

Triple Helix

Investigating successful Triple Helix collaborations in the Netherlands



Master thesis by

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Preface

I am delighted to present this master's thesis, which represents the culmination of dedicated effort and collaboration. As I reflect on this journey, I am compelled to express my gratitude to the individuals who have supported and guided me along the way.

Since the first day I started the (pre-)master Innovation Sciences, I have been surrounded by a group of students, with whom I had immense fun times, discussions, inspiring talks and adventures. For this, I would like to thank the people I met during the (pre-)master's.

Throughout my journey in the master's program, I have gained invaluable insights and experiences. The courses were not only intellectually stimulating but also enjoyable. The lectures were enlightening, and engaging discussions among fellow students sparked inspiration. Collaborating with peers during group projects further fuelled my motivation to excel.

The Master Innovation Sciences holds immense value within a university that emphasizes technology, as it encourages a critical examination of the societal implications of technological advancements. I am optimistic that this program will continue to inspire future students in its evolving iteration.

Dirk, from the student team Core, initially highlighted the issue concerning Triple Helix collaborations—a concept that seemed promising in theory but lacked practical insights. He noted that in practice, these collaborations often stranded shortly after starting. This eventually led to my research and research question. I extend my thanks to Dirk and Core for their assistance in facilitating the interview process, which greatly enhanced the empirical foundation of this thesis. I would like to thank the interviewees who I cannot call by name but am very grateful to for participating in this research.

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To Bas, I am grateful for your unwavering support and understanding during this period of intense focus and dedication.

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Summary

Introduction

Addressing climate change sustainably, especially in light of the approaching environmental targets for 2030 and 2050, has become increasingly urgent. This necessitates a global transition away from polluting technologies towards more sustainable practices. Developing green technologies through external collaborations has emerged as a preferable strategy, as the success of such innovations relies on the acquisition of externally developed resources and collaborative co-development within networks (Cainelli et al., 2015). This means collaboration can be used to develop technologies. A framework that emphasizes the importance of collaboration for the development of new technologies, is Triple Helix.

Triple Helix is a framework that stipulates that the interaction between government, industry and a university is needed to foster innovation. The Triple Helix framework, while widely acclaimed for its potential to foster collaboration among government, industry, and universities, has faced criticism for its lack of practical guidance on an operational level (Asheim & Coenen, 2006). This critique underscores concerns about the framework's ability to translate theoretical concepts into tangible outcomes, with the risk that Triple Helix collaborations may fail to yield significant results or products (Bressers, 2012). Moreover, the frameworks focus on the policy level often leaves companies seeking to enhance their collaborative relationships with limited practical recommendations (Brem & Radziwon, 2017). Hence, while the Triple Helix framework holds theoretical promise, its effectiveness in practical implementation remains a matter of contention, highlighting the necessity for continued exploration and refinement in both research and policy. Dankbaar (2019) attempted to address this disparity by proposing design rules for Triple Helix organisations. Nevertheless, these guidelines are primarily derived from existing literature, indicating a lack of empirical evidence. This thesis delves into the factors that contribute to a successful Triple Helix collaboration using literature and empirical methods, aiming to provide practical insights on how such collaborations need to take place.

This leads to the following overarching research question:

“What factors contribute to a successful Triple Helix collaboration in the Netherlands?”

Method

A traditional literature review was used to distil the factors present in the literature. Doing a traditional literature review means that there was no structured approach to the literature review, as it consisted of a variety of styles, with no predetermined defined method (Danson & Arshad, 2015).

Two case studies were chosen for the empirical study. The two cases that were chosen varied greatly in size, actors present and objectives. Both collaborations had spin-offs in the form of successful Growthfunds (Groeifonds) requests. Growthfunds is an initiative of the Dutch government aimed at stimulating investments that contribute to long-term economic growth, innovation, and sustainability. The scale of these Growthfunds spin-offs varies greatly, with the spin-offs from the smaller project being worth a couple of millions of euros, while the spin-offs of the larger are worth 600+ million euros. The smaller case study revolves around an environmental technology. The larger case study encompasses multiple technologies in the mobility sector. The smaller case study its objective was related to an individual project. The larger case study's objective was an ongoing relationship within a collaboration exploring areas of new technological knowledge in the mobility sector.

The two case studies were delved into using in-depth interviews. This was done to gain an in-depth knowledge of the experiences of the different interviewees from their respective collaborations (Creswell, 2009). In-depth interviews consist of open-ended questions which focus on digging deep into one's experiences with a few questions prepared in advance (Battacharya, 2017). The interviews from the two collaborations provided insight into how the interviewees experienced the collaboration in the context of the case study. The interviews were semi-structured, this choice was made as it allows for consistency across interviews and makes it possible to compare the responses of the different

participants in the study (Battacharya, 2017). The interview guide can be found in Appendix I. The interview guide was made using the methods explained by Braun & Clarke (2013).

Literature

The factors that were identified in the literature were categorized into three phases: start, partner selection and execution phase. In the starting phase only one factor was identified in the literature, the need for an innovation organiser. The innovation organiser is a key position in a Triple Helix collaboration because they take the initiative in the collaboration, tend to do most of the coordinating and ensure agreement and support for the realization of the collaboration (M. Ranga & Etzkowitz, 2013).

In the partner selection phase, three factors were identified: trust, complementarity, and compatibility. Trust in a collaboration determines what information is shared and what information is not shared between the partners (Arsanti et al., 2022). Trust is essential within a Triple helix collaboration because it holds the potential to effectively navigate the unpredictable challenges associated with utilizing relationships when other parties are used to achieve goals (Arsanti et al., 2022). Complementarity is described as complementary assets which are not identical, but are interdependent and mutually encouraging (Useyin Tanriverdi & Venkatraman, 2005). Businesses are inclined to engage in partnerships when possible partners possess resources that complement the company's existing capabilities and can be utilized alongside its resources (Arsanti et al., 2022). Compatibility between Triple Helix partners can be investigated through a variety of different criteria like, strategic and relational long-term orientation, cultural and organisation characteristics, values, norms and mindsets (Arsanti et al., 2022; Razak & White, 2015). By establishing a mutual understanding and shared approaches to collaboration, partners can cultivate and maintain positive interactions in a Triple Helix collaboration (Arsanti et al., 2022).

In the execution phase, six factors were identified: conflict, collaborative leadership, evaluator, traits of the university, industry and government. Conflict refers to having the right type of conflict, which is task conflict. Task conflict is content-driven and takes place because of differences of opinion in an organisation's functional department (Amason & Sapienza, 1997). Task conflict has a positive effect on innovative capabilities, as it causes the reconsideration of the dominant perspective and beliefs in an organisation, whilst allowing new original viewpoints (Amason & Sapienza, 1997). Collaborative leadership is a fundamental part of collaboration and conflict moderation (M. Ranga & Etzkowitz, 2013). Collaborative leadership is a management practice in which everyone is involved in making decisions that impact them. The sole responsibility of the evaluator is to collect information about the collaboration for management (Dankbaar, 2019). All this information is transparent, meaning it is shared with everyone involved.

Traits of the government/ industry/ university refer to which traits were identified in the framework of Triple Helix as traits these institutions should possess. The following traits that were identified for the university (*are traits identified for knowledge institute): (1) The development, production and application of advanced knowledge*, (2) reacting flexibly to market demands, (3) taking initiative when entering cooperations with the market*, (4) take a more active role in socio-economic development* and (5) hybridity of individuals and institutions* (Lanskoronskis et al., 2009; Zhou & Etzkowitz, 2021). There was only a single trait identified in the literature for the industry: (1) Development of innovation and the application of them (Etzkowitz & Zhou, 2017; L. M. Ranga et al., 2008; Zhou & Etzkowitz, 2021). There were four traits identified for the government in the literature: (1) Guarantee stable interactions and exchange, (2) be present as a moderator rather than control, (3) make policies to support innovation, (4) organise platforms for communication and collaboration (Borges da Costa & Ladders, 2022; Etzkowitz & Zhou, 2017; Zhou & Etzkowitz, 2021).

Empirical study

It was concluded from the literature and both case studies that the innovation organiser is indeed a key position in a Triple Helix collaboration. Found only in the empirical analysis is the need for someone to manage the unprofitable top, and government institutions were deemed most suitable for this role by interviewees. Unlike private entities, government institutions can invest in initiatives without immediate financial returns.

Alongside the three previously identified factors from the literature — trust, complementarity, and compatibility— an additional factor, interest, emerged in the empirical study. Complementarity of interest was also suggested as a means to prevent conflicts. This finding emphasised the importance of aligning partners' interests to foster synergy and mitigate potential discord within a collaborative setting.

Collaborative leadership was both identified in the literature and the empirical study. However, the empirical study highlighted that it is effective in smaller collaborations but may require adjustment as collaborations expand. The empirical study revealed that task conflict was not necessary in a collaboration. An evaluator, although identified in the literature as a necessary individual in a Triple Helix collaboration, was not present in either case study. It did not appear that institutional spheres needed to possess certain traits for there to be a successful collaboration. While the institutional spheres did possess most of the traits described in the literature, most of the time participants did not explicitly express a need for them. There are exceptions for the government traits (2) be present as a moderator rather than a controller and (3) make policies that support innovation.

In the smaller collaboration, the knowledge institute did not exhibit three out of the five traits outlined in the literature. However, this did not hinder the quality of the collaboration. This is likely attributable to differing objectives and scale between the two collaborations. Meaning that depending on the objective and scale the traits of a university or knowledge institute will vary. The trait of the industry did appear necessary as the development of innovation and application is often the things the collaboration centres around.

Discussion & Conclusion

During the starting phase of the collaboration, two factors were identified: the need for an innovation organiser and for an institution to deal with the unprofitable top. During the partner selection phase, four factors were identified: trust, complementarity, compatibility and interest. During the final phase the execution phase four factors were identified: collaborative leadership and traits for the industry, government and university/knowledge institute.

This thesis had one main contribution which was to create an overview of the factors of importance for a successful Triple Helix collaboration in the Netherlands. By creating an overview of the factors of importance, practical guidelines are created which were missing in the literature. These practical guidelines can be used by any institution wishing to partake in a Triple Helix collaboration.

There was a survivorship and generalization bias in this study, as only two successful cases were reviewed. Further research should include more collaborations and failed Triple Helix collaborations.

The Triple Helix framework is primarily centred around economic growth. As criticism mounts against economic-centred innovation frameworks, concerns arise about developing technologies sustainably within a framework that prioritizes economic growth. Despite its potential limitations, Triple Helix remains widely adopted by many countries. Although the Triple Helix framework was not originally designed with sustainability in mind, it can still be used to help mitigate climate change. However, future research should still look into the factors defined in this study and compare whether these factors also apply to a Quadruple or Quintuple Helix collaboration. These are related frameworks that do not centre around economic growth and do incorporate sustainability to some degree in the frameworks.

Table of Contents

Preface	2
Summary	3
1 Introduction.....	8
1.1 Background	8
1.2 Problem	8
1.3 Research question	9
1.4 Outline report	9
2. Methodology.....	11
2.1 Qualitative research design	11
2.2 Traditional literature review	11
2.3 Empirical analysis	12
2.3.1 Conducting and analysing the interviews.....	14
3. Traditional literature review.....	17
3.1 Background information	17
3.1.1 Triple Helix	17
3.1.2 (National) Innovation Systems Theory	18
3.1.3 Triple Helix Systems.....	19
3.2 The three phases	20
3.2.1 Start.....	20
3.2.2 Partner selection	20
3.2.3 Execution	22
3.3 Framework	26
4. Empirical analysis.....	27
4.1 The start of the collaboration.....	29
4.1.1 Innovation organiser.....	29
4.1.2 Unprofitable top.....	29
4.2 Partner selection	30
4.2.1 Trust.....	30
4.2.2 Complementarity	31
4.2.3 Compatibility	32
4.2.4 Interest.....	33
4.3 Execution phase of the collaboration	34
4.3.1 Conflict.....	34
4.3.2 Collaborative leadership	35
4.3.3 Evaluator	37

4.3.4 Traits of the Institutions.....	37
4.4 Reflection	42
4.4.1 Start.....	42
4.4.2 Partner selection	42
4.4.3 Execution	42
4.5 Improved Framework for Triple Helix Collaborations	43
5. Discussion and Conclusion.....	45
5.1 Answer to the research question	45
5.2 Framework evaluation	47
5.3 Practical implications	48
5.4 Limitations and avenues for future research.....	48
6. References	50
7. Appendix I: Interview guide.....	54

List of the tables

Table 2.3.1 Institutions present in the larger collaboration.....	13
Table 2.3.2 Institutions present in the smaller collaboration	14
Table 3.3.1 Framework for a successful Triple Helix collaboration.....	26
Table 4.1 Participants of the smaller collaboration	28
Table 4.2 Participants of the larger collaboration	28
Table 4.1.1 Factor for the starting phase.....	29
Table 4.2.1 Factors in the partner selection phase	30
Table 4.3.1 Factors for the execution phase	34
Table 4.5 Improved framework	44

List of abbreviations

- NIS: National innovation systems theory
- ERB: Ethical review board
- PPS: Public-private collaborations

1 Introduction

1.1 Background

Addressing climate change sustainably, especially in light of the approaching environmental targets for 2030 and 2050, has become increasingly urgent. This necessitates a global transition away from polluting technologies towards more sustainable practices. Developing green technologies through external collaborations has emerged as a preferable strategy, as the success of such innovations relies on the acquisition of externally developed resources and collaborative co-development within networks (Cainelli et al., 2015).

While most academics agree on the necessity of innovation, there is still ample discussion on how it should be cultivated (Seebode et al., 2012). With innovation is meant in this thesis the practical implementation of ideas that cause the introduction of new goods or services or enhance existing goods or services (Schumpeter, 1949). Innovation research often uses frameworks that make use of 'best practice' innovation (Seebode et al., 2012). These frameworks usually comprise a set of routines that organisations can use to structure their organisation or a set of policy recommendations that governments can use to improve the innovative capabilities of a country or region (Seebode et al., 2012). Triple Helix is one of these innovation frameworks that underscores the significance of collaborations for the development of new technologies.

The idea of the Triple Helix framework rests on the basis that the interaction between government, industry and universities is key to enhancing the conditions for innovation in a knowledge-based economy (Borges da Costa & Ladders, 2022). First developed in 1995 by Etzkowitz & Leydesdorff, it has since become a framework applied much in the field of innovation studies, with almost 200 papers being written on the framework over the period 1995 to 2017 (Galvao et al., 2019). In a policy context, Triple Helix principles are often used very loosely. The Triple Helix framework often being used as a symbolic or easy-to-use metaphor (Kinnunen et al., 2016). It is intended as a simple framework meant for the user to adapt according to the context of the country or field (Etzkowitz & Zhou, 2017).

There are numerous advantages for institutions involved in Triple Helix collaborations. Universities stand to benefit from partnering with industry by gaining access to financial resources, adopting best practices, and acquiring new technological knowledge. These resources can subsequently enhance academic research and teaching endeavours (Lundberg, 2013; Martin et al., 2000). Similarly, businesses in the private sector can bolster their innovation capabilities and competitive position through collaboration with universities. This collaboration enables them to leverage research findings, refine and develop prototypes, exchange economically relevant and scientific knowledge, and seek assistance in problem-solving for their products (Martin et al., 2000). Additionally, the government reaps the rewards of fostering innovative capacities within the region. Industries with a strong focus on innovation contribute to the creation of a highly skilled workforce, resulting in increased productivity and higher wages, ultimately driving economic growth (Kumar & Sundarraj, 2018).

