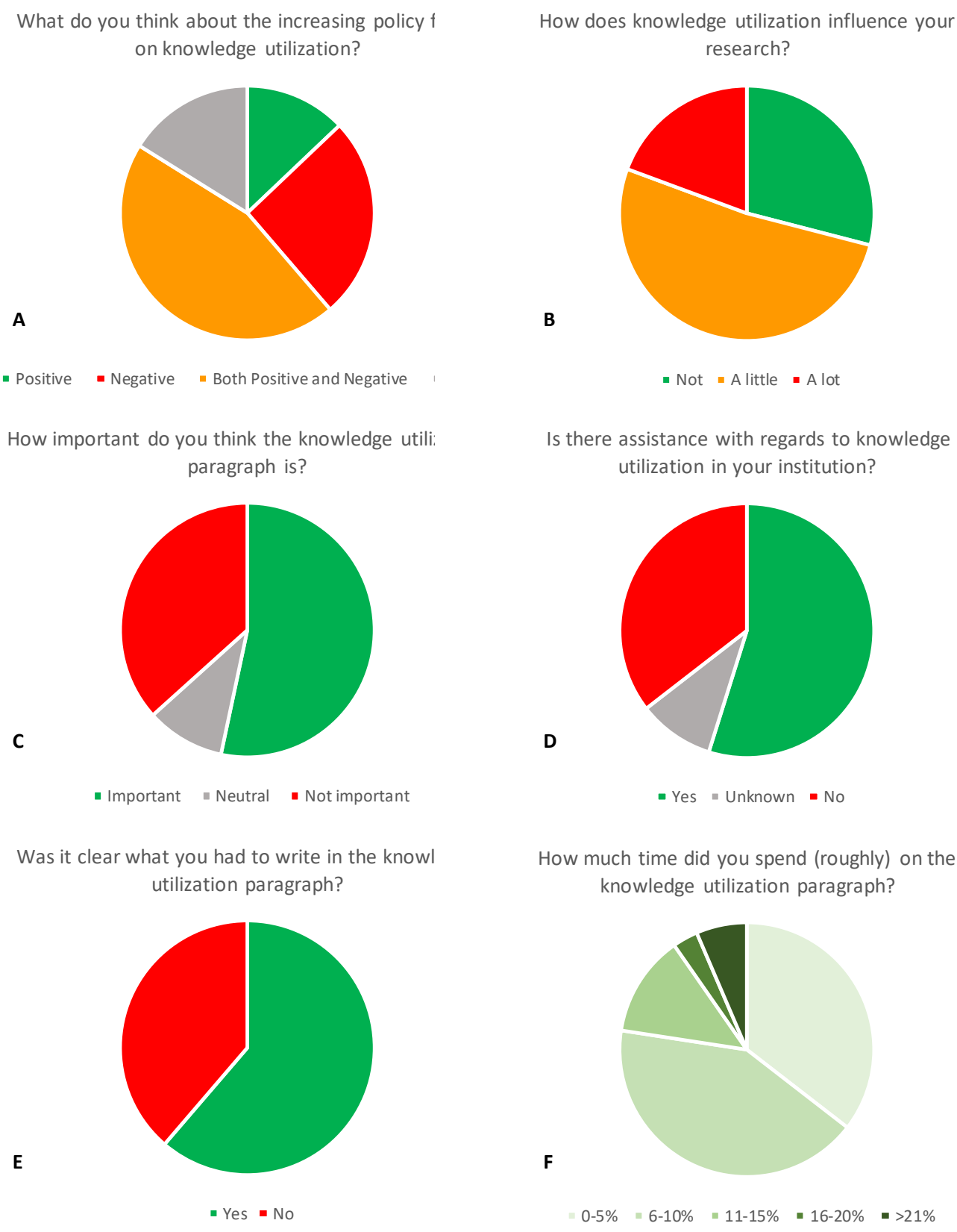

Figure 5: An overview of answers from the interviews.

7.2 Correlation

In H1 a change in KU promises was expected, either by more promises or due to higher specificity in the proposals. To test if these two parameters did not correlate, the specificity and the number of KU activities were plotted in a correlation graph. No significance could be detected between specificity and the activities as can be seen in figure 6.

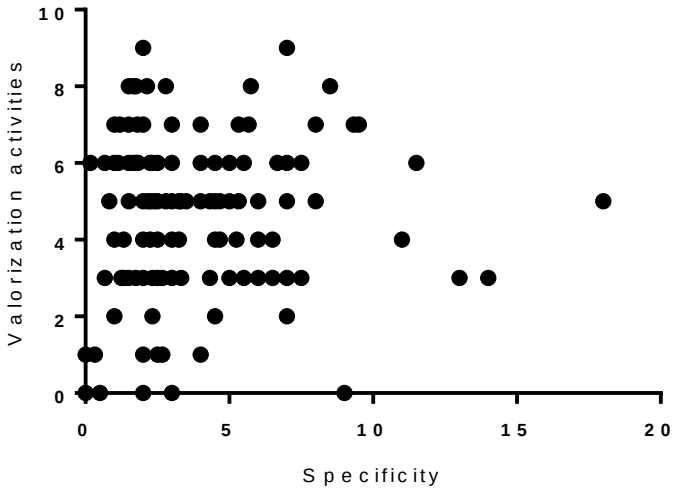

Figure 6: correlation between specificity and KU activities. No significant correlation could be calculated.

7.3 Knowledge utilization paragraphs

142 paragraphs were analyzed. The division of activities among the categories is shown in figure 8. The subdivision among the NWO disciplines is also depicted. The mentioned knowledge utilization activities are also summarized in table 1 in the appendix. The biggest activity is participation in conferences and scientific exchanges, 51% percent of all participants wrote in their proposals that they would participate in- or organize such an event. Other noticeable activities (with more than 50% of scientists within a discipline mentioning this activity) are depicted in table 5. An overview of all percentages within the groups is given in appendix table 1.

Table 5: The activities that have been promised by more than 50% in a discipline.

Activity	**Discipline**	**Mentioned**
Product, service or technology	CW	64%
Product, service or technology	EW	50%
Product, service or technology	STW	80%
Product or service for the public sector	GW	63%
Use of websites, blogs and social media	GW	56%
Collaboration with the public sector	MGW	51%
Advice for public sector	MGW	60%
Collaboration with professionals in the field	STW	50%
Collaboration with the private sector	STW	90%
New intervention, clinical trial or therapy	ZonMw	62%

In figure 7 the total number of activities per discipline are compared. No significant differences were found between the overall average and the rest of the disciplines. A significant difference was found however between MGW and ALW, EW and N. With MGW having more activities than the others. Averages are depicted in table 5.

Table 6: The average amount of activities promised per discipline.