The Triple Helix framework falls under the broad domain of innovation sciences, it is a framework created by drawing from evolutionary economics, policy analysis with an evaluative perspective, science and technology studies, and sociology of higher education (Zhou, 2014).

1.2 Problem

The Triple Helix framework, while widely acclaimed for its potential to foster collaboration among government, industry, and universities, has faced criticism for its lack of practical guidance in operational implementation, particularly within concrete policy settings (Asheim & Coenen, 2006). This critique underscores concerns about the framework's ability to translate theoretical concepts into tangible outcomes, with the risk that Triple Helix collaborations may fail to yield significant results or products (Bressers, 2012). Moreover, the frameworks focus on the macro level often leaves companies seeking to enhance their collaborative relationships with limited practical recommendations (Brem &

Radziwon, 2017). Hence, while the Triple Helix framework holds theoretical promise, its effectiveness in practical implementation remains a matter of contention, highlighting the necessity for continued exploration and refinement in both research and policy. Dankbaar (2019) attempted to address this disparity by proposing design rules for Triple Helix organisations. Nevertheless, these design rules are derived from existing literature, indicating a lack of empirical evidence (Dankbaar, 2019). This gap I attempted to address by identifying the factors that contribute to a successful Triple Helix collaboration using literature and empirical methods, aiming to provide practical insights on how such collaborations need to take place.

The Triple Helix framework is well-established in the literature, but there is limited empirical insight. Even though the Netherlands is often mentioned as an example of how Triple Helix collaborations should take place, insights about the Netherlands are lacking (Kinnunen et al., 2016; Morisson & Doussineau, 2019; Quintanilla & Romero, 2019). This gap is particularly surprising given the frequent mention of the Triple Helix framework by various governmental actors in the Netherlands. Alongside a strong emphasis by the Dutch government on Triple Helix collaboration, with subsidy schemes such as National Growthfunds or PPS (Public-private collaborations) (Keijzer, 2019; *Nationaal Groeifonds*, n.d.; *PPS-Toeslag Onderzoek En Innovatie*, n.d.). In these subsidy schemes by the Dutch government, a Triple Helix collaboration is a collaboration between government, industry and knowledge institutes.

1.3 Research question

This leads to the following overarching research question:

“What factors contribute to a successful Triple Helix collaboration in the Netherlands?”

This master thesis aims to understand what factors contribute to a successful Triple Helix collaboration in the Netherlands. This thesis aims to address the theoretical gap by providing actionable insights that can guide the implementation and maintenance of a Triple Helix collaboration in the Netherlands. This will be done by developing a coherent framework that encompasses the success factors obtained through a synthesis of both the literature and empirical research. The literature review will focus on the literature surrounding the Triple Helix framework, additional innovation frameworks and literature focused on external collaborations. The empirical research will make use of two case studies characterized by varying characteristics, yet both acknowledged as successful by the involved participants and Brockhoff & Teichert’s (1995) definition. The two case studies were anonymized to protect the anonymity of the participants of this study. Since only two successful cases were used there is a survivorship bias in this thesis (Shermer, 2014).

Triple Helix collaborations are often proclaimed to be successful because none of the parties involved are inclined in acknowledging it as a failure (Dankbaar, 2019). Hence, establishing a clear definition of successful becomes crucial. The definition for a successful collaboration that will be used is: a collaboration is successful when the objectives are met or surpassed (Brockhoff & Teichert, 1995). The degree of success in a collaboration depends on the use and impact of the newly acquired knowledge (Brockhoff & Teichert, 1995). There are two different types of objectives in a collaboration, objectives relating to individual projects or the ongoing relationship within collaboration exploring areas of new technological knowledge (Brockhoff & Teichert, 1995). There is a distinction made between the two case studies, as the smaller and larger case study. The smaller case study its objective is a single project surrounding the testing of an environmental technology. The larger case study its objective is an ongoing collaboration exploring multiple technologies in the mobility sectors.

1.4 Outline report

To address the research question, this thesis will integrate various bodies of scholarly literature and empirical insights on successful Triple Helix collaborations. The methodology for this integration is detailed in Chapter 2. Subsequently, Chapter 3 will merge the Triple Helix framework with other frameworks and supplementary literature on external collaborations to offer more practical guidance on

effectively implementing successful Triple Helix collaborations. The first half of Chapter 3 will provide the necessary background information, while the second half will delve into the identified phases of a Triple Helix collaboration—start, partner selection, and execution—and explain the factors identified during each phase in the literature. Chapter 3 will culminate in the development of a novel framework that outlines the key factors necessary for a successful Triple Helix collaboration according to the literature.

Following this, Chapter 4 will present the empirical analysis, applying the framework to the two case studies. The chapter will conclude with an enhanced version of the framework created in Chapter 3. In Chapter 5, the conclusion and discussion will unravel, delving into the implications of this research, limitations and exploring avenues for future research.

2. Methodology

This chapter outlines the methodology of the thesis, beginning with how the literature review was conducted. After which it explains how the empirical analysis took place.

2.1 Qualitative research design

The thesis followed a qualitative research approach. The choice for qualitative research methods was made to gain an in-depth, contextualized and nuanced understanding of the concepts researched. The research used various bodies of scholarly literature and empirical methods to gain insights into successful Triple Helix collaborations. Both inductive and deductive reasoning were used. Because there are very few insights on successful Triple Helix collaborations in the Netherlands, the flexible nature of qualitative research was a good fit for the research question (Creswell, 2009).

The thesis answers the research question using a combination of theoretical and empirical insights, using both inductive and deductive reasoning. The theoretical insights gained from Chapter 3 are used to answer the research question by creating a novel framework, this framework is then empirically tested and adjusted in Chapter 4.

2.2 Traditional literature review

A traditional literature review was used to gain insights into the Triple Helix success factors defined in the literature. The literature review was done to build the framework consisting of the success factors and to inform the empirical analysis. The goal of the literature review was to identify what factors were deemed essential for a successful Triple Helix collaboration, this was done by analysing and summarizing varying bodies of literature (Danson & Arshad, 2015). This aim made a narrative/traditional literature review the best fit. This means that there was no structured approach to the literature review, as it consisted of a variety of styles, with no predetermined defined method (Danson & Arshad, 2015). Although there is no predetermined method, there are different stages in a traditional literature review (Li & Wang, 2018).

The first stage was to define the research problem or research question for the study (Li & Wang, 2018). The research question defined for this study was: “*What factors contribute to a successful Triple Helix collaboration in the Netherlands?*”.

The second stage was searching for the literature that is possibly relevant to the review (Li & Wang, 2018). The electronic databases that were used were: Google Scholar, Scopus and Web of Science. To pinpoint the crucial factors for a successful Triple Helix collaboration, I looked at the domains of literature on Triple Helix, (national) innovation systems theory, Triple Helix systems, and external collaborations. Literature on external collaborations was incorporated to provide insights at the meso-level, complementing the macro-level perspectives offered by the other domains of literature.

The third stage was selecting which articles are relevant for answering the research questions (Li & Wang, 2018). When selecting the articles for a traditional literature review, four criteria were considered such as: the study must be representative, studies must be included that present a different theory, the research must be relevant and the studies must be of sufficient quality (Li & Wang, 2018).

The fourth stage was reading the literature in depth (Li & Wang, 2018). First familiarity with the overall literature must be created before being able to reflect on it.

The fifth stage was organising the data (Li & Wang, 2018). The data was organised by themes, adding notes along with the authors in a file. The relevant literature was divided into the themes of innovation frameworks and the different phases of a collaboration. For example the themes that were created in for the literature review are the different phases of the collaboration: start, partner selection and execution.

The final stage was writing the review (Li & Wang, 2018). To answer the research question first factors were distilled from the literature, to create a framework.

After completing the traditional literature review the framework was tested using two case studies. The framework was critically evaluated and adjusted based on these empirical findings. The framework consists of the factors that contribute to a successful Triple Helix collaboration in the Netherlands.

2.3 Empirical analysis

For Chapter 4 two successful case studies were used. In the 4th chapter, the framework created in Chapter 3 was empirically tested using in-depth interviews.

The two cases were chosen because they varied greatly in size, actors present and objectives. Both cases were selected by using the network of the student-team Core Changemakers by contacting people from varying sectors and asking for successful collaborations. Both collaborations had spin-offs in the form of successful Growthfunds (Groeifonds) requests. Growthfunds is an initiative of the Dutch government aimed at stimulating investments that contribute to long-term economic growth, innovation, and sustainability. The scale of these Growthfunds spin-offs varied greatly, with the spin-offs from the smaller project being worth a couple of millions of euros, while the spin-offs of the larger are worth 600+ million euros. Both collaborations took place in different sectors and locations. The smaller collaboration took place in the northern region of the Netherlands. The larger collaboration started in the southern region of the Netherlands but later expanded to the entire Netherlands. The smaller case study its objective is a single project surrounding the testing of an environmental technology. The larger case study its objective is an ongoing collaboration exploring multiple technologies in the mobility sectors.

The Triple Helix framework was developed as a manner to foster innovation. With innovation is meant in this thesis the practical implementation of ideas that cause the introduction of new goods or services or enhance existing goods or services (Schumpeter, 1949). Both case studies meet this definition. The smaller collaboration concerned a newly developed environmental technology that needed further testing. Further testing was needed for the product to shorten the time till market entry and have a smooth market introduction overall. The larger collaboration centred around developing new goods and services or enhancing existing goods and services in the mobility sector. The larger collaboration did include some goals that were not innovative such as making joint purchases to decrease costs.

The literature on Triple Helix collaborations states it as a collaboration between university, industry and government. However, the Dutch government views Triple Helix collaborations as collaborations between knowledge institutes, industry and government. Universities are included since they fall under the term knowledge institute. However, not all knowledge institutes are universities, as some knowledge institutes do not have an educational component. It will be assessed on how missing a university in a Triple Helix collaboration influenced the smaller collaboration.

There is a survivorship bias present in this study. A survivorship bias is when only successful cases are selected for a study (Shermer, 2014). Survivorship bias can lead to incorrect conclusions by studying only a subset of the population (Shermer, 2014). The reason for selecting two cases which are best practices was to gain insight into: what the actors see as a successful collaboration and what they think contributed to it being a success. Even though there is very little literature written about Triple Helix collaborations in the Netherlands, the literature that is written focuses mostly on unsuccessful collaborations (Borges da Costa & Ladders, 2022; Bressers, 2012; Kinnunen et al., 2016; Lanskoronskis et al., 2009; Park et al., 2005; L. M. Ranga et al., 2008).

The information about the case studies is deliberately kept vague to ensure the anonymity of the participants. This was done since participants expressed in the ERB form the wish for anonymity. The interviews were anonymized, as per the guidelines of the Ethical Review Board of the TUE.

In total thirteen in-depth interviews were conducted. In the larger collaboration which centred around the mobility sector, eight in-depth interviews were done. In the smaller case study which centred around an environmental technology, five in-depth interviews were done. Key informant interviews were done,

as the interviewees were representing the institution they were from. All interviewees were involved in the collaboration throughout the project. The first couple of interviews in both cases were set up using the network of the student-team Core Changemakers. After the first few interviews snowballing was used, meaning already recruited interviewees were used to get in touch with other possible interviewees.

The larger collaboration started with ten founding partners. The larger collaboration first started during COVID-19 since then the collaboration has grown significantly. The choice was made to limit the interviews only to the founding partners since they were involved during all stages of the collaboration.

Institution	Interviewed	Location	Industry	Government	Research Institute	University	Length
(1) Government 4	Yes	In-person	/	X	-	-	50 min
(2) Industry 2	Yes	In-person	X	-	-	-	74 min
(3) Industry 3	Yes	In-person	X	-	-	-	28 min
(4) Industry -	No	-	X	-	-	-	-
(5) Industry 4	Yes	Online	X	-	-	-	25 min
(6) Industry -	No	-	X	-	-	-	-
(7) Industry -	No	-	X	-	-	-	-
(8) University 1 & 2	Yes	In-person/ Online	-	-	-	X	42 min / 31 min
(9) Knowledge institute 2	Yes	In-person	-	-	X	-	49 min
(10) Government 5	Yes	Online	-	X	-	-	44 min

Table 2.3.1 Institutions present in the larger collaboration

Table 2.3.1 Shows which institutions were present from the start in the larger collaboration. A total of seven of the ten founding partners were interviewed. Two individuals from the same university were interviewed – one actively engaged on an operational level in the collaboration and another person who was active on a strategic level in the collaboration. Single-sphere institutions refer to, an institutional sphere which can be industry, government or university, which are characterized by rigid institutional boundaries, with low levels of interaction with other institutional spheres (Cai & Amaral, 2021; M. Ranga & Etzkowitz, 2013). Multi-sphere institutions are institutions that operate at the junction of the university, industry, and government spheres and have characteristics of multiple spheres (Cai & Amaral, 2021). An X in Table 2.3.1 represents the main sphere from which an institution is and if an institution only possesses an X it means it is a single-sphere institution. An / is used when it is a multi-sphere institution, in which case the X represents the main sphere and the / represents the additional sphere in which this institution also operates. In Table 2.3.1 this means that (1) government is a multi-sphere organisation, with its main sphere being government and its additional sphere being industry. Chapter 3.1.1 explains why having a mix of multi and single-sphere organisations in a Triple Helix collaboration is important.

The larger collaboration started as a way to protect the innovative abilities of the mobility sector during COVID-19. The goal was to organise a public-private collaboration around the mobility sector in the Netherlands in which the necessary competencies and knowledge needed to be developed. The ambition of the collaboration is: to gain a unique position in the international supply chain, depending less on the international supply chain, and conservation and growth of existing employment and business activity.

In the smaller collaboration, six partners were present. Of these six partners, five were interviewed. The partner that was not interviewed was only briefly a part of the collaboration and did not play a large part in the collaboration. The collaboration started in 2017. There was an environmental technology created by the industry party that needed objective testing in an unnamed environment. The outcomes of this research interested all participants for varying reasons.

Institutions	Interviewed	Date	Location	Industry	Government	Research Institute	Length
(1) Government 1	Yes	22-6-2023	Online	/	X	-	99 min
(2) Industry 1	Yes	14-4-2023	Online	X	-	-	35 min
(3) Knowledge institute 1	Yes	5-4-2023	Online	-	-	X	32 min
(4) Government 2	Yes	3-4-2023	Online	-	X	-	29 min
(5) Government 3	Yes	3-4-2023	Online	/	X	-	68 min
(6) Industry -	No	-	-	X	-	-	-

Table 2.3.2 Institutions present in the smaller collaboration

Table 2.3.2 shows which institutions were present in the smaller collaboration. Single-sphere institutions refer to, an institutional sphere which can be industry, government or university, which are characterized by rigid institutional boundaries, with low levels of interaction with other institutional spheres (Cai & Amaral, 2021; M. Ranga & Etzkowitz, 2013). Multi-sphere institutions are institutions that operate at the junction of the university, industry, and government spheres and have characteristics of multiple spheres (Cai & Amaral, 2021). An X in Table 2.3.2 represents the main sphere from which an institution is and if an institution only possesses an X it means it is a single-sphere institution. An / is used when it is a multi-sphere institution, in which case the X represents the main sphere and the / represents the additional sphere in which this institution also operates. In table 2.3.1 it can be seen that there are two multi-sphere organisations present in the collaboration: (1) Government and (5) Government, with both their main sphere being the government, and their additional sphere being industry. Chapter 3.1.1 explains why having a mix of multi and single-sphere organisations in a Triple Helix collaboration is important.

2.3.1 Conducting and analysing the interviews

In-depth interviews were done with the different professionals from both collaborations. This was done to gain an in-depth knowledge of the experiences of the different interviewees from their respective collaborations (Creswell, 2009). All interviewees contributed to their respective collaborations. In the larger collaboration, some interviewees were exclusively involved on the strategic level. While others in the larger collaboration were more involved on an operational level. In the smaller collaboration, each interviewee was involved on all levels. In-depth interviews consist of open-ended questions which focus on digging deep into one's experiences with a few questions prepared in advance (Battacharya, 2017). The interviews from the two collaborations provided insight into how the interviewees experienced the collaboration in the context of the case study.

The interviews were semi-structured, meaning questions were prepared in advance with possible probes identified beforehand (Battacharya, 2017). This choice was made as it allows for consistency across interviews and makes it possible to compare the responses of the different participants in the study (Battacharya, 2017). The interview guide was made in advance, the interview guide can be found in Appendix I. The interview guide was made using the methods explained by Braun & Clarke (2013). A good interview guide is key as it allows the interviewer to build trust or rapport with the participants (Braun & Clarke, 2013). The first step of making an interview guide was brainstorming questions (Braun & Clarke, 2013). The second was creating opening and closing questions (Braun & Clarke, 2013). The third step is the sequencing of the questions, in which the order of the questions was decided so there was a good flow in the questions (Braun & Clarke, 2013). The fourth step is constructing and wording the questions (Braun & Clarke, 2013). Poorly constructed and worded questions can damage the rapport built by the interviewer. Additionally, prompts and probes are added to the questions (Braun & Clarke, 2013). Finally, the questions are checked on social desirability and wording (Braun & Clarke, 2013). With social desirability is meant that the questions need to be phrased so that not only the socially

desirable answer is given (Braun & Clarke, 2013). With wording is meant that the researcher needs to make sure that the research question does not directly translate to a singular interview question (Braun & Clarke, 2013). Meaning the research question is answered using multiple questions. For example, it was unlikely that interviewees would directly express whether or not there was conflict. So multiple indirect questions were used to gather whether or not there was conflict during the collaboration. The questions of the interview aimed to discuss the interviewee's experiences in a Triple Helix collaboration. The interviews were an iterative process, meaning the interview guide was revised when more information was learned from the interviews. An example of this is the removal of the question: Were there partners involved from outside of the Netherlands? (If yes, who? And how was this experienced?). This was removed since in the first interviews it became evident that no partners outside of the Netherlands were directly involved in the collaborations.

The interviews were anonymized, as per the guidelines of the Ethical Review Board of the TUE. Meaning the interviewees cannot be identified in any of the research data. This allows for the interviewees to be more open and critical about their experiences. It should be noted that most of the time only one person was active from their particular institution, which is why information about the participating interviewees is deliberately vague to allow for the participants to remain anonymous. This is why the specifics of both cases are missing such as: names of the institutions involved, names of the individuals involved and the specifics of the innovations that research centred around. Before each interview, an ERB form was shared with the interviewees in which they could convey what information could be shared and what not. An ERB form includes questions on whether the interviewees can be mentioned by name, and whether the interviewees can be quoted.

The interviews either took place in person or online. One hour was always scheduled for the interviews. However, the length of the interviews varied greatly, with the shortest taking 25 minutes, and the longest one hour and 45 minutes. The interviews were recorded, either by recording by phone or using Microsoft Teams. The interviews were recorded and transcribed, to capture the interviewee's expressions, words, and phrases representing the interviewee's attitude during the interviews. The data collection stopped after a point of saturation was achieved, meaning no new information was gathered after additional interviews did not lead to new insights.

After the interviews were transcribed. The coding process started as described by Creswell (2009). The coding was done by organising the materials into segments of text before bringing meaning to the information (Creswell, 2009). The text gathered was segmented into categories which were subsequently labelled (Creswell, 2009). Both inductive and deductive coding were used. Deductive coding meant that possible codes were already constructed when performing the literature review. Inductive coding was used, meaning that depending on the codes and insights from other interviews, codes might change. For example, before reviewing the literature there the following codes: partner selection and interest/personal gain were created, after reviewing the literature partner selection became a theme with the codes: trust, compatibility, complementarity and interest. The software program NVivo 14 was used for the coding of the interviews. The codes are then used to generate a smaller number of themes or categories, Creswell (2009) suggests using 5 to 7 categories per research study. The themes are the major findings in the qualitative research study. These themes should display multiple perspectives and be supported by diverse quotations and evidence from the different interviews (Creswell, 2009). The themes were analysed for the individual cases and across both case studies. The themes that were created in this study are: start, partner selection, execution and others. The first three themes follow the different phases of a collaboration. Things that directly influenced their respective phase were put under that theme. However, when interviewees shared information that did not directly belong to a phase it was put under the theme others, for example, criticism of the Triple Helix framework was put under the theme others. The final step was interpreting the data and comparing it to the literature which is done in Chapter 4 (Creswell, 2009). After this, all of the insights gained from chapters 3 and 4

were combined to answer the main research question by creating a framework. In chapter 5 the discussion and conclusion took place, reflecting on this study and its limitations.

This type of research method comes with the risk that biases might be present in the study. As previously mentioned this study has a survivorship bias, since only two successful cases were used for the study. A survivorship bias is when only successful cases are selected for a study (Shermer, 2014). Survivorship bias can lead to incorrect conclusions by studying only a subset of the population (Shermer, 2014).

There is also a possibility for a researcher bias. Semi-structured interviews were used for the empirical research. Semi-structured interviews are susceptible to the researcher's biases. The questions can influence the answers the respondents might give and analysing the interviews leaves a lot of room for researcher bias. This could potentially result in the misinterpretation of results. The choice for semi-structured interviews was made so there could be an in-depth exploration of the topic and it offers flexibility, allowing for clarification or exploration of unexpected themes or insights.

This study may also be susceptible to a generalization bias, where individuals make broad assumptions or draw conclusions based on limited information or experiences since only two successful cases were used (Peters et al., 2022). However, due to time limitations, no more case studies could be added.

In the next chapter, chapter 3, the traditional literature review took place. The traditional literature review looks at what factors contribute to a successful Triple Helix collaboration in the Netherlands according to the literature.

3. Traditional literature review

The literature review is based on literature that centres on: the Triple Helix framework, (National) Innovation systems theory, Triple Helix systems theory, and literature focused on external collaborations.

“What factors contribute to a successful Triple Helix collaboration in the Netherlands?”

To answer the main research question first factors will be derived from the literature which then will be used to create a novel framework. First, background information is provided, which is essential for comprehending the literature from which the identified factors were drawn. After which the identified factors are discussed. The factors identified in the literature were categorized into the three phases of a collaboration start, partner selection and execution phase.

3.1 Background information

3.1.1 Triple Helix

The Triple Helix framework is an effective tool for understanding the mechanism of innovation on a regional, national and international level, it however has since its development been most applied on a regional level (Cai & Amaral, 2021; Kinnunen et al., 2016). The concept provides key insight into: what are the key actors, what are the mechanisms of interaction, and what enables the interaction (Cai & Amaral, 2021). As a tool, it is meant to improve the innovative capabilities of a certain region. Policy decisions often result from the interaction between the three institutional spheres rather than regulation (Lundberg, 2013).

There are several benefits to entering into such a Triple Helix collaboration. Universities gain benefits by entering a collaboration with the industry by gaining financial resources, best practices and new technological knowledge, which in turn can be used to improve academic research and teaching (Lundberg, 2013; Martin et al., 2000). In the private sector, businesses can increase their innovation capacity and improve their position by collaborating with universities (Lundberg, 2013; Martin et al., 2000). They do this by accessing research results, testing and developing prototypes, sharing economically relevant and scientific knowledge, and accessing support in finding solutions for problems in their products (Martin et al., 2000).

The framework Triple Helix was first introduced in the 1990s by Etzkowitz and Leydesdorff (1995), The Triple Helix framework rests on the basis of a double Helix model (Etzkowitz & Leydesdorff, 1995; Leydesdorff, 2000). The Triple Helix framework differs from the double Helix model, due to the university taking a leading role when it comes to innovation (Etzkowitz & Leydesdorff, 2000; Leydesdorff, 2000). In a Triple Helix configuration, research, technology, and development networks change the relevant R&D environment increasingly (Leydesdorff, 2000).

The framework and its university-industry-government relations interpret a shift from the dominating industry-government collaborations in the industrial society to a growing triadic relationship in which universities/knowledge institutes were included in the knowledge society (M. Ranga & Etzkowitz, 2013). Triple Helix for innovation makes use of the idea of a knowledge economy and knowledge society. A knowledge economy's key component is a greater reliance on intellectual capabilities than on natural resources or physical outputs (Powell & Snellman, 2004).

The Triple Helix thesis posts that the capacity for economic advancement and innovation within a knowledge society hinges on an increased emphasis on the universities role and increased hybridization of elements from university, government and industry (M. Ranga & Etzkowitz, 2013). This fusion aims to create new institutional and social formats for the production, transfer and application of knowledge (M. Ranga & Etzkowitz, 2013).

Since the mid-2000s, the original developers of the Triple Helix model, Etzkowitz and Leydesdorff, have expanded on the dynamics of Triple Helix interactions from different theoretical perspectives (Cai & Lattu, 2022). Etzkowitz uses a neo-institutional perspective and emphasizes the relationships among the university, industry, and government spheres. While Leydesdorff uses a neo-evolutionary perspective that focuses on three selection mechanisms: market, innovation, and control (Cai & Lattu, 2022).

Although the Triple Helix framework provides a theory as to how innovation, economic growth and entrepreneurship can be encouraged by policymakers in a region. It provides no practical direction on how to resolve differences and support cooperation and offers few practical recommendations for companies that wish to build better relations (Brem & Radziwon, 2017; Lundberg, 2013).

Another much-applied framework, that forms an extension of the Triple Helix framework is the quadruple Helix framework (Borges da Costa & Ladders, 2022). The fourth Helix includes the role of the public or civil society (Borges da Costa & Ladders, 2022; Zhou & Etzkowitz, 2021). In empirical applications, the fourth Helix can sometimes be identified as; user/consumer, non-governmental organisations, and community (Cai & Etzkowitz, 2020). The frameworks differ in that the Triple Helix is a framework based on concepts such as the 'knowledge economy', while the Quadruple Helix framework uses concepts such as the 'knowledge society' and 'knowledge democracy' (Cai & Lattu, 2022).

An advantage of the Quadruple Helix is that it tackles some of the issues from the Triple Helix framework such as becoming less generalized and including society more. Another advantage of a quadruple Helix is that it allows for the inclusion of a variety of innovations other than strong technology-focused or science-based ones (Kinnunen et al., 2016). An often-heard critique of the Quadruple model is that society cannot be placed on the same level as the other institutional spheres, making applying this framework even more difficult (Cai & Lattu, 2022).

Another extension of the Triple Helix framework is the quintuple Helix framework, naming the actors as: political, economic, educational, natural and public sub-systems (Cai & Etzkowitz, 2020; Zhou & Etzkowitz, 2021). The quintuple Helix framework highlights the role of the natural and societal environment (Zhou & Etzkowitz, 2021). A critique of this framework is that it might become too broad, and infinite spheres could be added to better suit the problem.

To conclude Triple Helix is a useful tool for improving innovative capabilities, stimulating economic growth and encouraging entrepreneurship in a region. Nevertheless, it offers very little practical direction for institutions that wish to build better relations. Implying that it can be utilized more effectively when supplemented with other theories and frameworks.

3.1.2 (National) Innovation Systems Theory

A theory that is often used in combination with Triple Helix is the Innovation systems theory. Both Triple Helix as well as Innovations systems theory are analytical tools which should be applied on a societal level (Cai & Amaral, 2021). However using a combination of them offers the user more flexibility and provides a more comprehensive framework for empirical research (M. Ranga & Etzkowitz, 2013). Innovation systems theory looks at the entire innovation ecosystem. Innovation systems theory does not only consider the interaction between the three institutional spheres but also takes a look at the broader institutional and systemic context in which innovation occurs.

It was originally developed because there was a need for a new kind of economic theory, with a different perspective on economic policy in which innovation and learning were seen as the driving factors behind economic growth and welfare (Lundvall, 2007).

Innovation systems theory was later refined as national innovation systems (NIS) theory (M. Ranga & Etzkowitz, 2013). According to the NIS approach flow of technology and information among people,

enterprises and institutions is key to the innovative process. Technology and innovation development are a consequence of a complex set of relationships among actors in the system such as firms, universities, financial institutions etc (M. Ranga & Etzkowitz, 2013). The concept of NIS reflects the belief that the pattern of innovation varies across countries and that such differences can be explained by systemic features (Lundvall, 2016). An understanding of the NIS can help policymakers identify leverage points for increasing the innovative performance and overall competitiveness. NIS can help in identifying mismatches within the system, both in relation to government policy as well as among institutions, which can encourage technology development and innovation (M. Ranga & Etzkowitz, 2013). NIS also rest on the idea that the innovative performance of a country depends to a large extent on how these actors relate to each other as elements of a larger collective system of knowledge creation and use, and technology use (M. Ranga & Etzkowitz, 2013).

Triple Helix and Innovation systems theory, are theories that are often mixed up (Cai & Lattu, 2022). However, the Triple Helix Framework is based on Occam's razor principle and Simmel's triadic interaction (Cai & Lattu, 2022). Innovation systems theory is based on general systems theory (Cai & Lattu, 2022).

Although no factors that contribute to a successful Triple Helix collaboration were taken directly from innovation systems theory. Factors were taken from Triple Helix systems theory, which is a combination of National innovation systems theory and the Triple Helix framework.

To conclude both Triple Helix as well as Innovations systems theory are analytical tools which should be applied on a societal level (Cai & Amaral, 2021). However using a combination of them offers the user more flexibility and provides a more comprehensive framework for empirical research, which is why a combination of both theories known as Triple Helix systems is used (M. Ranga & Etzkowitz, 2013).

3.1.3 Triple Helix Systems

It is possible to combine the structural characterization, structure and process of innovation systems, with Triple Helix, and form an approach called Triple Helix systems (M. Ranga & Etzkowitz, 2013). When synthesising the Triple Helix interaction into an innovation systems format it is defined by; Components (and boundaries), relationships among system components, and functions of the system.

In Triple Helix systems and innovation systems theory, the market and (non)-market relationships between components are of importance, which are primarily manifested through technology transfer or acquisition (M. Ranga & Etzkowitz, 2013). Other relationships derived from the triadic nature of the interaction can be included, such as: collaborative leadership, collaboration and conflict moderation, and substitution (M. Ranga & Etzkowitz, 2013). These relationships are significant as they reflect evolutionary social, change-inducing and economic mechanisms at play in the Triple Helix interaction (M. Ranga & Etzkowitz, 2013).

The function of a Triple Helix system is that of generating, diffusing and using knowledge and innovation (M. Ranga & Etzkowitz, 2013). This differs from the main function of innovation systems theory, which is generating, diffusing and utilizing technology (M. Ranga & Etzkowitz, 2013). Triple Helix systems goes beyond the technology and include more competencies than the four described by innovation systems theory (learning abilities, selective, technical and organisational) and include societal, entrepreneurial, policy and cultural characteristics (M. Ranga & Etzkowitz, 2013).