Overall	ALW	ArC	CW	EW	GW	MGW	N	STW	ZonMw
4.66	4.10	5.25	3.82	3.00	5.22	5.71	3.11	4.30	4.54

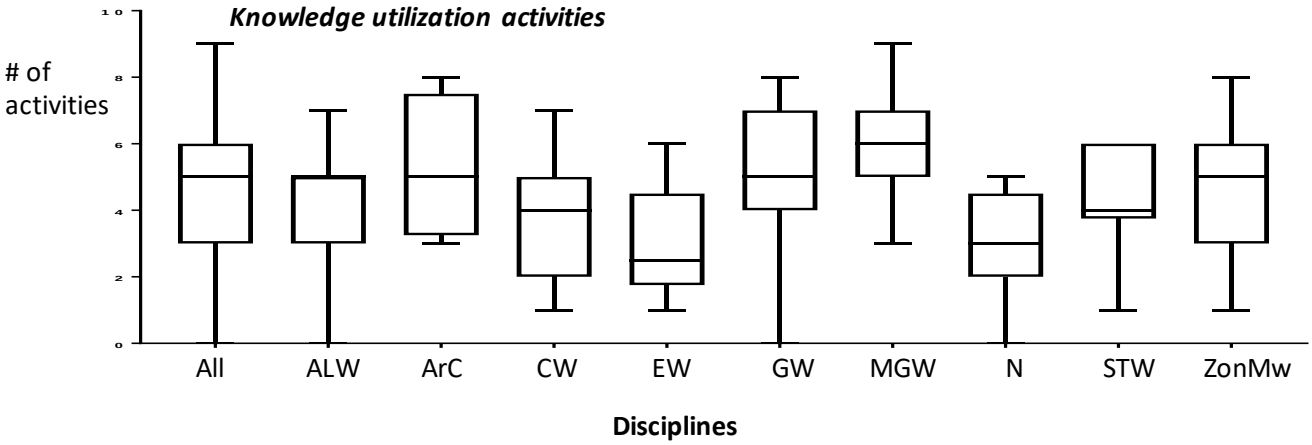

Figure 7: *The average number of activities each participant promises in their proposals per discipline. With an average of 4.66 for all groups. A maximum average of 5.71 for MGW and a minimum average score of 3 for EW.*

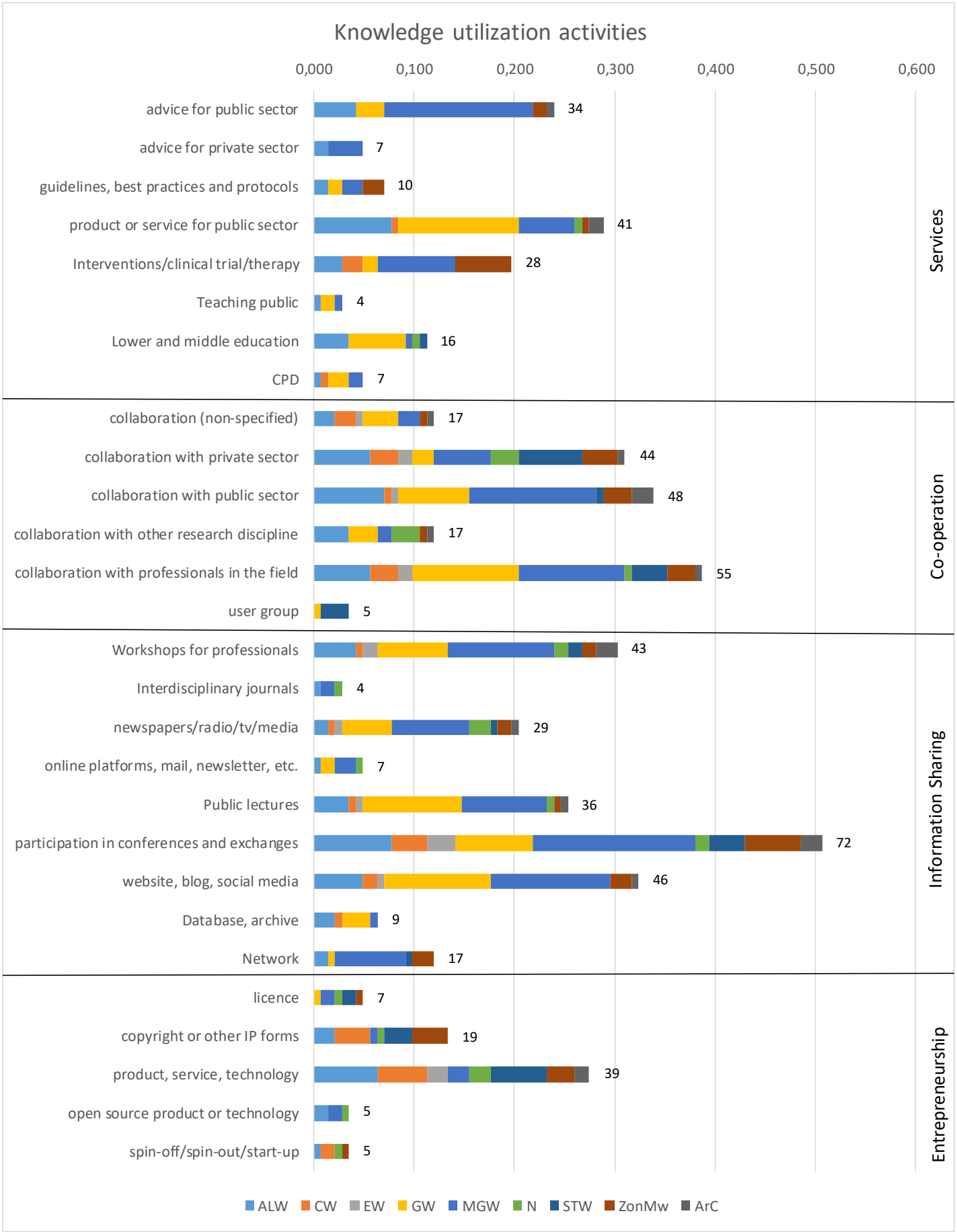

Figure 8: All KU activities summarized. Relative to the number of proposals (x-axes) and in numbers (figures after the bars). Distinction within the bars can be made.

7.3.1 Entrepreneurial activities

The entrepreneurial activities (licenses, other IP forms, products and new companies) were counted over the years to see if an increase could be seen. Figure 9 depicts the number of entrepreneurial activities promised in each year, relative to the received proposals, which is given as a percentage (grey line). As can be seem in the figure, in 2013, 33 proposals were submitted and 22 entrepreneurial activities were promised. In 2014, 48 proposals were submitted in which 22 entrepreneurial activities were promised. In 2015 31 activities were promised out of 61 proposals. A decrease of entrepreneurial activities can even be observed, with a relative lower amount of activities in 2014 and 2015, compared to 2013.

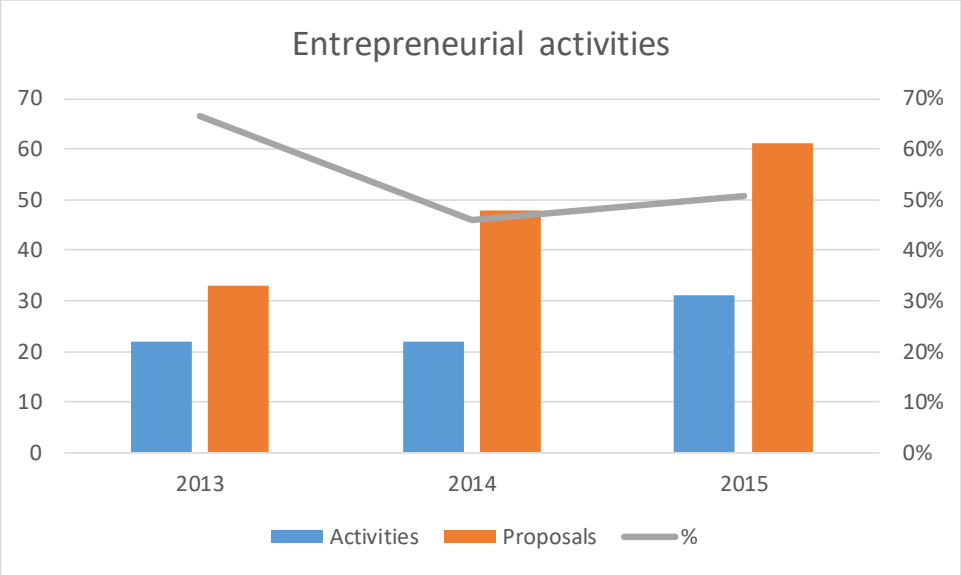

Figure 9: The entrepreneurial activities over the years. The activities are depicted in blue, the amount of proposals in orange and the relative amount of activities per year in grey as a percentage.