3.1.3.1 Single-sphere and multi-sphere institutions

Single-sphere and multi-sphere (hybrid) institutions are a part of the Triple Helix systems theory (Cai & Amaral, 2021; M. Ranga & Etzkowitz, 2013). Single-sphere institutions refer to, an institutional sphere which can be industry, government or university, which are characterized by rigid institutional boundaries, with low levels of interaction with other institutional spheres (Cai & Amaral, 2021; M. Ranga & Etzkowitz, 2013). Multi-sphere (hybrid) institutions, are institutions that operate at the junction

of the university, industry, and government spheres, and have characteristics of each of the spheres (Cai & Amaral, 2021; M. Ranga & Etzkowitz, 2013). These type of institutions often exists in a model III configuration in which universities and other knowledge institutes act in partnership with government and industry and even take the lead in joint initiatives (Etzkowitz & Leydesdorff, 2000). In such a Triple Helix configuration there are no longer separated elements between university, industry, and government but unifying ones, boundaries identified in innovation systems take on a new meaning because of this (M. Ranga & Etzkowitz, 2013).

To conclude using a combination of Triple Helix and (national) innovation systems theory offers the user more flexibility and provides a more comprehensive framework for empirical research, which is why a combination of both theories known as Triple Helix systems is used (M. Ranga & Etzkowitz, 2013). Multi-sphere institutions are institutions that operate at the junction of the university, industry, and government spheres (Cai & Amaral, 2021; M. Ranga & Etzkowitz, 2013).

3.2 The three phases

Upon reviewing the literature on Triple Helix collaborations, various factors emerged that could be categorized into three distinct phases. These phases correspond to the different stages of a collaboration: start, partner selection and execution. Below, the factors that were identified in the literature associated with each phase will be described.

3.2.1 Start

The starting phase in a collaboration refers to the phase in which the first initiatives are taking place, in this phase a first idea for the potential collaboration is starting to form, yet concrete plans are still missing. In the starting phase, only one factor was identified in the literature, which is having an innovation organiser present. The innovation organiser plays a pivotal role in orchestrating a blend of bottom-up and top-down initiatives, facilitating economic and social development, and securing consensus and support for the realization of the collaboration (M. Ranga & Etzkowitz, 2013).

3.2.1.1 Innovation organiser

The innovation organiser is an individual identified in the literature on individual and institutional innovators. Individual and institutional innovators are a part of the Triple Helix systems theory. Innovation system theory uses institutions as a key explanatory factor as to why certain regions, countries or sectors have better innovation processes (M. Ranga & Etzkowitz, 2013). Originally Innovation systems theory heavily focuses on institutional innovators, which are seen as key explanatory mechanisms in the innovation process (M. Ranga & Etzkowitz, 2013). However, this could result in limited visibility for individual innovators. Hence, the Triple Helix systems also emphasize the significance of recognizing individual innovators such as the innovation organiser.

An innovation organiser initiates a Triple Helix collaboration by bringing together all relevant stakeholders and helps mobilize resources that were previously untapped (Etzkowitz, 2003). Innovation organisers typically come from a key institutional position. Their role is to coordinate a mix of bottom-up and top-down initiatives processes, economic and social development, and ensure agreement and support for the realization (M. Ranga & Etzkowitz, 2013). An innovation organiser is a person that has sufficient authority and respect to bring the leadership of the institutional spheres together (M. Ranga & Etzkowitz, 2013).

3.2.2 Partner selection

The partner selection phase refers to the phase after the first initiatives are taken and there is a clear idea for the collaboration, in the partner selection phase, partners for the collaboration are selected. The partner selection phase is important since an inability to select the right partners for a collaboration leads to opportunistic behaviour, failure of the collaboration and reluctance to collaborate (Arsanti et al., 2022; Razak & White, 2015). Three factors were identified in the literature as important for a successful Triple Helix collaboration; complementarity, compatibility and trust (Arsanti et al., 2022). Complementarity

refers to institutions having complementary assets which were not identical but were interdependent and mutually encouraging (Useyin Tanriverdi & Venkatraman, 2005). The literature cited complementary resources as a motivating factor for engaging in a collaboration (Arsanti et al., 2022; Useyin Tanriverdi & Venkatraman, 2005). Compatibility between partners could be investigated through a variety of different criteria like strategic and relational long-term orientation, cultural and organisational characteristics, values, norms, and mindsets (Arsanti et al., 2022; Razak & White, 2015). Compatibility was identified in the literature as a factor because it affects how valuable the parties perceived each other's knowledge (Arsanti et al., 2022). Trust was identified as an essential factor within a Triple Helix collaboration because it holds the potential to effectively navigate the unpredictable challenges associated with utilizing relationships when other parties are used to achieve goals (Arsanti et al., 2022).

3.2.2.1 Complementarity

Complementarity is described as complementary assets which are not identical, but are interdependent and mutually encouraging (Useyin Tanriverdi & Venkatraman, 2005). Businesses are inclined to engage in partnerships when possible partners possess resources that complement the company's existing capabilities and can be utilized alongside its own resources (Arsanti et al., 2022). While the complementary nature of external resources has the potential to enhance innovative capacity, it does not ensure the seamless progression of interactions throughout a collaboration (Arsanti et al., 2022). Being transparent about what each partner wishes to contribute, what resources they possess and the expected benefits of the collaboration is also one of the rules described by Dankbaar (2019). Dankbaar (2019) explains that these contributions should be specified in detail.

3.2.2.2 Compatibility

Compatibility between companies can be investigated through a variety of different criteria like, strategic and relational long-term orientation, cultural and organisation characteristics, values, norms and mindsets (Arsanti et al., 2022; Razak & White, 2015). By establishing a mutual understanding and shared approaches to collaboration, partners can cultivate and maintain positive interactions in a Triple Helix collaboration (Arsanti et al., 2022). Social ties, network memberships and allocation of resources are determinants in building a collaboration between institutions that last (Aiken & Hage, 1968).

One factor often mentioned as an important enabler of a good collaboration is cultural similarity (Santoro & Chakrabarti, 1999). Stronger collaborations take place for academics when there are shared habits, language, cultural traits and ways of working with the company employees (Razak & White, 2015).

Establishing compatibility between companies and universities in a Triple Helix collaboration can be challenging because companies prefer function-centred arguments while academics prefer technology-centred arguments (Razak & White, 2015). Universities tend to not be market-oriented, which leads to a disregard for the commercial and practical implications of most academic research products (Martin et al., 2000). There is also a difference in time standpoint in collaborations between academics and industry, with academia taking a long-term view in research while industry has a short-term view in research (Rossoni et al., 2023).

3.2.2.3 Trust

Trust in a collaboration determines what information is shared and what information is not shared between the partners. Trust is essential within a Triple Helix collaboration because it holds the potential to effectively navigate the unpredictable challenges associated with utilizing relationships when other parties are used to achieve goals (Arsanti et al., 2022). In the context of collaborative innovation, trust is a fundamental requirement and frequently plays a role in shaping the quality of the relationship (Arsanti et al., 2022).

Trust plays a pivotal role in any collaborative endeavour (Dankbaar, 2019). In a Triple Helix collaboration, partners are dedicated to achieving a common goal. Initially, it is reasonable to assume

that all partners are eager to collaborate. However, maintaining collaboration over time is a multifaceted process influenced by various factors beyond the partners' control, underscoring the importance of trust (Dankbaar, 2019).

Trust can be built through a variety of ways, it can be built through direct interactions or indirect interactions (Arsanti et al., 2022). Direct interactions are, for example, previous experiences or situational trust (Arsanti et al., 2022). Indirect interactions are for example reputation (Arsanti et al., 2022). Generally speaking, trust is based on predictability and past behaviour (Daronnat et al., 2021).

Trust in a Triple Helix collaboration can be increased by: establishing awareness of the expectations of all participating parties before commencement, maintaining transparency regarding the opportunities and constraints of each party, and fostering honesty and clarity about individual objectives (Bressers, 2012; Dankbaar, 2019).

3.2.3 Execution

The execution phase refers to the phase in which the tasks and plans are carried out and objectives are pursued. During the execution phase, the following factors were identified as essential in the literature: conflict, collaborative leadership, evaluator and traits of the government/ industry/ university. Conflict refers to having the right type of conflict, which is task conflict. Task conflict is content-driven and takes place because of differences of opinion in an organisation's functional department (Amason & Sapienza, 1997). Task conflict has a positive effect on innovative capabilities, as it causes the reconsideration of the dominant perspective and beliefs in an organisation, whilst allowing new original viewpoints (Amason & Sapienza, 1997). Collaborative leadership is a fundamental part of collaboration and conflict moderation (M. Ranga & Etzkowitz, 2013). Collaborative leadership is a management practice in which everyone is involved in making decisions that impact them. An evaluator is someone who provides transparency in the collaboration.

The Triple Helix framework is a framework developed for macro level being applied at the meso-level in this study. Complicating matters is the absence of explicit guidance within the Triple Helix framework regarding the specific traits that each sphere should possess to qualify as a Triple Helix institution. Consequently, it's more appropriate to consider the traits of institutions as guiding principles rather than strict requirements in this study.

3.2.3.1 Conflict

Effective conflict resolution holds significant importance in a collaborative setting, particularly when engaging with multiple partners, as seen in a Triple Helix collaboration. Proficient conflict resolution plays a crucial role in fostering successful and enduring collaborations.

Valuable analytical instruments for investigating conflict moderation within Triple Helix systems can be derived from the literature on organisational innovation and cross-functional collaboration (M. Ranga & Etzkowitz, 2013). In which two key conflict dimensions are characterized, task conflict and relationship conflict (de Clercq et al., 2009). Task conflict is content-driven and takes place because of differences of opinion in an organisation's functional department (Amason & Sapienza, 1997). Task conflict has a positive effect on innovative capabilities, as it causes the reconsideration of the dominant perspective and beliefs in an organisation, whilst allowing new original viewpoints. Relationship conflict is person-driven and is caused by incompatibilities between different personalities (Jehn & Mannix, 2001). Relationship conflict has a negative effect on both decision-making and high-quality knowledge exchange (Jehn & Mannix, 2001).

Because of cultural differences or diverging interests between the industry and universities relationship conflict can sometimes take place (M. Ranga & Etzkowitz, 2013). If not properly addressed it could impede the knowledge exchange and bring challenges to collaborative projects.

Conflict resolution involves more than just addressing institutional gaps and diverging institutional logic. It also requires improved monitoring of university-industry relationships and the dissemination of best entrepreneurial practices (Bjerregaard, 2010; Goldstein, 2010). Additionally, social skills and dialogue play a crucial role in managing expectations, addressing individual fears, and creating shared cultural spaces for knowledge exchange (Goldstein, 2010).

3.2.3.2 Collaborative leadership

Collaborative leadership is a fundamental part of collaboration and conflict moderation (M. Ranga & Etzkowitz, 2013). Collaborative leadership is a management practice in which everyone is involved in making decisions that impact them (Lawrence, 2017). Collaborative leadership is characterized by shared vision and values, interdependence, shared accountability, mutual respect, empathy and willingness to be vulnerable, comfort with ambiguity, effective communication and the creation of synergy (Lawrence, 2017). This means that collaborative leadership has some overlap with the previously mentioned factors. Shared vision and values are a significant part of the factor compatibility, while mutual respect and a willingness to be vulnerable contribute to building trust.

Innovation organisers whether as individual leaders or institutional figures, hold a pivotal position in this form of relationship. They have the ability to link individuals across various sectors, closing gaps, reconciling differing perspectives, fostering consensus, and managing conflicts of interest (M. Ranga & Etzkowitz, 2013). As a result, the innovation organizer frequently takes the lead in initiating collaborative leadership as a management approach (M. Ranga & Etzkowitz, 2013).

Dankbaar (2019) in his design rules for Triple Helix collaborations does not seem to agree with the idea of collaborative leadership as a management method for Triple Helix collaborations. Explaining that more formal management methods are needed that hold more power over the collaboration (Dankbaar, 2019). Project management according to Dankbaar (2019) should be independent of the participating parties. This contradicts the idea of collaborative leadership in which everyone is involved in making decisions that impact them.

3.2.3.3 Evaluator

The need for an independent evaluator was identified by Dankbaar (2019) as a necessary factor in Triple Helix collaborations. An evaluator needs to be present so the project can be objectively evaluated by all participants (Dankbaar, 2019). The evaluator needs to be independent of all participating parties (Dankbaar, 2019). The sole responsibility of the evaluator is to collect information about the collaboration for management (Dankbaar, 2019). The management information includes information on activities, progress reports, expectations and producing evaluation reports (Dankbaar, 2019). The evaluator's job is completely transparent, meaning all information is shared (Dankbaar, 2019).

3.2.3.4 The traits of the university in Triple Helix

When Etzkowitz & Leydesdorff originally developed the framework it revolved around the three spheres, university, industry and government. However, since then colloquially speaking with Triple Helix is meant, industry, government and knowledge institute, with a knowledge institute including the university. This means that the Dutch government includes all knowledge institutes in their legislation and subsidies regarding Triple Helix collaborations (*PPS-Toeslag Onderzoek En Innovatie*, n.d.). Because of this in the literature, the role or traits a knowledge institute should possess in a Triple Helix collaboration are completely absent. This is why the traits of the university will try to be applied to a knowledge institute.

In the framework of Triple Helix the concept of the entrepreneurial university is described (Lanskoronskis et al., 2009). In which the main role of the university is, to serve as a source for new knowledge and technology, thus forming the basis of a knowledge-based economy (Borges da Costa & Ladders, 2022). It should be noted that there are also various criticisms on the concepts. One is that in these concepts universities are treated as homogeneous entities that are interchangeable. While the

research and the university's third mission have a positive effect on one another, teaching is negatively affected by both (Taliento, 2022). Taliento (2022) suggested that universities should specialize in one mission as it allows for a better understanding of how various funding approaches and alternative models of governance can align with the strategic priorities of the university.

The Triple Helix framework emphasizes hybridity and with it hybridity of individuals. An often-heard example in Triple Helix is the possible hybrid role of scholars when they teach at the university and consult the industry (Etzkowitz & Zhou, 2017). An often-heard criticism of this is that there is a diminished focus on teaching students and there is a possibility of there being a conflict of interest using the university's resources and objectivity for the benefit of the industry (Boyer & Lewis, 1984).

Companies have to remain competitive, which partly depends on getting qualified labour (Borges da Costa & Lodders, 2022). Universities and other educational institutes need to understand the changing landscape, understand the changing market demand and consequently define and implement these alterations in their educational program (Borges da Costa & Lodders, 2022). This means that universities should develop their managerial structure, infrastructure and researchers to react flexibly to market needs (Lanskoronskis et al., 2009). The university needs to take an active stance and propose beneficial forms of cooperation to the industry and not wait for the industry to take the sole initiative (Lanskoronskis et al., 2009). Universities should develop, produce and apply advanced knowledge they developed (Zhou & Etzkowitz, 2021). Universities should not only fulfil educational and research functions but should also take on business functions by creating small innovative companies and becoming stakeholders in socio-economic development (Ivanova & Leydesdorff, 2014).

To conclude when the university enters a successful Triple Helix collaboration it likely possesses the following traits:

- (1) The development, production and application of advanced knowledge (Zhou & Etzkowitz, 2021).
- (2) React flexibly to market demands (Lanskoronskis et al., 2009).
- (3) Take initiative when entering cooperations with the market (Lanskoronskis et al., 2009).
- (4) Take a more active role in socio-economic development (Ivanova & Leydesdorff, 2014).
- (5) Hybridity of individuals and institutions (Etzkowitz & Zhou, 2017).

When examining these traits not all traits can be utilized for a knowledge institute. This is because not all knowledge institutes educate. Meaning concepts such as the entrepreneurial university cannot be applied to them, since knowledge institutes do not always educate and some do not have students. Traits one, three, four and five can all still apply for a knowledge institute.

3.2.3.4 The traits of the industry in Triple Helix

The industry is also known as the Triple Helix firm in the Triple Helix framework (Etzkowitz & Zhou, 2017). The boundaries of all institutional spheres are increasingly overlapping. Universities and governments used to only make indirect contributions to the industry by supplying trained personnel and providing laws for stable transactions (Etzkowitz & Zhou, 2017).

The industry increasingly creates its own research and training centres for employees (Ivanova & Leydesdorff, 2014). Hybridity is an important characteristic for firms in Triple (Etzkowitz & Zhou, 2017). Hybridity brings the firm more resources, by being able to use the resources from various institutional spheres (Etzkowitz & Zhou, 2017). However, it also brings increasing complexity as decisions need to be approved by all stakeholders (Etzkowitz & Zhou, 2017).

To summarize when the industry enters a successful Triple Helix collaboration it likely possesses the following traits:

- (1) Development of innovation and the application of them (L. M. Ranga et al., 2008; Zhou & Etzkowitz, 2021).

3.2.3.5 The traits of the government in Triple Helix

The government mainly functions as a facilitator in Triple Helix. The main trait of the government is to guarantee stable interactions and exchange, by for example giving contractual relations (Borges da Costa & Ladders, 2022). Key in this facilitatory role is that the government is present as a moderator rather than trying to control the collaboration, make policies that support innovation and organise platforms for communication and collaboration (Etzkowitz & Zhou, 2017; Zhou & Etzkowitz, 2021). The goal of the government should be to ensure all double Helixes and the Triple Helix function well (Etzkowitz & Zhou, 2017). The government is one of the main drivers of a Triple Helix by providing resources for academic research and driving demand on the other hand as a customer (Etzkowitz & Zhou, 2017).

Due to the generalized nature of Triple Helix, it has restricted explanatory power for many practical problems, especially when applied to many different contexts (Cai & Etzkowitz, 2020). This is especially true for applying the framework in the global south as the framework assumes that the government is stable, has resources to provide, can provide policies that are adhered to and can drive demand. The creators of this framework tried to tackle this issue by stating that hybridization can be used (Cai & Lattu, 2022). That means the other institutional spheres or other institutions can take on the traits of one another (Cai & Lattu, 2022). For example, in the global south donor organisations can partly take over the traits of the government (Cai & Lattu, 2022).

There are three different types of Triple Helix configurations. The first one is a Triple Helix I configuration, in which the government has a leading role, driving the university and industry. However, this also limits the university and industry to initiate and develop innovative ideas (Etzkowitz & Leydesdorff, 2000; M. Ranga & Etzkowitz, 2013). The Triple Helix II configuration consists of separate spheres with clearly defined boundaries. The industry is considered to be the driving force with government and academia acting as support (M. Ranga & Etzkowitz, 2013). In the Triple Helix III model universities and other knowledge institutes act in partnership with government and industry and even take the lead in joint initiatives (Etzkowitz & Leydesdorff, 2000). Each sphere maintains its primary role, organisations partly take on the roles of the other spheres (Bressers, 2012). In the areas where the spheres overlap, actors can partially substitute for one another (Ivanova & Leydesdorff, 2014). This last configuration is what the Triple Helix framework is based on. This is why there is such an emphasis on the government having a facilitatory role and not controlling.

To summarize when the government enters a successful Triple Helix collaboration it likely possesses the following traits:

- (1) Guarantee stable interactions and exchange (Borges da Costa & Ladders, 2022).
- (2) Be present as a moderator rather than control (Etzkowitz & Zhou, 2017).
- (3) Make policies to support innovation (Zhou & Etzkowitz, 2021).
- (4) Organise platforms for communication and collaboration (Zhou & Etzkowitz, 2021).

3.3 Framework

The literature from the previous chapter was combined and synthesized to form a framework which answers the question: “*What factors contribute to a successful Triple Helix collaboration in the Netherlands?*”

The framework is shown in Table 3.3.1 presents the factors necessary for a successful Triple Helix collaboration according to the literature described previously. These factors were categorized into three different phases; start, partner selection and execution phase. In table 3.3.1 a brief explanation is given about what each factor entails. In Chapter 4 Results the framework will be empirically tested using two case studies. The two case studies were identified as successful collaborations.

Phase	Factor	Explanation
Start	Innovation organiser	Orchestrates a blend of bottom-up and top-down initiatives, facilitating economic and social development, and securing consensus and support for the realization of the collaboration (M. Ranga & Etzkowitz, 2013).
Partner selection	Trust	Trust is established by: awareness of the expectations, transparency regarding the opportunities and constraints of each party, and fostering honesty and clarity about individual objectives (Bressers, 2012; Dankbaar, 2019).
	Complementarity	Having complementary assets which are not identical, but are interdependent and mutually encouraging in the collaboration (Useyin Tanriverdi & Venkatraman, 2005).
	Compatibility	Compatibility means having similar; strategic and relational long-term orientation, cultural and organisation characteristics, values, norms and mindsets (Arsanti et al., 2022; Razak & White, 2015).
Execution	Conflict	Have task conflict which is content-driven and takes place because of differences of opinion in an organisation's functional department (Amason & Sapienza, 1997).
	Collaborative leadership	Collaborative leadership is a management practice in which everyone is involved in making decisions that impact them (Lawrence, 2017).
	Evaluator	Responsible for providing transparency in the collaboration (Dankbaar, 2019)
	Traits of university (*knowledge institute trait 1, 3, 4, 5 apply)	(1) The development, production and application of advanced knowledge*, (2) react flexibly to market demands, (3) take initiative when entering cooperations with the market*, (4) take a more active role in socio-economic development* and (5) hybridity of individuals and institutions* (Lanskoronskis et al., 2009; Zhou & Etzkowitz, 2021).
	Traits of the industry	(1) Development of innovation and the application of them. (Etzkowitz & Zhou, 2017; L. M. Ranga et al., 2008; Zhou & Etzkowitz, 2021).
	Traits of the government	(1) Guarantee stable interactions and exchange, (2) be present as a moderator rather than control, (3) make policies to support innovation, (4) organise platforms for communication and collaboration (Borges da Costa & Ladders, 2022; Etzkowitz & Zhou, 2017; Zhou & Etzkowitz, 2021).

Table 3.3.1 Framework for a successful Triple Helix collaboration

4. Empirical analysis

In Chapter 3, I identified the factors contributing to a successful Triple helix collaboration according to the literature. The framework that was conceptualized at the end of chapter 3 will be empirically tested in this chapter. The factors will be presented in order of the three phases identified in the literature: start, partner selection and execution.

For this two case studies will be used which were both identified as successful collaborations by participating interviewees. To protect the anonymity of the participants the two case studies will be named the smaller case study and the larger case study. Due to the different sizes of the collaborations. A collaboration is considered successful when the objectives are met or surpassed (Brockhoff & Teichert, 1995). There are two different types of objectives in a collaboration, objectives relating to individual projects or the ongoing relationship within collaboration exploring areas of new technological knowledge (Brockhoff & Teichert, 1995). The objectives of a collaboration can change over time. The success of a collaboration depends on the use and impact of its newly acquired knowledge (Brockhoff & Teichert, 1995).

The objective of the smaller collaboration was an objective relating to an individual project. This means the objective of the smaller collaboration was the successful finalization of a project surrounding an environmental technology. This was different from the larger collaboration, whose objective was to have ongoing relationships exploring areas of new technological knowledge in the mobility sector. This means the objective of the larger collaboration, is to have a collaboration that lasts indefinitely while exploring areas of new technological knowledge together. The larger collaboration did have intermediate objectives which needed to be met for the collaboration to move to the next stage. This means that the smaller collaboration has a clear ending of the collaboration, while the larger collaboration does not. Both of these objectives were met to the extent that they could be met. The smaller collaboration successfully finalised the project, with the publication of a research article that was positive about the innovation developed by the industry partner. The larger collaboration is still ongoing, with the intermediate objectives being met and moving along to the next stages.

The collaborations varied in size and institutions present. To give an idea of the variation in size, both had Growthfunds spin-off projects. However, the scale of the Growthfunds spin-offs varied greatly, with the spin-offs from the smaller project being worth a couple of million, while the spin-offs of the larger are worth approximately 800+ million. Spin-offs in most cases only occur when the participants of a collaboration are positive about the previous outcomes (Dankbaar, 2019).

The collaborations varied in composition: the smaller one included only a knowledge institute, while the larger one encompassed both a knowledge institute and a university. It is important to note that in this study when referring to a knowledge institute, it pertains to an institution solely focused on knowledge dissemination without an educational component. Conversely, when mentioning a university, which also falls under the category of a knowledge institute, it will simply be referred to as a university.

That the smaller collaboration only includes a knowledge institute contradicts the Triple Helix literature, which stipulates the necessity of a university's presence in such collaborations. This decision was made because the Dutch government promotes collaborations among industry, government, and knowledge institutes, labelling them as Triple Helix collaborations.

Using two Triple Helix collaborations with different characteristics will offer insight into the extent to which such a generic framework is genuinely universally applicable.

In the smaller collaboration, a total of six actors were present, and five of these participants were interviewed. The smaller collaboration centred around researching an environmental technology that

was developed by the industry partner in the collaboration. Each participant was interested in the possible impact the product could have on the environment.

Interview	Industry	Government	knowledge institute	Length
Government 1	/	X	-	99 min
Industry 1	X	-	-	35 min
Knowledge Institute 1	-	-	X	32 min
Government 2	-	X	-	29 min
Government 3	/	X	-	68 min

Table 4.1 Participants of the smaller collaboration

Table 4.1 shows who was interviewed from the smaller collaboration and to which institutional sphere they belonged. In a Triple Helix collaboration, institutions will exhibit different traits depending on the sphere they belong to. These traits will be elaborated on in section 4.3.4. It can be seen that there are multiple multi-sphere institutions present in the collaboration.

Interviewed	Industry	Government	University	Knowledge institute	Length
Government 4	/	X	-	-	50 min
Industry 2	X	-	-	-	74 min
Industry 2	X	-	-	-	28 min
Industry 3	X	-	-	-	25 min
University 1 & 2	-	-	X	-	42 min / 31 min
Knowledge Institute 2	-	-	-	X	49 min
Government 5	-	X	-	-	44 min

Table 4.2 Participants of the larger collaboration

It is shown in Table 4.2 who was interviewed from the larger collaboration and to which sphere they belonged. In a Triple Helix collaboration, institutions will exhibit different traits depending on the sphere they belong to. These traits will be elaborated on in section 4.3.4. It can be seen that there was only one multi-sphere institution present in the collaboration originally. In the original collaboration, ten actors were present, and only seven different actors were interviewed. Two individuals from the same university were interviewed, both of whom were involved in the collaboration at different levels. Meaning a total of eight interviews were done in the larger collaboration.

I present the results according to the three phases created for the framework: start, partner selection and execution. In section 4.1 the start of the collaboration is investigated. It elaborates on what is necessary at the start of a Triple Helix collaboration. Next in section 4.2, I investigated how partners were selected in these collaborations. These findings were examined in light of the factors identified earlier in the literature. In section 4.3 I investigated what factors were important in the execution phase of the collaboration, which were tested against the findings from the literature. Section 4.4 reflected, adjusted and deepened the framework created in the previous chapter by using these findings.

4.1 The start of the collaboration

Phase	Factor	Explanation
Start	Innovation organiser	Orchestrates a blend of bottom-up and top-down initiatives, facilitating economic and social development, and securing consensus and support for the realization of the collaboration (M. Ranga & Etzkowitz, 2013).
	Unprofitable top	Having an institution present, most likely a government institution, that can invest resources that do not need to yield returns.

Table 4.1.1 Factor for the starting phase

In Table 4.1.1 two factors are shown. One was identified in the literature, the need for an innovation organiser. This however contrasts the empirical findings, which are highlighted in green in Table 4.1.1. The empirical findings also explain the need for an actor to deal with the ‘unprofitable top’. The unprofitable top was not mentioned in the literature but was mentioned in the larger collaboration, it is someone who can invest resources that do not need to yield returns but are needed to initiate the collaboration.

This means that during the start of the collaboration, two factors are of importance: the presence of an innovation organiser and someone to take care of the unprofitable top.

4.1.1 Innovation organiser

Both collaborations started when a party recognized that multiple individuals shared common questions (Knowledge Institute 1, 2023, Industry 1, 2023; Industry 2, 2023; Government 4, 2023). The innovation organiser is a key position because they take the initiative in the collaboration, tend to do most of the coordinating and ensure agreement and support for the realization of the collaboration (M. Ranga & Etzkowitz, 2013). An innovation organiser is a person that has sufficient authority and respect to bring the leadership of the institutional spheres together (M. Ranga & Etzkowitz, 2013). The innovation organiser in both cases took the first initiative and connected the different institutions to each other.

The role of innovation organiser in the smaller collaboration was for the most part executed by Government 2 and partly by Knowledge Institute 1 (Knowledge Institute 1, 2023; Industry 1, 2023; Government 3, 2023; Government 2, 2023). Government 2 was able to connect the different actors and ensured agreement for the realization of the collaboration. In the larger collaboration, the primary innovation organiser was Government 4, with partial involvement from Industry 2 (Industry 2-4, 2023; Government 4-5, 2023; Knowledge Institute 2, 2023; University 1-2, 2023). Government 4 together with Industry 2 took the first initiative and connected the different actors. This is all in line with what the literature proposed an innovation organiser should do.

4.1.2 Unprofitable top

In the larger collaboration, something that was not mentioned in the literature is the need for someone, most likely the government, to invest in the “Unprofitable top” (Government 5, 2023; Government 4, 2023). The unprofitable top refers to an actor, most likely a governmental institution, having to invest resources that do not need to yield returns but are needed to initiate the collaboration (Government 5, 2023; Government 4, 2023).

*“Well, as a *Name government 5*, you can sometimes assist in terms of facilitating. This may involve lobbying for regulations, providing in-kind support, just brainstorming based on experience, expertise, and so on, putting things on a national agenda, or even providing some initial funding or financial resources to make those necessary things happen. We actually call that **the unprofitable top—money that doesn't yield returns but needs to be invested to get things up and running.**” (Government 5, 2023).*

The concept of the unprofitable top shares a resemblance to the individual the innovation organiser, both have a proactive role in organising the collaboration. The innovation organiser can be the institution that invests in the unprofitable top.

To conclude although only the factor, innovation organiser, needed to be present according to the literature, the empirical study found that there was also the factor of the unprofitable top. Both case studies had innovation organisers present that coordinated, and ensured agreement and support for the collaborations. The unprofitable top refers to the need for someone, most likely a government institution, to invest money that does not yield returns.

4.2 Partner selection

Following the start of the collaboration, the next phase is partner selection. The interviewees emphasized the importance of partner selection (Industry 1, 2023; Industry 3, 2023; Government 2, 2023; Government 3, 2023; Government 5, 2023). An inability to select the right partners for a collaboration leads to opportunistic behaviour, failure of the collaboration and reluctance to collaborate (Arsanti et al., 2022; Razak & White, 2015).