7.3.2 Other

The proposals were also scored on other things than knowledge transfer activities. These included fundamental knowledge acquisition, cultural preservation or impact, track record and higher education. These are no outreach activities, but are interesting to mention:

- One out of the 142 proposals submitted a paragraph in which he explained that his research was of a fundamental nature and no knowledge transfer was possible. 15 other proposals were also very fundamental and were scored on fundamental knowledge acquisition (10A). A comparison corrected for the size of the disciplines is depicted in figure 10B. The more exact sciences like EW, N and CW have a high percentage of fundamental knowledge acquisition within their groups (50%, 33%, 27%).

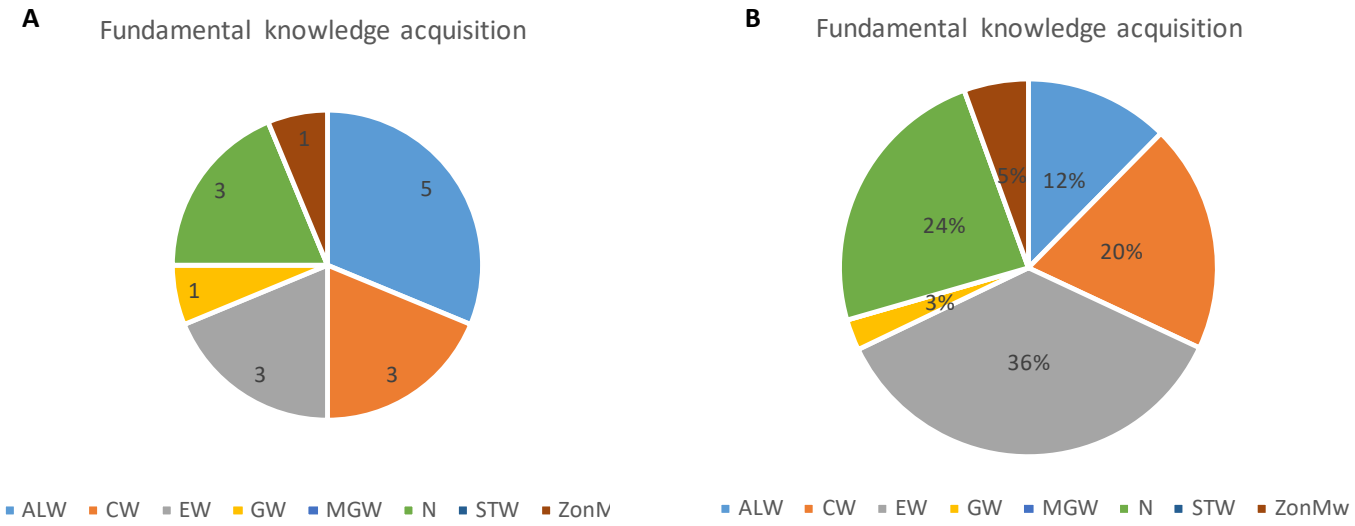

Figure 10: An overview of the fundamental knowledge acquisition mentioned in the proposals. A) The amount of promises. B) The percentage of total that is mentioned this acquisition corrected for group size.

- 4 other proposals contributed severely to cultural preservation and impact, and were scored in this category. These 4 proposals were written by scientists in the GW.
- Mentioning experience in organizing outreach activities contributes to the credibility of the mentioned activities. 19 scientists mentioned their KU track record, which is depicted in figure 11A. 11D is based on the relative contribution to track record, corrected for discipline group sizes. ALW with 21% of the scientists within this discipline, and MGW with 23% of the scientists within their discipline, that mention track record are the top scores.

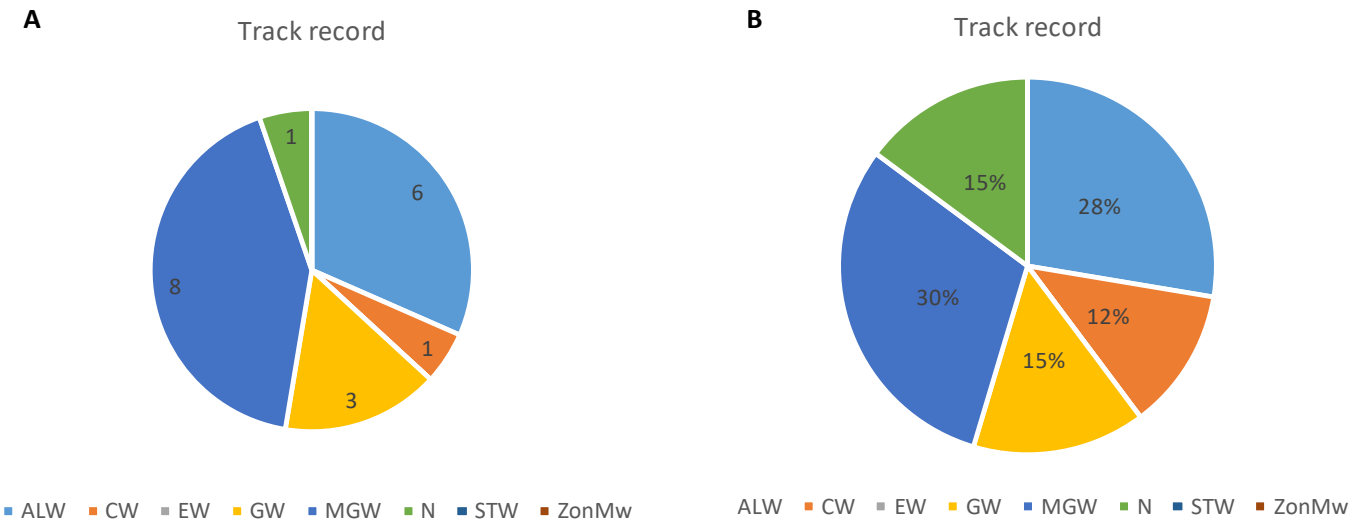

Figure 11: An overview of the KU track records mentioned in the proposals. A) The amount of mentioned track records. B) The contribution of different disciplines corrected for discipline group size.

- Although Higher Education is an outreach activity. It is not considered KU by the NWO, because higher education is the second core task of universities and it is innate to research. However, 21 scientists mentioned this (12A), distributed evenly among all disciplines (12B).