Phase	Factor	Explanation
Partner selection	Trust	Trust is established by: awareness of the expectations, transparency regarding the opportunities and constraints of each party, and fostering honesty and clarity about individual objectives (Bressers, 2012; Dankbaar, 2019).
	Complementarity	Having complementary assets which are not identical, but are interdependent and mutually encouraging in the collaboration (Useyin Tanriverdi & Venkatraman, 2005).
	Compatibility	Compatibility means having similar; strategic and relational long-term orientation, cultural and organisational characteristics, values, norms and mindsets (Arsanti et al., 2022; & White, 2015a).
	Interest	Being aware of one's own interests and transparently communicating them to one another.

Table 4.2.1 Factors in the Partner Selection Phase

Table 4.2.1 presents the three factors identified as essential during the partner selection phase according to the literature, which are unmarked, and the factor highlighted in green, which was included based on empirical findings. Alongside the three previously identified factors — trust, complementarity, and compatibility— an additional factor, interest, emerged.

The literature did not emphasize the importance of complementarity of interest as a significant factor, which contrasts the empirical findings in both case studies. Complementarity of interest was also suggested as a means to prevent conflicts by interviewees, and as a way to address contradicting interests before they can escalate into conflicts. Conflict moderation will be further touched upon in section 4.3.1.

4.2.1 Trust

Both the literature and empirical findings highlight that trust in a collaboration determines what information is shared and what information is not shared between the partners (Arsanti et al., 2022). Trust is essential within a Triple helix collaboration because it holds the potential to effectively navigate the unpredictable challenges associated with utilizing relationships when other parties are used to achieve goals (Arsanti et al., 2022).

*“I think that's also what characterizes a successful collaboration. Informal, **trust**, openness, and a common goal, but also the shared motivation to get started and make something beautiful out of it.”* (Government 5, 2023).

The interviewees expressed that trust was also needed to be able to express the individual interests of the partners (Government 2, 2023; Industry 2, 2023; Government 5, 2023; Government 4, 2023). Openness in communication is required in these types of collaborations (Government 2, 2023; Industry 2, 2023; Government 5, 2023; Government 4, 2023)(Bressers, 2012).

“Openness, openness about what you can do, what you want, but also what you can't do, and where you need help.” (Industry 2, 2023).

Trust serves as a cornerstone for fostering openness and transparency within a Triple Helix collaboration. These qualities are imperative for factors such as interest, collaborative leadership, and evaluator. Hence, trust significantly influences these factors as well.

Trust plays a crucial role in Triple Helix collaborations, particularly because participants lack power over one another (Government 4, 2023) (Dankbaar, 2019). It was emphasized in both the literature and empirical study that trust is essential in the early stages of collaboration when contracts are not signed yet (Government 4) (Dankbaar, 2019). Contracts were signed in both cases, but participants were still able to leave the collaboration if they wished (Industry 1, 2023; Government 2, 2023; Government 4, 2023).

In both cases, trust was established through indirect interactions, as almost every partner was acquainted with the reputation of the others (Government 3, 2023; Government 2, 2023; Government 4, 2023). Given the positive reputation they had heard, they felt more assured when entering the collaboration (Government 3, 2023; Government 2, 2023; Government 4, 2023). There was also trust due to direct interactions, in the case of the larger collaboration the partners had worked together in the past on other technologies (University 1, 2023; Industry 4, 2023; Government 4, 2023; Industry 3, 2023). In both cases, it was emphasized that there was a period needed to build trust at the beginning of the collaboration (Government 2, 2023; Government 4, 2023; Knowledge Institute 2, 2023).

*“The focus is to **become friends first**. First make sure you get along with each other and respect each other's interests.”* (Government 2, 2023).

A pitfall in building trust at the beginning of collaboration is that it might turn into a chitchat club and nothing will come off of it (Knowledge Institute 2, 2023; Industry 3, 2023).

*“**We don't want to be a chitchat club**; there are already enough chitchat clubs. And yes, we can't do anything with that, and companies can't do anything with that either. So, we want to focus on projects; that's actually the first step we've taken.”* (Knowledge Institute 2, 2023).

At the beginning of the larger collaboration, there was some reluctance from companies to share information (Knowledge Institute 2, 2023). As trust in the collaboration increased, this reluctance to share information decreased (Knowledge Institute 2, 2023).

To conclude trust was identified in both the literature and empirical study as a necessary factor (Arsanti et al., 2022; Bressers, 2012; Dankbaar, 2019). The empirical study highlighted the importance of trust for individuals to articulate their interests and engage in open communication. Both the literature and empirical study emphasized the importance of trust because participants lack power over one another (Government 4, 2023) (Dankbaar, 2019). A pitfall emphasized in the empirical study is that excessive focus on building trust may lead to the formation of a mere chitchat club.

4.2.2 Complementarity

Complementarity is described as complementary assets which are not identical, but are interdependent and mutually encouraging (Useyin Tanriverdi & Venkatraman, 2005). Businesses are inclined to engage in partnerships when possible partners possess resources that complement the company's existing capabilities and can be utilized alongside its resources (Arsanti et al., 2022). This aligns with the empirical findings, complementary resources were often given as the reason for entering both

collaborations (Knowledge Institute 1, 2023; Industry 1, 2023; Industry 3, 2023; Government 2, 2023; Government 5, 2023).

*“But by working together you see that willingness grows and that people start to see, hey, this works, but then we can indeed **be stronger together**”* (Knowledge Institute 2, 2023).

The participant aimed to attain something in the collaboration that they could not do on their own.

*“These are the parties you need to make it possible, that was evident. **We couldn't have cut anyone out of it**”* (Government 1, 2023).

Complementarity is a factor intertwined with trust and interest. It requires trust to be able to be transparent about what each partner wishes to contribute (Dankbaar, 2019). It is intertwined with interest because the interests that will be identified need to be complementary to each other. Contradictory interest will likely cause conflict. However, due to the emphasis by participants on interest, interest was introduced as a separate factor in 4.2.4 Interest. This was done due to the insufficient emphasis on the significance of interest in the literature concerning complementarity.

To conclude both the literature and empirical study underscore the importance of complementarity in Triple Helix collaborations. Initially, complementarity of interest was recognized in the literature. However, given the significance placed on interest in the empirical study, it will be addressed independently in section 4.2.4 Interest.

4.2.3 Compatibility

Compatibility was emphasized both in the literature and empirical study as an important factor. Compatibility between partners can be investigated through a variety of different criteria like, strategic and relational long-term orientation, cultural and organisation characteristics, values, norms and mindsets (Arsanti et al., 2022; Razak & White, 2015). By establishing a mutual understanding and shared approaches to collaboration, partners can cultivate and maintain positive interactions in a Triple Helix collaboration (Arsanti et al., 2022). In both cases, there was good compatibility between the institutions. In the larger collaboration, the ‘*name region*’ culture of informal and direct communication was mentioned as an important factor (University 2, 2023).

*“Within *name region*, it's easy, right? Because then you have the community with the same objectives, and you **speak the same language** with a similar background.”* (Government 5, 2023).

In the smaller collaboration, they emphasised the importance of bringing together the right kind of people, people who were innovative, creative and searching for answers (Government 3, 2023).

*“Yes, occasionally you don't speak each other's language, but what I found enjoyable is that we quickly discovered, through engaging in such a collaborative project, that you develop a shared narrative. And at a certain point, it no longer matters who stood where. **We all had the same story**. And, at that point, you couldn't tell anymore if someone was a government official, someone from the business sector, or someone from an academic institution. It had all just blended together.”* (Government 2, 2023).

The literature expressed that establishing compatibility between companies and universities in a Triple Helix collaboration can be challenging because companies prefer function-centred arguments while academics prefer technology-centred arguments (Razak & White, 2015). This is because universities tend to not be market-oriented, which leads to a disregard for the commercial and practical implications of most academic research products (Martin et al., 2000). However, in contrast to the literature, no friction between the companies and universities/knowledge institutes was expressed.

The literature highlighted that there is also a difference in time standpoint in collaboration between academics and industry, with academia taking a long-term view in research while industry has a short-term view in research (Rossoni et al., 2023). This contrasted the empirical findings in which a difference

in time standpoint between industry and research was not observed. However, there was a difference in time standpoint observed between the government and the university (University 1, 2023). With the government taking a long-term view and the university taking a short-term view (University 1, 2023).

To conclude in both the literature and empirical study compatibility between institutions was identified as an important factor. In the empirical study, similar working cultures and long-term orientations were given as reasons for the success of the collaboration.

4.2.4 Interest

Interest, while briefly mentioned in the literature, was not underscored to the extent observed in both empirical studies. With interest being mentioned by almost all participants (Industry 1-7, 2023; Government 4-12, 2023). Dankbaar (2019) initially noted the surprising lack of attention given to diverging interests in the original literature on Triple Helix collaborations. However, in the subsequent rules identified by Dankbaar (2019), the consideration of interest or the potential for diverging interests is largely overlooked.

*“We have always been aware that everyone had their **own interest**, but that the common denominator lay in the **overlap of those interests**.”* (Government 2, 2023).

Expressing their shared interests created clarity as to why they entered the collaboration and what a successful collaboration meant. By expressing their interests, everyone gained a clear understanding of what success meant for each participant in the collaboration (Industry 1, 2023; Industry 3, 2023; Government 2, 2023; Government 4, 2023; University 1, 2023). It also created awareness of possibly conflicting interests before it could turn into a conflict.

*“It rarely clashes, but the **conflicting interests do exist**, so we (we refer to the university) prefer to share all our knowledge openly, while companies, to remain competitive, ideally prefer not to disclose any of its knowledge.”* (University 2, 2023).

Expressing interest has as a benefit that partners that add very little are exposed (Industry 3, 2023). This also ties in with the factor of complementarity.

*“And we are also trying to create more and more awareness that subsidies are good, but **it still has to come from ourselves**, our own knowledge, efforts, to achieve something. And if you are then assisted by a subsidy, that's always fine, but it should never be the sole objective.”* (Industry 3, 2023).

Triple Helix collaborations are often subsidized collaborations in the Netherlands. The participants had experiences with other companies entering a collaboration, with the sole objective of getting a subsidy which is unwanted (Knowledge Institute 2, 2023; Industry 3, 2023).

To conclude interest, while briefly mentioned in the literature, was not underscored to the extent observed in the empirical study. Interest pertains to the necessity of raising awareness of one's own interests and transparently communicating them to one another.

It can be concluded that for the partner selection phase: complementarity, compatibility, interest and trust are the factors that are needed for a successful Triple Helix collaboration. The literature did not emphasize the importance of interest as a significant factor, which contrasts the findings in both case studies.

4.3 Execution phase of the collaboration

Phase	Factor	Explanation
Execution	Conflict	Have task conflict which is content-driven and takes place because of differences of opinion in an organisation's functional department (Amason & Sapienza, 1997).
	Collaborative leadership	Collaborative leadership is a management practice in which everyone is involved in making decisions that impact them (Lawrence, 2017).
	Evaluator	Responsible for providing transparency in the collaboration (Dankbaar, 2019)
	Traits of university (*knowledge institute trait 1, 3, 4, 5 apply)	(1) The development, production and application of advanced knowledge*, (2) react flexibly to market demands, (3) take initiative when entering cooperations with the market*, (4) take a more active role in socio-economic development* and (5) hybridity of individuals and institutions* (Lanskoronskis et al., 2009; Zhou & Etzkowitz, 2021).
	Traits of the industry	(1) Development of innovation and the application of them. (Etzkowitz & Zhou, 2017; L. M. Ranga et al., 2008; Zhou & Etzkowitz, 2021).
	Traits of the government	(1) Guarantee stable interactions and exchange, (2) be present as a moderator rather than control, (3) make policies to support innovation, (4) organise platforms for communication and collaboration (Borges da Costa & Lodders, 2022; Etzkowitz & Zhou, 2017; Zhou & Etzkowitz, 2021).

Table 4.3.1 Factors for the execution phase

After partner selection, the next phase is the execution phase of the collaboration. There were four factors identified in the literature, these are also shown in Table 4.3.1: conflict, collaborative leadership, evaluator and the Triple Helix traits. In the empirical study, only two of these four were identified: collaborative leadership and Triple Helix traits. The factors that were deleted based on the empirical findings are highlighted in orange in Table 4.3.1. However, the case studies did elaborate that collaborative leadership is only an effective management method when the collaboration is not too large. This contradicts the literature's findings, which suggest that collaborative leadership is an effective management method in all Triple Helix collaborations. There was no empirical evidence that suggested that task conflict had a positive influence on the collaboration. There was also no empirical evidence indicating the necessity of having an evaluator present in the collaboration.

According to the Triple helix framework each sphere has different traits it could possess. In the Triple Helix framework, the government plays a dominant role, possessing the most traits within the framework. The government was also the only sphere whose traits almost fully aligned with the empirical study. In the smaller collaboration, the knowledge institute did not exhibit most of the traits outlined in the literature. However, this did not hinder the quality of the collaboration, as all involved parties remained positive about the role played by the knowledge institute. Conversely, in the larger collaboration, both the university and knowledge institute exhibited all of these traits, which did appear to impact the success of the collaboration.

4.3.1 Conflict

A part of collaboration and conflict moderation is the different types of conflict. There are two types of conflict, task conflict and relationship conflict. In a collaboration task conflict is wanted, and relationship conflict is unwanted (Jehn & Mannix, 2001). Relationship conflict is person-driven and is caused by incompatibilities between different personalities (Jehn & Mannix, 2001). Relationship

conflict harms decision-making and high-quality knowledge exchange (Jehn & Mannix, 2001). There was no mention of relationship conflict taking place in both case studies.

Task conflict is content-driven and takes place because of differences of opinion in an organisation's or institutions functional department (Amason & Sapienza, 1997). Task conflict has a positive effect on innovative capabilities, as it causes the reconsideration of the dominant perspective and beliefs in an organisation, whilst allowing new original viewpoints (Amason & Sapienza, 1997). Task conflict did take place in both collaborations. The smaller collaboration was delayed due to being unable to get the right permits (Knowledge Institute 1, 2023). Due to this delay interviewees experienced time pressure to reach certain goals (Knowledge Institute 1, 2023; Government 1, 2023). In the interview with Government 1, they referred to what conflicts did take place in the smaller collaboration as:

*“The bumps I refer to have mainly proven to be very **practical**”.*

In the larger collaboration, the task conflict that happened was mostly on administrative matters (Industry 4, 2023). In the interview with University 2, they explained the conflict moderation in the larger collaboration as:

*“**Identifying the pain points** and then, yes, having a cup of coffee over it, expressing it, and trying to **think in terms of Win-Win.**”*

However, none of the interviewees expressed that these conflicts had a positive effect on the collaboration or their innovative capabilities. This contrasts the findings in the literature, which suggested that task conflict should have a positive effect on innovative capabilities.

When it came to conflict resolution in the interview with Government 4 in the smaller collaboration they had to say:

*“Solve. Discuss. Let go. Overcome your **own fears.**”*

This is similar to what was said in the interview with Industry 2 in the larger collaboration:

*”And then being able to step over your **own ego**, I mean organisational ego, not personal ego but organisational ego.”*

To conclude the empirical findings did not support the literature in that task conflict has a positive effect on innovative capabilities. Both cases experienced conflict but stressed the importance of overcoming personal fears or egos as a vital step in conflict resolution.

4.3.2 Collaborative leadership

Collaborative leadership is a fundamental part of collaboration and conflict moderation (M. Ranga & Etkowitz, 2013). Collaborative leadership is a management practice in which everyone is involved in making decisions that impact them (Lawrence, 2017). Collaborative leadership was identified in both the literature and empirical study as a necessary factor for a successful Triple Helix collaboration. However, the case studies did elaborate that collaborative leadership is only an effective management method when the collaboration is not too large. An added benefit of collaborative leadership that was not highlighted in the literature but was mentioned in the interviews was that it increases the agility of the collaborations.

In the smaller collaboration, participants had the perception that everybody was equally responsible for the collaboration (Government 3, 2023; Government 2, 2023). Problems during the smaller collaboration were tackled as a collective and were perceived as “Shared challenges” (Knowledge Institute 1, 2023).

In the smaller collaboration, there was not a project leader, there was a project group which discussed progress, results and new developments (Government 3, 2023). This corresponds with the findings in

the literature stating that collaborative leadership is a management practice in which everyone is involved in making decisions that impact them (Lawrence, 2017).

*“How we manage it? ...-Yes, **anarchist is perhaps too strong a word**, but a bit just in **mutual agreement actually**”* (Knowledge Institute 1, 2023).

There were also perceived downsides to this type of management method in the smaller collaboration.

*“It may have been a bit **too informal**, saying that people maybe should have been a bit more involved or a bit more like, ‘Hey, are you paying attention?’ Sometimes a bit too passive, and maybe we missed out on something in that regard. So, is that- is a drawback. But it's challenging because **you are equals in such a...** Yes, you beautifully refer to it as a Triple Helix collaboration.”* (Knowledge Institute 1, 2023).

Another perceived downside was that the research question, goal and future of the project were not always clear (Government 3, 2023). However, each participant was positive about the smaller collaboration often noting that they did not think another management technique would have improved the collaboration (Knowledge Institute 1, 2023; Industry 1, 2023; Government 3, 2023).

The beginning of the larger collaboration was managed in a similar informal manner (Government 5, 2023; Industry 4, 2023). As the collaboration grew and more projects were created in the larger collaboration, management methods became more formal, with steering committees and project managers (Government 4, 2023; Industry 3, 2023). Even when management became more formal in the collaboration, there was still no hierarchy as all participants were considered equal in a Triple helix collaboration (Government 4, 2023). An added benefit of having very little hierarchy within a collaboration is that the communication lines were short (University 2, 2023). This facilitated swift communication among the relevant individuals beyond their respective organisations in the larger collaboration even when the collaboration increased in size (University 2, 2023).

*“Yes, collaboration (collaboration was translated from *samenwerken*, which consists of the words together and working), the word says it all, right? You have to do something together. **Together, work.** I think that might be the most beautiful summary for *name collaboration*. And if it works, that's a nice bonus too. And, coincidentally, it did. Coincidence does not exist there were just the right people. That is together right?”*(Government 2, 2023).

An added benefit of collaborative leadership that was not highlighted in the literature, but was in the interviews, was it increases the agility of the collaborations. Collaborative leadership allows for quick decision-making, increasing the agility of the collaborations. Agility was highlighted in multiple interviews as a necessity for innovative collaborations (Knowledge Institute 1, 2023; Industry 1-2, 2023; Government 1-3, 2023; University 2, 2023).

*“Because, yes, the environment is constantly changing, right? Uh, rules of the game are adjusted, new laws are introduced in Europe, then **you have to be adaptive in industrial innovation, you have to be adaptive.**”* (Industry 2, 2023).

Dankbaar (2019) suggested the implementation of more formal management methods. However, given the positive feedback on collaborative leadership from participants in both collaborations, it seems unlikely that these proposed formal management methods would be effective. Future research could look into whether a mix of collaborative leadership and the formal methods proposed by Dankbaar (2019) would be an effective management tool in a large Triple Helix collaboration.

To conclude, collaborative leadership is an effective management method as long the collaboration does not become too large. An added benefit of collaborative leadership that was not mentioned in the literature was that it increased the agility of the collaborations, allowing for quicker decision-making.

4.3.3 Evaluator

The need for an independent evaluator was identified by Dankbaar (2019) as a necessary factor in Triple Helix collaborations. An evaluator needs to be present so the project can be objectively evaluated by all participants (Dankbaar, 2019). The sole responsibility of the evaluator is to collect information about the collaboration for management (Dankbaar, 2019). However, this actor or person was not identified in either collaboration. It could be that this person or actor was absent in the smaller collaboration because the collaboration was too small to warrant the need for an evaluator. However, it would have been expected that an evaluator would have been present in the larger collaboration especially as the collaboration grew. Part of the evaluator's job has been described in the larger collaboration as being taken on by the steering committee. However, the people involved with the steering committee were directly involved in the collaboration, which an evaluator cannot be. An evaluator needs to be independent of all participating parties (Dankbaar, 2019).

In conclusion, neither case study involved the presence of an evaluator, which contradicts the literature.

4.3.4 Traits of the Institutions

Most of the traits described in the Triple Helix framework do not directly influence the collaborative capabilities of an institution. This is because it is a framework developed for macro level being applied at the meso-level. Complicating matters further is the absence of explicit guidance within the Triple Helix framework regarding the specific traits that each sphere must possess to qualify as a Triple Helix institution. Consequently, it's more appropriate to consider the traits of institutions as guiding principles rather than strict requirements.

When the original Etzkowitz & Leydesdorff originally developed the framework it revolved around the three spheres, university, industry and government. However, since then colloquially speaking with Triple Helix is meant, industry, government and knowledge institute, with a knowledge institute including the university. This means that the Dutch government includes all knowledge institutes in their legislation and subsidies regarding Triple Helix collaborations (*PPS-Toeslag Onderzoek En Innovatie*, n.d.). Because of this in the literature, the role or traits a knowledge institute could possess in a Triple Helix collaboration are completely absent.

It did not appear that institutions needed to possess certain traits for there to be a successful collaboration. While the institutional spheres did possess most of the traits described in the literature, most of the time participants did not explicitly express a need for them. With an exception for the government traits (2) be present as a moderator rather than control and (3) make policies to support innovation.

4.3.4.1 Traits of the Government

The empirical findings were in accordance with the literature's suggestions for the traits: (1) guarantee stable interactions, (2) be present as a moderator rather than control and (3) make policies to support innovation. The empirical findings contradict the literature for the trait: (4) organise platforms for communication and collaboration (Zhou & Etzkowitz, 2021). This trait did take place in the larger collaboration but did not directly impact the collaboration. Trait (3) Making policies to support innovation was especially highlighted in the interviews as an important trait for the government. It often being cited as the reason for institutions to involve the government in the collaboration.

Trait (1) guarantee stable interactions is a trait that mostly functions on the macro level. It does affect the collaboration, but it is a characteristic that proves challenging to implement, particularly in countries where the government lacks credibility. The Dutch government plays a pivotal role in both case studies, establishing regulations and providing stability for interactions and exchange (Borges da Costa & Ladders, 2022). This stability is manifested in various forms, including safeguarding intellectual property rights and imposing rules on subsidized projects. Both cases required approval of proposals by the Dutch government (Government 2, 2023; Industry 2, 2023; Government 4, 2023).

A trait of the government is its role as a moderator rather than a controller (Etzkowitz & Zhou, 2017). It oversees collaborations by setting rules for subsidy requests and ensuring compliance throughout the collaboration. Governments 2 and 4 primarily facilitate collaborations, acting as innovation organisers and actively initiating projects. As stated by University 2 (2023),

"If the supervising institution feels that the collaboration is progressing, they also scale back their efforts to the minimum."

There was an emphasis in both case studies for the government to be present as a facilitator aligning with trait (2) be present as a moderator rather than control (Government 1-2, 2023; Government 4-5, 2023; Industry 2, 2023).

The government also focuses on crafting policies supporting innovation (Zhou & Etzkowitz, 2021). Interviews underscored the gap between innovation and policy development, with innovation often outpacing regulatory frameworks (Knowledge Institute 1, 2023; Industry 1, 2023; Government 1, 2023; Industry 2, 2023). Collaborating with the government enables concurrent innovation and legislation development, mitigating potential future regulatory issues (Knowledge Institute 1, 2023; Industry 2, 2023).

"Legislation always comes later than innovation, and one of the lessons learned is simply to share where things are going in parallel with each other, even in the short term, so that you don't start developing first. Then, you say, 'I already have a product, there's no legislation or anything, just wait a year.' (...). It's best to start the conversation initially with, 'We're thinking about this,' and then legislation will come out. 'Can we periodically sit together to accelerate this?'" (Industry 2, 2023).

In the smaller collaboration, Government 2 used the partnership to inform policy decisions about environmental technologies, adjusting subsidy requirements for this said new technology (Knowledge Institute 1, 2023; Industry 1, 2023; Government 1, 2023). Government 2 even expressed it was one of their objectives when entering the collaboration (Government 2, 2023).

The trait (4) organising platforms for communication and collaboration, did not seem to influence the collaboration (Zhou & Etzkowitz, 2021). While the smaller collaboration lacked such platforms, the government did aid in organising the collaboration. In the larger collaboration, the government did leverage international platforms to foster collaboration (Government 4, 2023),

"In summary, what we actually do is, we focus on ecosystem development and community building" (Government 4, 2023).

Different government institutions participated in collaborations driven by distinct interests. In the smaller collaboration, societal impact motivated government involvement (Government 2-3, 2023), while socioeconomic interests motivated participation in the larger collaboration (Industry 2, 2023; Government 5, 2023). As articulated by Government 5 (2023),

*"So perhaps a bit of a peculiar position for a *name government institution*. But the idea behind it is that if you ensure a strong economy in a region, it benefits the prosperity of the residents."* (Government 5, 2023).

When asked about tackling societal issues Government 5 had to say: *"You can't pay the baker with idealism alone, right?"* (Government 5, 2023).

To conclude the empirical findings contradict the literature for the trait: (4) organise platforms for communication and collaboration. It did not seem that the trait influenced the success of the collaboration. The need for the government to make policies that support innovation was emphasised in both case studies as important, as innovation often outpaces legislation which could cause legislative

problems. There was also an emphasis in the empirical study on the need for the government to take on a facilitatory role, aligning with the trait (2) being present as a moderator rather than a controller.

4.3.4.2 Traits of a knowledge institute

As mentioned previously it is important to note that in this study when referring to a knowledge institute, it pertains to an institution solely focused on knowledge dissemination without an educational component. Conversely, when mentioning a university, which also falls under the category of a knowledge institute, it will simply be referred to as a university.

An unexpected discovery was that while all traits were evident in the larger collaboration, most were absent in the smaller one. This contrast likely was not due to the presence of only a knowledge institute in the smaller collaboration but rather stemmed from differences in objectives between the two cases. With the smaller case study being project-centred and the larger one being, exploring areas of new technological knowledge. The smaller case study not having most of the traits outlined in the literature did not hinder the quality of the collaboration, as all involved parties remained positive about the role the knowledge institute played in the smaller collaboration. Conversely, in the larger collaboration, both the university and knowledge institute exhibited all of these traits, which did appear to impact the success of the collaboration.

When the original framework was developed by Etzkowitz & Leydesdorff, it centred around three spheres: university, industry, and government. However, colloquially speaking, Triple Helix now typically refers to industry, government, and knowledge institutes, with a knowledge institute encompassing the university. Consequently, the Dutch government incorporates all knowledge institutes in their legislation and subsidies concerning Triple Helix collaborations (*Nationaal Groeifonds*, n.d.; *PPS-Toeslag Onderzoek En Innovatie*, n.d.). As a result, the literature lacks any discussion on the role, traits or characteristics that a knowledge institute should possess within a Triple Helix collaboration. Therefore, the traits attributed to the university were also applied to a knowledge institute. The larger collaboration had both a knowledge institute and a university present. The smaller collaboration only had a knowledge institute present.

The collaborations differed in what their objective was. A collaboration is defined as successful when the objectives are met or surpassed (Brockhoff & Teichert, 1995). There are two different types of objectives in a collaboration, objectives relating to individual projects or the ongoing relationship within collaboration exploring areas of new technological knowledge (Brockhoff & Teichert, 1995).

The objective of the smaller collaboration was an objective relating to an individual project. This meant the objective of the smaller collaboration was the successful finalization of the project. The project centred around successfully measuring the impact of an environmental technology. This differed from the larger collaboration, whose objective was to have ongoing relationships exploring areas of new technological knowledge. The sector around which acquiring this new knowledge is centred is the mobility sector. This meant the objective of the larger collaboration, is to have a collaboration that lasts indefinitely while exploring areas of new technological knowledge together. The larger collaboration did have intermediate objectives which needed to be met for the collaboration to move to the next stage. This meant that the smaller collaboration had a clear ending of the collaboration, while the larger collaboration did not. Both of these objectives were met. The smaller collaboration successfully finalised the project, with the publication of a research article that was positive about the environmental technology developed by the industry partner. The larger collaboration is still ongoing as of March 2024, with the intermediate objectives being met and moving along to the next stage.

It was hypothesized that four of the five traits of the university could have been applied to a knowledge institute. However, likely due to the case study's differing objectives only traits (1) the development, production and application of advanced knowledge and (3) take initiative when entering cooperations with the market, were witnessed in the smaller case study.

This means traits (2) react flexibly to market demands, (4) take a more active role in socio-economic development and (5) hybridity of individuals and institutions were absent in the smaller collaboration.

This is likely because trait (2) react flexibly to market demands partly references changing research and education according to the market needs. As previously mentioned when referring to knowledge institutes here, it pertains to an institution solely focused on knowledge dissemination without an educational component. Which is why trait (2) does not apply to a knowledge institute since it does not have an educational role the same way a university does.

In the larger collaboration, the university emphasised the importance of these types of collaborations as a way to determine what needs to be researched:

*“The role of companies at a university is also that **they need to tell us what the real problems are**, because otherwise those **scientists will just lie under their rocks** in a room, happily researching, and then something will come out that nobody is waiting for”* (University 2, 2023).

It was also highlighted that universities require such collaborations to effectively educate their students by understanding the market needs (Industry 2, 2023; University 1, 2023).

Trait (4) to take a more active role in socioeconomic development, was present in the larger collaboration but absent in the smaller one (Ivanova & Leydesdorff, 2014). In the smaller collaboration, the knowledge institute did not appear to be directly motivated by socioeconomic factors, as these were not mentioned in the interviews.

This is probably attributable to the differing objectives and scales of the two cases. The smaller one revolves around a singular project, focused on testing an environmental technology. Testing such a technology may indeed have a positive impact on society, but given the limited scale, it did not lead to socioeconomic development.

In the larger collaboration, both the university and the knowledge Institute were driven by socioeconomic factors. As mentioned earlier, both were actively engaged in maintaining the region's innovative capabilities (University 1, 2023). Both desired for the region to continue being recognized as a knowledge region (University 1, 2023). This was also reflected in the objective of the collaboration, having ongoing relationships exploring areas of new technological knowledge in the mobility sector.

The trait (5) hybridity of individuals and institutions, was only present in the larger collaboration (Etzkowitz & Zhou, 2017). In the smaller collaboration, the hybridity of individuals and institutions was not mentioned. This discovery was unexpected and intriguing. However, the reason for its absence was not clarified during the interviews.

In the larger collaboration, hybridity of individuals did take place between the knowledge institute and the university (Knowledge Institute 2, 2023). Hybridity of individuals did positively impact the larger collaboration, with it also helping with conflict resolution. In the early stages of the larger collaboration, there was little friction between the knowledge institute and the university, as it was unclear who was responsible for what (University 1, 2023). This was eventually overcome with communication. It helped that both institutions had done a lot of collaborations in the past and shared employees (Knowledge Institute 2, 2023). Meaning hybridity of individuals can help with conflict resolution.

Two traits were present in both case studies (1) the development, production and application of advanced knowledge and (3) take initiative when entering collaborations with the market.