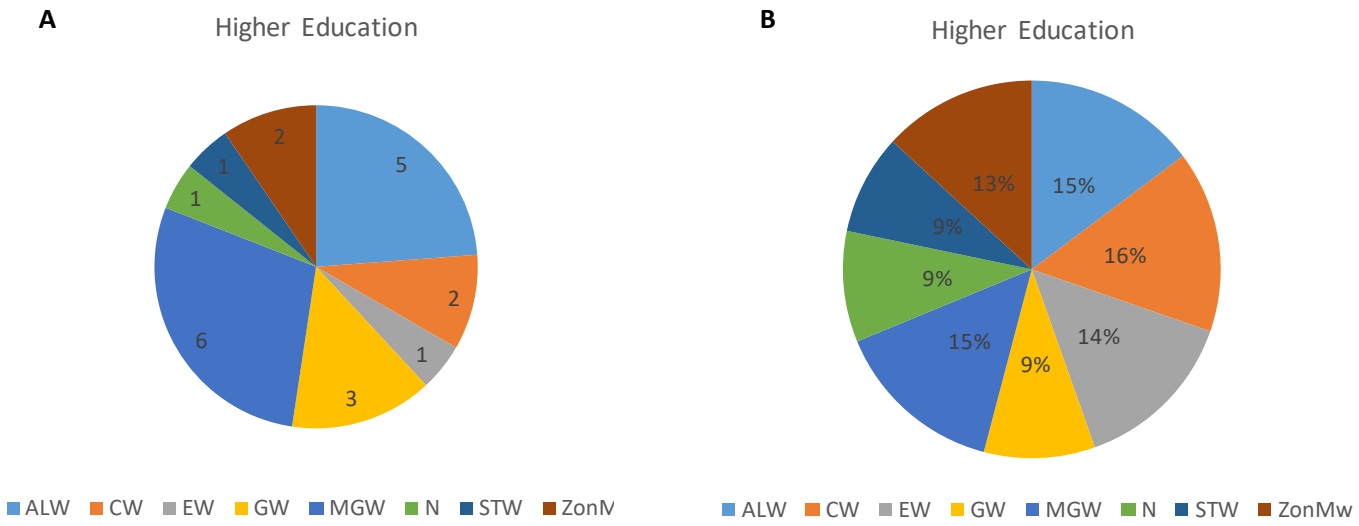

Figure 12: An overview of higher education mentioned as activity in the KU paragraphs. A) The amount of mentioned activities. B) The contribution per discplines corrected for sizes discipline group sizes

7.4 Text mining

As mentioned in the methods: the mining analysis was conducted on 142 proposals and differences between disciplines, seniority and year were visualized. The texts were compared on the mentioned KU activities, the readability of the proposal, the specificity of the proposal and the terminology of the proposal.

7.4.1 Seniority

The differences between the more junior scientists (Veni) and more senior scientists (Vidi) are depicted in figure 13. The KU activities promised by the two groups are depicted in figure 13A. An average of 4.76 promises are made by the Veni candidates and an average of 4.44 for the Vidi. This difference is not significant. When looking at readability, Veni proposals were harder to read then Vidi proposals, but the difference was nog significant (13B). The difference in specificity is depicted in 13C. The two groups were significantly different from each other with a specificity score of 3.35 for the Veni scientists and a score of 4.75 for the Vidi scientists. The difference in terminology, depicted in figure 13D, also did not differ significantly. With an average score of 6.34 for the Veni and 6.82 for the Vidi.

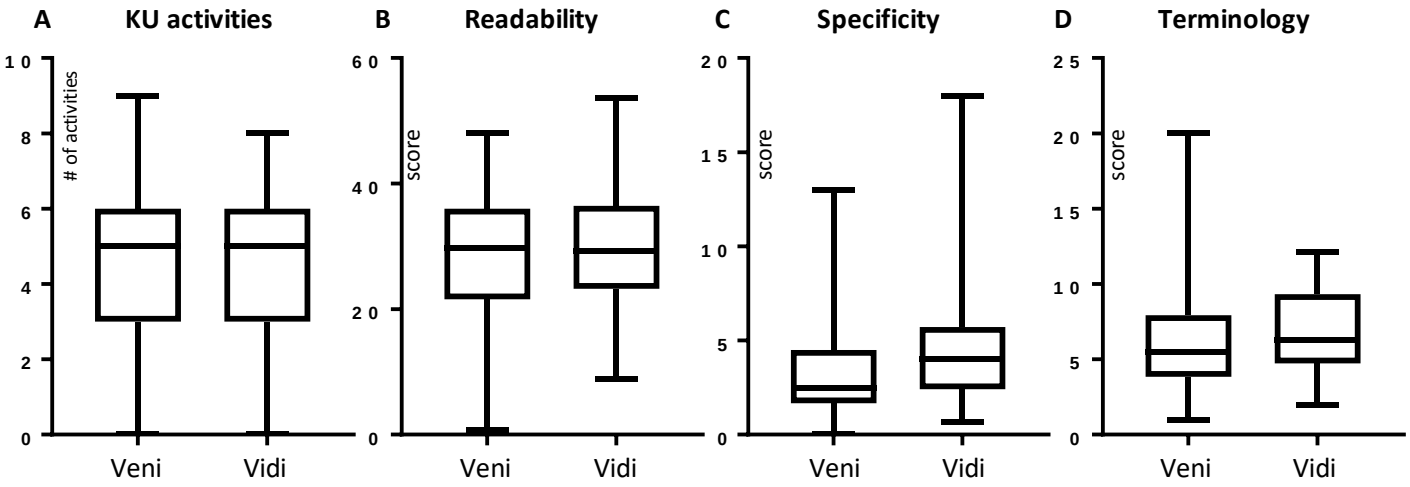

***Figure 13**: The difference in KU activities, readability, specificity and terminology between groups of vernieuwingsimpuls applicants. A) Number of KU activities with an average for the Veni of 4.76 and an average for the Vidi of 4.44. B) Readability scores for the two groups, with an average readability score for Veni scientists of 28.38 and 30.6 for Vidi scientists. (score: tougher to read < 30 < easier to read) C) Specificity scores for the two groups with an average specificity of 3.35 for the Veni and an average score of 4.75 for the Vidi (score: low specificity < 1 < normal specificity < 5 < high specificity). D) Terminology score for the Veni and Vidi, with an average of 6.34 for the Veni and an average of 6.82 for the Vidi. (score: low terminology < 3 < some terminology < 7 < a lot terminology).*

7.4.2 Years

The difference over the years for the different indicators is shown in figure 14, the spread of the measured scores is also depicted. The averages for the years for the different parameters are depicted in table 6. When looking at the readability, specificity or terminology, nog significant difference could be seen. The only significant difference was seen in the amount of knowledge utilization activities promised in 2015, compared to 2014 and 2013. An increase can be seen.

Table 6: The averages over the years for the different parameters.				
Year	**Activities**	**Readability**	**Specificity**	**Terminology**
2013	4.06	27.4	4.36	6.43
2014	4.33	29.8	3.53	6.59
2015	5.42	29.5	3.66	6.37

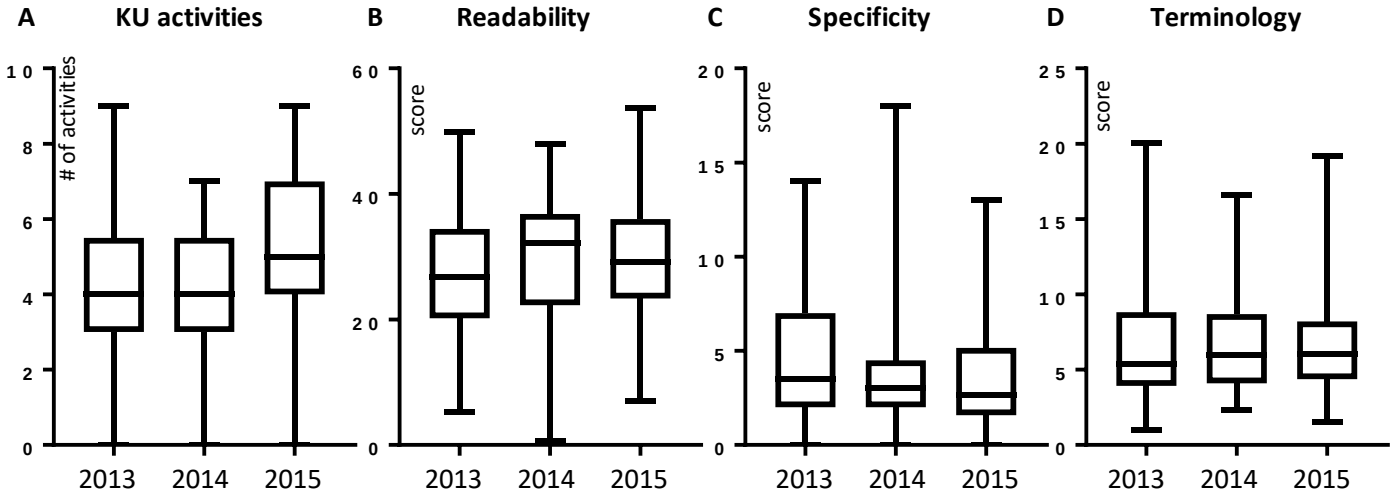

***Figure 14**: The difference in KU activities, readability, specificity and in years. A) An average of 4.06; 4.33; and 5.24 KU activities were mentioned in 2013, 2014 and 2015. B) Readability scores for the three years, with an average readability score for 2013 of 27.36; for 2014 of 29.85; and for 2015 of 29.49. (score: tougher to read < 30 < easier to read) C) Specificity scores. The average specificity for 2013 was 4.37, for 2014 3.53 and for 2015 3.66 (score: low specificity < 1 < normal specificity < 5 < high specificity). D) Terminology score throughout the years. The average scores for 2013, 2014 and 2015 were 6.43, 6.69 and 6.37. with an average of (score: low terminology < 3 < some terminology < 7 < a lot terminology).*

7.4.3 Disciplines

Figure 15 depicts the differences between the categories and the spread of the scores. Table 7 provides an overview of all averages calculated for the groups. No significant differences in readability could be seen. All groups have comparable scores, as can also be seen in 15A. When looking at the specificity scores for the disciplines in the table and in figure 15B, a significant difference between the average of STW compared to the average of all could be seen. STW is significantly more specific. When looking at the last parameter terminology, CW and N have significantly more scientific terminology than average. MGW has significantly less terminology than the average, as can be seen in table 7 and in figure 15C.

Table 7: The average readability, specificity and terminology scores for all disciplines.										
	All	ALW	ArC	CW	EW	GW	MGW	N	STW	ZonMw
Readability	29.08	26.17	24.08	26.45	24.37	32.75	31.99	30.51	33.6	22.12
Specificity	3.92	3.85	3.52	4.17	4.31	3.23	3.08	4.23	7.18	3.27
Terminology	6.49	8.11	5.14	9.85	5.57	5.26	4.20	9.96	7.52	6.15

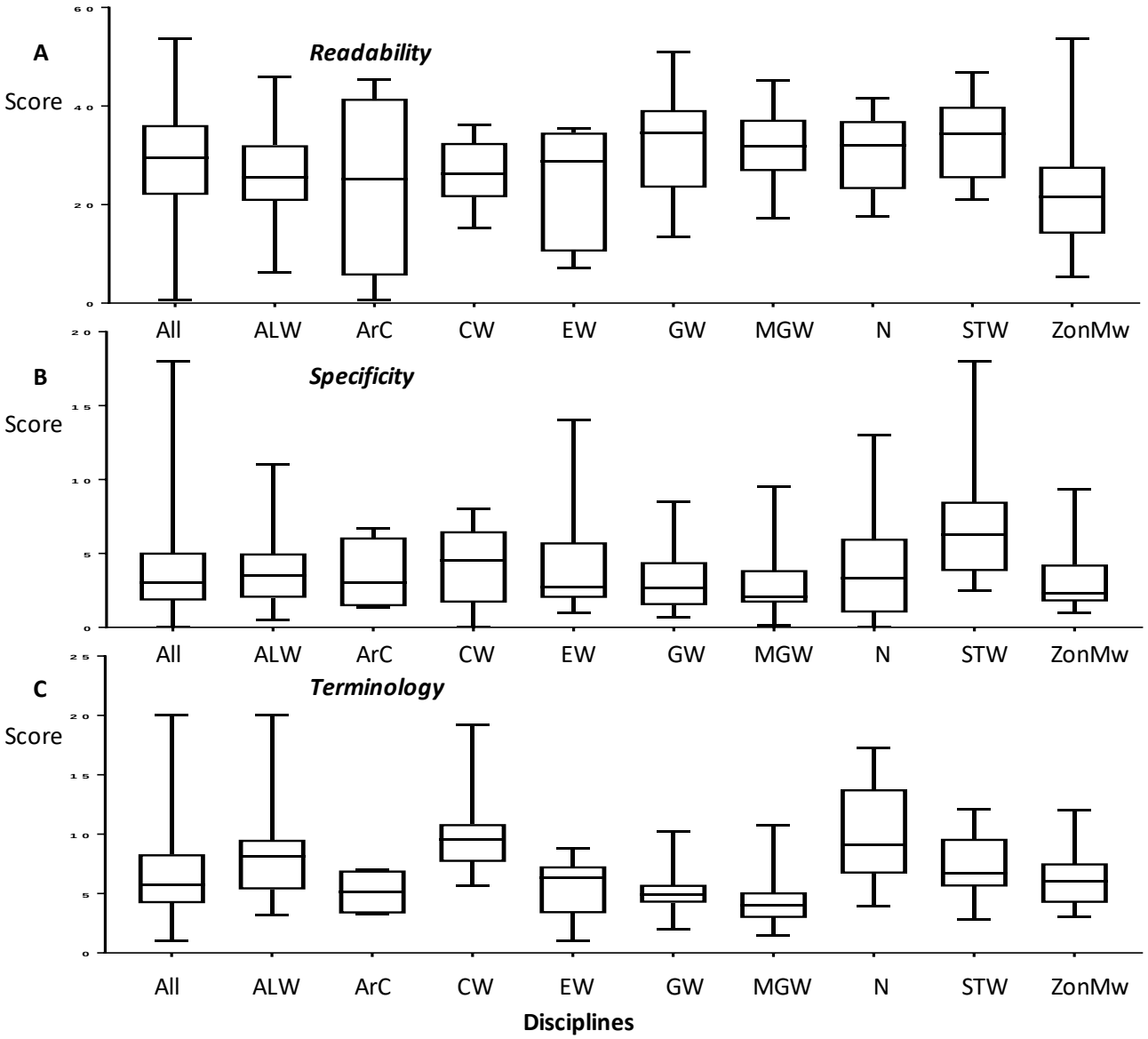

***Figure 15**: Comparison of readability, specificity and terminology between different disciplines. A) The readability score of the proposals. The average readability is 29.08. A score of 22.08 for ZonMw being the lowest and a score of 33.6 for STW being the highest. The threshold for readability is 30, with everything above being readable and everything below being tougher to read. B) The specificity score for different disciplines. With everything beneath 1 not specific, everything between 1 and 5 quite specific and everything above 5 very specific. An average score of 3.79, the highest average score being 7.18 for STW and the lowest average score for MGW, with 3.23. C) The terminology score for different disciplines. Average 6.49, highest average 9.96 for N, lowest average 4.20 for MGW. Everything below three does not have much scientific terminology, everything between 3 and 7 has some scientific terminology and everything above 7 has very much terminology.*

7.4.4 Active/passive

No significant differences were found between the disciplines, groups or years. An overview of active and passive use of language is given in figure 2 in the appendix. All averages were comparable.

Chapter 8 Conclusion

In this thesis an exploratory study was conducted to see how a policy focus on KU (KU paragraph) influences scientists. Several hypotheses were formulated to answer the research questions:

- What is the effect of the increased policy focus on the paragraphs?
- What are the unintended effects of the policy focus?
- How does this policy focus influence different groups?

The focus of this study was on the KU paragraph, obligatory since 2012 in grant applications from the Vernieuwingsimpuls. These paragraphs were analyzed in several ways. The proposals were screened for promises made, text mining exercises were performed on the proposals and interviews were conducted. To answer the sub questions hypotheses were formed, which could provide an answer to those questions when tested. This discussion will elaborate on the results and provide a context for the findings.

8.1 What is the effect of the increased policy focus on the paragraphs?

As mentioned in the methods, the KU activities were grouped in four different categories (Services, Co-operation, Information Sharing and Entrepreneurship). Information sharing activities can be considered as the most common way of KU. This can be seen in the amount of information sharing promises and especially in the attendance, or organization of conferences and exchanges by scientists. With more than 50% of all scientists with the promise to attend or organize such an event. GW and MGW have a lot of information sharing activities (relative to the amount of submitted proposals). Given the content of these two disciplines this is to be expected, because the main product of their research is knowledge.

Another category in which a lot of promises were made is co-operation. Co-operation was similar among all disciplines, with every scientists collaborating with 1 group on average, only STW collaborated with 2 groups on average. Due to the application orientated character of STW, this is logical.

Services were provided the most by ALW, GW, MGW and ZonMw. With ZonMw contributing greatly in clinical trials and therapies. And finally, in the category entrepreneurship. The more applied disciplines like ZonMw and STW contributed to this category, but also more fundamental disciplines like CW and N.

A change in KU promises, written by the scientists, was expected over the years. This change could be realized in two ways: (1) more KU promises, increased quantity of promises, to increase the KU by society and (2) more specific KU promises, more named partners and more elaborate plans. This led to the first hypotheses: (H1) Scientists change their way of KU promises (H1.1) Over time, more knowledge utilization promises can be seen and (H1.2) Over time, higher specificity in knowledge utilization paragraphs can be seen.

First the correlation between the amount of promises and the specificity was tested. If a significant correlation was present, which would mean that increased specificity resulted in decreased amount of promises and vice versa, only one of these parameters would be tested. No significant correlation was found however, so both parameters were tested.

The specificity did not show any increase over the years. The amount of promises however, did show a significant increase between 2014 and 2015, which confirmed H1.1. To increase the knowledge transfer scientists would organize more activities. The change in this paragraph was also expected to be seen back in the readability and terminology scores of the proposals (H2). Because the knowledge utilization paragraph is not a scientific paragraph, better (higher) readability scores over the years and lower terminology scores over the years were expected. Although the readability increased a little in 2014 and 2015 compared to 2013, this change was not significant. Also no significant differences were seen in the terminology. It would appear that scientists write this paragraph in a scientific way.

This assumption was supported when looking at the use of passive voice or active voice (H3). Scientific articles are mostly phrased in a passive way, with considerably more use of passive than active, this phrasing was also used in the KU paragraph. With the averages over the years being around 0,25. With no significant differences seen between the years.

The sentiment during the interviews also indicated that the paragraph does not influence their work that much. More than half of the interviewees were not, or little influenced by KU. The greatest change people experienced was that they had to think more about KU than before, but they mentioned not to have changed their way of writing. Which can also be seen in the results obtained by the text mining exercises. Compared to the rest of the proposal, little time was spent on the KU paragraph. This might also be attributed to the effect the obligatory paragraph has on the referees and on the committee. During the interviews some respondents mentioned that they had the feeling that the referees and committee members did not contribute that much attention to the KU paragraph.

In conclusion: An increase in knowledge utilization activities could be seen in 2015. Scientists organize more activities to transfer knowledge to society, which was the purpose of the policy focus. Other expected effects, to increase the quality of the paragraph (better readability, lower terminology, more active voice) did not show. The interview also showed that scientists think more about KU than before.

8.2 What are the unintended side-effects of the policy focus?

From the proposals received unintended side effects can hardly be deduced. Unintended effects are hard to foresee, or the measures would not have been executed in the first place (or it would have been executed in a slightly different way). In time the effects of the policy focus on the KU paragraph might become apparent. Nonetheless, some scenarios of unintended side effects were devised.

The possible economic interpretation of knowledge utilization as mentioned by Bennisworth. This view on KU was confirmed in interviews, where participants gave a definition for KU with a focus on the economic impact. Others mentioned that, although the general consensus considers KU as economic, they think it is broader. An expectation was to see more entrepreneurial activities over the years in the proposals (H4). However, when looking at the amount of entrepreneurial activities compared to the amount of proposals no increase can be seen. And even a slight decrease in activities compared to 2013.

Interviews provided more insight into the unintended effects. Expectations were that scientists spent less time on their research due to an increased focus on KU (H5). Scientists were not that much influenced by KU however. They thought more about KU, but did not have the feeling that they spend more time on these activities. Time used to establish and maintain contacts with companies or public institutes was already something they had planned for independent of the KU paragraph. It is possible that this change in mindset has already begun since 2004, when KU became the universities 3rd core task and the current situation might differ greatly from before 2004.

Another possible unintended side-effect, which could not be tested in this study was the reduced funding of fundamental research. Concerns about this were expressed during the interviews and it was given as negative effect of the increased policy focus. However due to a lack of 'unsuccessful' proposals, this could not be verified. A correlation to economic activities might be expected however. With an increase of applied research funded, suggesting a reduction of fundamental research funded, but again, this could not be verified. Fundamental research generates knowledge for which no direct application is evident. If this kind of research is reduced, long term technological and societal development might be hampered.

In conclusion: the unintended effects that could be tested in this study: the amount of entrepreneurial activities and the increased time spend on knowledge utilization, did not show in the study. Other side-effects may show over time

8.3 How does this policy focus influence different groups?

The different groups that were identified were the different scientific disciplines. With proposal analysis and text mining exercises these groups were compared to each other. This analysis was exploratory, to see what differences between the groups existed (H6). The amount of KU activities was quite comparable, with only MGW having significantly more activities than ALW, EW and N. This might be because societal and behavioral studies have a broad public who might be interested, and that can be reached with more KU activities. Whereas physics, natural sciences and exact sciences might have a more limited target audience, whom can be reached with lesser activities. This is also in accordance with the high amount of information sharing activities (mentioned previously) within the MGW group. The readability did not differ between the groups, which suggest that all the writing is at the same scientific level with the same difficulty. Because all applicants are excellent scientists this was to be expected. When looking at the specificity, STW differs significantly from the average. STW encourages the development of technology derived applications, applicants should have a clear end-product in mind before applying before STW, which might explain the higher specificity. Compared to the rest of the applicants, an STW scientist might already know what his or her research will produce and has already established all the partners necessary. CW and N have significantly more scientific terminology than average. Because chemical science and physics are exact sciences, common terms in those fields might be recognized as scientific terminology, explaining the high scores. MGW on the other hand has significantly lower terminology. Because this discipline is very close to the society, the research terms used might be very common, explaining the lower scores. And finally the use of active or passive phrases

did not show any significant differences. As already explained, this is probably because of the scientific writing of the paragraph by all scientists.

Seniority was also taken into account in the comparison of the paragraphs. Veni applicants were compared to Vidi applicants. No significant differences were found in the organization of KU activities or the readability. An increase in the specificity and terminology can be seen, but only the specify differed significantly.

So in conclusion: although the disciplines do not vary overly much, a slight distinction can be made between the disciplines, but most of these differences are not significant. Disciplines that do differ significantly are MGW due to the high amount of knowledge transfer activities promised and lower terminology. But also STW due to the high specificity. Distinctions can also be made in the types of activities that were promised in each category. With several disciplines being very prevalent in one category, but almost absent in another, which could be traced back to the background of their studies.

Between the different groups hardly any difference was seen. Vidi applicants were more specific than Veni applicants. The experience acquired over the years appears to increase in the quality of the knowledge transfer activities, by being more specific.

8.4 Conclusion

The effects of the policy focus on the writing of the KU paragraphs can be summarized as follows: scientist are slightly influenced by a policy focus on KU. Scientists think more about KU and show more KU promises. Scientists from different disciplines write the paragraphs in similar ways, but promise different KU activities. It would seem that no single discipline is influenced more by the focus than other disciplines. Vidi laureates write their paragraph better than Veni laureates.

The KU paragraphs are a contributor to the opening of the ivory tower, and the ivory tower might eventually become an ivory attraction.

Chapter 9 Reflection

9.1 Limitations

Only a select group of scientists win the Vici grant each years (around 35-40) The response rate among this group was very low, so paragraphs from this group were excluded in the study. A complete comparison between different experience levels could therefore not be executed.

Some of the disciplines contained only a few proposals (with less than 10 proposals), this made a comparison between the disciplines harder.

All the proposals acquired were from successful applications. No unsuccessful applications have been analyzed, so differences found or hypotheses which have been rejected or approved might have been different if unsuccessful application were also taken into account.

No KU paragraphs before 2013 were analyzed. Because the paragraph only became obligatory in 2012, with 2013 being the year all groups included this paragraph in their application. A study to measure improvement in this paragraph is missing a baseline provided by paragraphs before 2013. It is possible that from 2013 onward all paragraphs have shown great improvement, which might explain the lack of significant differences in several analyses.

The text mining analysis is based on words and databases that can be recognized. It is possible that some words are not in the database, or are written in a way that cannot be recognized. False positives and false negatives should be taken into account.

9.2 Implications

One of the things this study seems to show is that no bias is made based on the amount of entrepreneurial activities. During the interviews scientists expressed their fears about the fundamental sciences being less funded, this in line with the expectation of knowledge utilization as an economic form of knowledge transfer. Over the years no difference could be seen, which would suggest that the broader interpretation of knowledge utilization has already established itself among the society.

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Appendix

***Table A1**: This table depicts the percentage of scientists within each discipline that promises a certain activity.*

Indicators	ALW	CW	EW	GW	MGW	N	STW	ZonMw	Area Crossing
advice for public sector	21%	0%	0%	15%	60%	0%	0%	15%	25%
advice for private sector	7%	0%	0%	0%	14%	0%	0%	0%	0%
guidelines, best practices and protocols	7%	0%	0%	7%	9%	0%	0%	23%	0%
product or service for public sector	38%	9%	0%	63%	23%	11%	0%	8%	50%
Interventions/clinical trial/therapy	14%	27%	0%	7%	31%	0%	0%	62%	0%
Teaching public	3%	0%	0%	7%	3%	0%	0%	0%	0%
Lower and middle education	17%	0%	0%	30%	3%	11%	10%	0%	0%
CPD	3%	9%	0%	11%	6%	0%	0%	0%	0%
collaboration (non-specified)	10%	27%	17%	19%	9%	0%	0%	8%	25%
collaboration with private sector	28%	36%	33%	11%	23%	44%	90%	38%	25%
collaboration with public sector	34%	9%	17%	37%	51%	0%	10%	31%	75%
collaboration with other research discipline	17%	0%	0%	15%	6%	44%	0%	8%	25%
collaboration with professionals in the field	28%	36%	33%	56%	43%	11%	50%	31%	25%
user group	0%	0%	0%	4%	0%	0%	40%	0%	0%
Workshops for professionals	21%	9%	33%	37%	43%	22%	20%	15%	75%
Interdisciplinary journals	3%	0%	0%	0%	6%	11%	0%	0%	0%
newspapers/radio/tv/media	7%	9%	17%	26%	31%	33%	10%	15%	25%
online platforms, mail, newsletter, etc.	3%	0%	0%	7%	9%	11%	0%	0%	0%
Public lectures	17%	9%	17%	52%	34%	11%	0%	8%	25%
participation in conferences and exchanges	38%	45%	67%	41%	66%	22%	50%	62%	75%
website, blog, social media	24%	18%	17%	56%	49%	0%	0%	23%	25%
Database, archive	10%	9%	0%	15%	3%	0%	0%	0%	0%
Network	7%	0%	0%	4%	29%	0%	10%	23%	0%
licence	0%	0%	0%	4%	6%	11%	20%	8%	0%
copyright or other IP forms	10%	45%	0%	0%	3%	11%	40%	38%	0%
product, service, technology	31%	64%	50%	0%	9%	33%	80%	31%	50%
open source product or technology	7%	0%	0%	0%	6%	11%	0%	0%	0%
spin-off/spin-out/start-up	3%	18%	0%	0%	0%	11%	0%	8%	0%

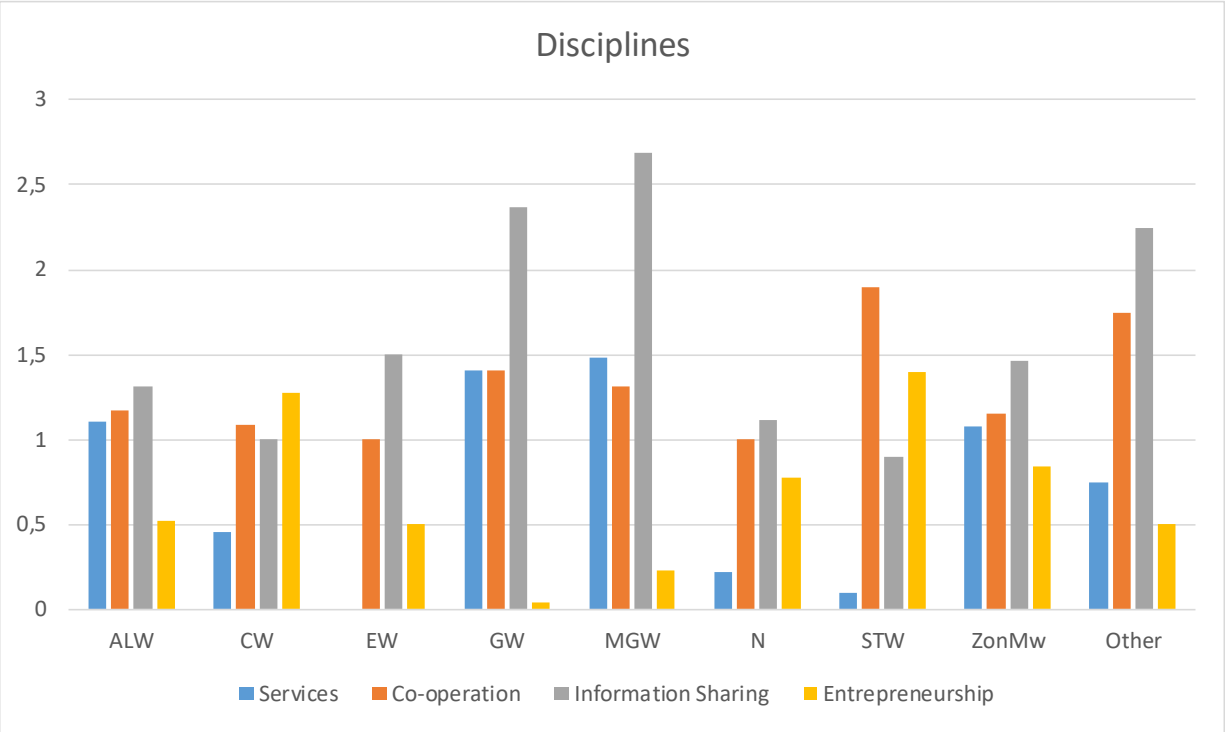

***Figure A1**: The distribution among several types of activities is depicted. How many activities each discipline promises on average with the categories Services, Co-operation, Information Sharing and Entrepreneurship*

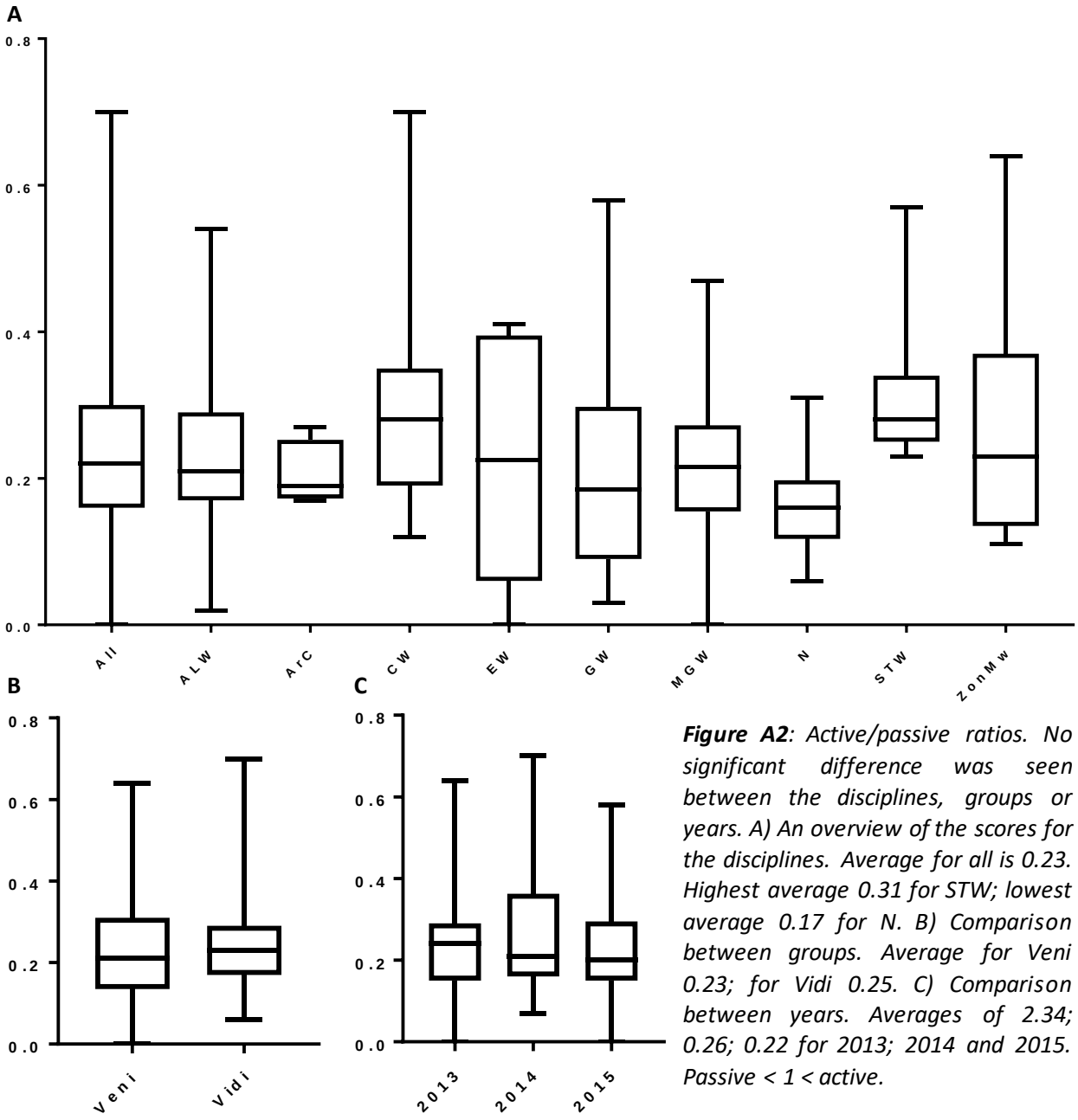

***Figure A2**: Active/passive ratios. No significant difference was seen between the disciplines, groups or years. A) An overview of the scores for the disciplines. Average for all is 0.23. Highest average 0.31 for STW; lowest average 0.17 for N. B) Comparison between groups. Average for Veni 0.23; for Vidi 0.25. C) Comparison between years. Averages of 2.34; 0.26; 0.22 for 2013; 2014 and 2015. Passive < 1 < active.*

Personal experience report

When I started this internship I was supposed to do a study on valorization, see what scientists do with valorization and write a thesis about it. I had no guidelines or restrictions, so I was able to design my own study and decide for myself where I wanted to go with this study. The first month, maybe even more, was spend on framing my thesis. What did I want to investigate, whom did I need for that and how would I do this? Eventually, through my internship, the shape of my thesis took form and I was able to analyze the results more targeted. I participated in projects IDfuse was undertaking and saw how they approached certain problems and provided solutions for them. I had hoped to have a project of my own to work on, but the contact responded very slow to the mails with IDfuse, so this did not happen. I really enjoyed the freedom I was given at IDfuse, that I could decide for myself what I wanted to do, as long as I delivered.

My first internship was in the lab, while doing the master Molecular and Cellular Life Sciences. Lab work is a lot of repetition, with lots of experiments delivering nothing. I switched to Science and Business Management after I followed the Fundamentals of Business and Economics courses because I wanted something else. I wanted to talk to people and engage in project that are of immediate value. And I have the feeling I got what I wanted at IDfuse, with this study into valorization.

I learned to conduct interviews and how to conduct a study, completely different from what I had learned previously. How to approach people for interviews and how to process the interviews.

This internship also provided me with a unique insight in entrepreneurship. Because IDfuse is located at UtrechtInc, where a lot of start-ups are housed, the projects and ambitions of these start-ups came to my attention. I don't think being an entrepreneur is something I would like to be, but some interesting job-opportunities might present themselves in time.