The trait (1) the development, production and application of advanced knowledge, was present in both case studies (Zhou & Etzkowitz, 2021). For the most part, the smaller collaboration was executed by the knowledge institute in collaboration with the industry (Knowledge Institute 1, 2023).

In the larger collaboration, the university and knowledge institute did help in developing, producing and applying advanced knowledge. The knowledge institute had to say:

*“We divided that, so the more fundamental part is with the *name university*, the more practical part is with *name knowledge institute”*

They did this so the institutions were complementary to each other.

Another trait is (3) to take initiative when entering cooperations with the market (Lanskoronskis et al., 2009). When entering a cooperation with the market, a knowledge institute or university needs to take the initiative and have a proactive role during the collaboration (Lanskoronskis et al., 2009). In the case of the smaller collaboration, it revolved around an innovation developed by the industry party. Meaning the knowledge institute was not able to take the first initiative. However, the knowledge institute did have an active role, in linking the different partners, fundraising and in making the project proposal (Industry 1, 2023).

In the larger collaboration, the university and knowledge institute had a more active role from the beginning. This aligns with the idea that the university needs to have a proactive role in a Triple Helix collaboration (Lanskoronskis et al., 2009). Both the university and knowledge institute did not want to lose knowledge workers and innovative capabilities in the region during COVID-19 and sought out ways to prevent this (University 1, 2023). The university gave an additional reason for joining the collaboration they wanted to expand their expertise and wanted to play a role nationally and internationally on these subjects surrounding mobility (University 1, 2023).

The most frequently cited reason for involving the knowledge institute in the smaller collaboration was to provide a sense of objectivity regarding the project's outcomes (Knowledge Institute 1, 2023; Industry 1, 2023). This is different from the reasons given in the larger collaboration for involving the knowledge institute and university which were; the availability of well-educated personnel/students, objectively evaluating the industry and developing new knowledge (Government 5, 2023; Government 4, 2023).

*“Every startup claims to have the best product, so how are we going to verify whether it's true or not? Well, that's where *name knowledge institute* or the universities come in. They have a lot of in-depth technical knowledge in various areas and can assist us with that.”* (Government 4, 2023).

In the smaller collaboration, the knowledge institute did not exhibit three out of the five traits outlined in the literature. However, this did not hinder the quality of the collaboration, as all involved parties remained positive about the role played by the knowledge institute. Conversely, in the larger collaboration, both the university and knowledge institute exhibited all of these traits, which did appear to impact the success of the collaboration. This disparity is likely attributable to differing objectives and scale between the two collaborations. In the smaller collaboration, the knowledge institute was keen on contributing to the research by developing new methodologies to test the environmental technology produced by the industry. The product itself likely had a positive impact on its environment, prompting the knowledge institute's interest in assessing its effects. In contrast, in the larger collaboration, both the knowledge institute and the university aimed to preserve the region's innovative capabilities. Making the interest of the larger collaboration more socioeconomic-centred than that of the smaller one. This discrepancy in interests, coupled with the differences in the size of the collaborations, likely explains why the traits were present in one collaboration but not the other.

This means that depending on the interest, objective and scale of the collaboration, the knowledge institutes or universities traits differ.

4.3.4.3 Traits of the Industry

Both collaborations exhibited only one trait identified in the literature. Only the development of innovation and application of them was identified as a necessary trait in both cases (L. M. Ranga et al., 2008; Zhou & Etzkowitz, 2021). This is likely because the collaboration centred around the development

and application of innovations. Making it one of the core activities in Triple Helix collaborations in general.

In the smaller collaboration, Industry 1 was responsible for the creation of the innovation, which was tested during the collaboration (Industry 1, 2023). So the smaller collaboration for a large part took place to apply the innovation. The reason given for why the industry itself joined the collaboration includes getting objective research results which would result in a better market entry with their new product (Industry 1, 2023).

The larger collaboration did cause the development and application of new knowledge. In the collaboration, the industry focused on applying and testing the knowledge produced by the university and knowledge institute (Industry 4, 2023).

In summary, both collaborations exhibited the trait development of innovation and application. This is inherent to Triple Helix collaborations, as they are primarily centred around innovation development and application.

4.4 Reflection

4.4.1 Start

It can be concluded from the literature and both case studies that the innovation organiser is indeed a key position in a Triple Helix collaboration. The innovation organiser takes initiative, does most of the coordinating and ensures agreement and support for the collaboration (M. Ranga & Etzkowitz, 2013).

Found only in the empirical analysis is that during the initial phases of a Triple Helix collaboration, managing the unprofitable top is crucial, and government institutions were deemed most suitable for this role by interviewees. Unlike private entities, government institutions can invest in initiatives without immediate financial returns, thereby supporting long-term collaborative efforts. This highlights the unique capacity of government entities to provide stability and sustained investment, particularly in the nascent stages of collaboration.

4.4.2 Partner selection

According to the literature, three factors are important when successfully selecting partners for a collaboration; the complementarity and compatibility of the partners and trust (Arsanti et al., 2022). These three factors were also identified in the interviews of both cases. However, the literature did not emphasize the importance of complementarity of interest as a significant factor, which contrasts the empirical findings. Complementarity of interest was also suggested as a means to prevent conflicts, by being a way to address contradicting interests before they can escalate into conflicts. This finding emphasizes the importance of aligning partners' interests to foster synergy and mitigate potential discord within a collaborative framework.

4.4.3 Execution

Collaborative leadership, characterized by inclusive decision-making, was both identified in the literature and the empirical study. However, the empirical study highlighted that it is effective in smaller collaborations but may require adjustment as collaborations expand. In larger collaborations, the adoption of more formal management methods becomes necessary to maintain efficiency and accountability. However, implementing formal management in a Triple Helix collaboration poses challenges, given the distributed power dynamics inherent to such partnerships. What type of formal management methods could be employed for large Triple Helix collaborations should be researched in future research. An added benefit of collaborative leadership that was not addressed in the literature was that it increased the agility of the collaborations, allowing for quicker decision-making.

Both case studies did have task conflict but no relationship conflict. However, it did not appear that task conflict improved innovative capabilities.

An evaluator, although identified in the literature as a necessary individual in a Triple Helix collaboration, was not present in either case study.

It did not appear that institutional spheres needed to possess certain traits for there to be a successful collaboration. Future research should focus on this and add more cases since the traits of the institutional spheres are prone to a generalization bias. While the institutional spheres did possess most of the traits described in the literature, most of the time participants did not explicitly express a need for them. There are exceptions for the government in which the traits (2) be present as a moderator rather than control and (3) make policies that support innovation.

In the smaller collaboration, the knowledge institute did not exhibit three out of the five traits outlined in the literature. However, this did not hinder the quality of the collaboration. Conversely, in the larger collaboration, both the university and knowledge institute exhibited all of these traits, which also appeared to impact the success of the collaboration. This disparity is likely attributable to differing objectives and scale between the two collaborations. Meaning that depending on the objective and scale the traits of a university or knowledge institute will likely vary. Future research could look into what exactly the influence of objective and scale is on traits of a knowledge institute or university.

The trait of the industry did appear necessary as the development of innovation and application is often the things the collaboration centres around.

4.5 Improved Framework for Triple Helix Collaborations

The previously developed framework was improved based on the findings in this chapter. The improved framework is shown in Table 4.5. The factors that were absent in the empirical study are crossed out in the table below. The factors that were added based on the empirical findings are highlighted in green.

What I found as important inclusion factors contributing to the success of a Triple Helix collaboration are: Innovation organiser, unprofitable top, trust, complementarity, compatibility, interest, collaborative leadership and traits of the government and university/knowledge institute. The factors of unprofitable top and interest were added due to the empirical insights. The case studies led to the exclusion of multiple factors, such as conflict, evaluator and a few individual traits of the government and university/knowledge institute.

The factors of innovation organiser and unprofitable top are linked to the traits of the government. With an innovation organiser often being a government institution and the unprofitable top often being financed by the government. Both are linked to the facilitatory role participants of the case study described as necessary for the government.

Interest is linked to the factors of trust and compatibility. Trust is a requirement for being able to transparently communicate about one own interests. Compatibility references the need for compatible interests.

Conflict is linked to the factors of interest, collaborative leadership and compatibility. This is because competing interest is often a reason for conflict. Transparently communicating about these interests from the start of the collaboration will ensure that conflict will not take place later in the collaboration. Conflict is linked to collaborative leadership since employing collaborative leadership as a management method tends to decrease conflict in a collaboration. Conflict is linked to compatibility since if companies do not have compatible working cultures, values and norms it may cause conflict later in the collaboration.

Phase	Factor	Explanation
Start	Innovation organiser	Orchestrates a blend of bottom-up and top-down initiatives, facilitating economic and social development, and securing consensus and support for the realization of the collaboration (M. Ranga & Etzkowitz, 2013).
	Unprofitable top	Having an institution present, most likely a government institution, that can invest resources that do not need to yield returns.
Partner selection	Trust	Trust is established by: awareness of the expectations, transparency regarding the opportunities and constraints of each party, and fostering honesty and clarity about individual objectives (Bressers, 2012; Dankbaar, 2019).
	Complementarity	Having complementary assets which are not identical, but are interdependent and mutually encouraging in the collaboration (Useyin Tanriverdi & Venkatraman, 2005).
	Compatibility	Compatibility means having similar; strategic and relational long-term orientation, cultural and organisation characteristics, values, norms and mindsets (Arsanti et al., 2022; Razak & White, 2015).
	Interest	Being aware of one's own interests and transparently communicating them to one another.
Execution	Conflict	Have task conflict which is content driven and takes place because of differences of opinion in an organisation's functional department- (Amason & Sapienza, 1997)-
	Collaborative leadership	Collaborative leadership is a management practice in which everyone is involved in making decisions that impact them (Lawrence, 2017).
	Evaluator	Responsible for providing transparency in the collaboration (Dankbaar, 2019)
	Traits of university (*knowledge institute trait 1, 3, 4, 5 apply)	(1) The development, production and application of advanced knowledge*, (2) react flexibly to market demands, (3) take initiative when entering cooperations with the market*, (4) take a more active role in socio-economic development and (5) hybridity of individuals and institutions (Lanskoronskis et al., 2009; Zhou & Etzkowitz, 2021).
	Traits of the industry	(1) Development of innovation and the application of them (Etzkowitz & Zhou, 2017; L. M. Ranga et al., 2008; Zhou & Etzkowitz, 2021).
	Traits of the government	(1) Guarantee stable interactions and exchange, (2) be present as a moderator rather than control, (3) make policies to support innovation, (4) organise platforms for communication and collaboration (Borges da Costa & Lodders, 2022; Etzkowitz & Zhou, 2017; Zhou & Etzkowitz, 2021).

Table 4.5 Improved framework

5. Discussion and Conclusion

This master thesis aimed to understand what factors contribute to a successful Triple helix collaboration in the Netherlands. This thesis aimed to address the theoretical gap by providing actionable insights that can guide the implementation and maintenance of a Triple Helix collaboration in the Netherlands. Practical recommendations for institutions aiming to foster better relations within the Triple Helix framework were notably absent, and the framework itself does not offer guidance on implementing such collaborations (Asheim & Coenen, 2006; Brem & Radziwon, 2017). The Triple Helix framework is well-established in the literature, but there is limited empirical insight. Even though the Netherlands is often mentioned as a best practice for Triple Helix collaborations, actual empirical insights about the Netherlands were missing or were focused on unsuccessful cases (Kinnunen et al., 2016; Morisson & Doussineau, 2019; Quintanilla & Romero, 2019). This gap was particularly surprising given the frequent mention of the Triple Helix framework by various governmental actors in the Netherlands, alongside a strong emphasis by the Dutch government on Triple Helix collaborations (Keijzer, 2019; *Nationaal Groeifonds*, n.d.; *PPS-Toeslag Onderzoek En Innovatie*, n.d.).

A collaboration is defined as successful when the objectives are met or surpassed (Brockhoff & Teichert, 1995). There are two different types of objectives in a collaboration, objectives relating to individual projects or the ongoing relationship within collaboration exploring areas of new technological knowledge (Brockhoff & Teichert, 1995).

The objective of the smaller collaboration was an objective relating to an individual project concerning the testing of an environmental technology. The larger collaboration its objective was to have ongoing relationships exploring areas of new technological knowledge in the mobility sector. Both of these objectives were met. The smaller collaboration successfully finalised the project, with the publication of a research article that was positive about the innovation developed by the industry partner. The larger collaboration is still ongoing, with the intermediate objectives each time being met and moving along to the next stage.

The study began with a comprehensive literature review, leading to the development of a novel framework. This framework was then tested through empirical validation using two case studies, each representing collaborations of different scales. Both collaborations were deemed successful by the stakeholders involved, aligning with the criteria set forth by Brockhoff & Teichert (1995). Following the empirical testing phase, the framework was critically evaluated and adjusted based on the empirical findings.

5.1 Answer to the research question

The main research question was:

“What factors contribute to a successful Triple Helix collaboration in the Netherlands?”

To answer the research question first factors were distilled from the literature, to create a framework. This framework was then empirically tested using two case studies. The framework was critically evaluated and modified based on these empirical findings. The framework consists of the factors that contribute to a successful Triple Helix collaboration in the Netherlands. These factors were placed into three phases in which collaboration takes place: start, partner selection and execution.

The most important phases during a Triple Helix collaboration are the start and partner selection phases. This is because an often-heard risk of being in Triple Helix collaborations is that little will come out of it in terms of tangible results (Bressers, 2012). These early phases of collaboration are vital since they lay the groundwork for the rest of the collaboration. The starting phase is when enough support and resources need to be collected for the collaboration. The partner selection phase is present so the right partners will be selected. Inadequate partner selection leads to opportunistic behaviour, failure of the collaboration, and reluctance to collaborate (Arsanti et al., 2022).

During the start phase, only one factor was identified in the literature, the need for an innovation organiser. However, empirically two factors were identified, the need for an innovation organiser and the need for someone to deal with the unprofitable top. It was important to have an innovation organiser present as they do most of the coordinating and ensure agreement and support for the collaboration. The unprofitable top refers to an actor, most likely a governmental institution, having to invest money or time that did not yield returns but was needed to initiate the collaboration.

During the partner selection phase, three factors were deemed necessary according to the literature. However, the empirical study revealed four factors in this phase. Alongside the three previously identified factors — trust, complementarity, and compatibility— an additional factor, interest, emerged. Trust was essential within a Triple helix collaboration because it held the potential to effectively navigate the unpredictable challenges associated with utilizing relationships when other parties were used to achieve goals. Complementarity is having complementary assets which are not identical, but are interdependent and mutually encouraging in the collaboration (Useyin Tanriverdi & Venkatraman, 2005). Complementary resources were often the reason for entering a Triple Helix collaboration. Compatibility between partners could be investigated through a variety of different criteria like strategic and relational long-term orientation, cultural and organisational characteristics, values, norms, and mindsets. Compatibility between partners was key when entering a Triple helix collaboration because it affected how valuable the parties perceived each other's knowledge. Communicating shared interests created clarity regarding participants' motivations for joining a collaboration and their respective definitions of success. By articulating their interests, each participant gained a clear understanding of what success entailed for them within the collaboration.

During the execution phase, there were four factors identified in the literature: conflict, collaborative leadership, evaluator and the Triple Helix traits. In the empirical study, only two of these four were identified: collaborative leadership and Triple Helix traits. Collaborative leadership was characterized by inclusive decision-making and was effective in smaller collaborations but required adjustments as the collaborations expanded. That the management method of collaborative leadership needed adjustments as the size of the collaboration increased was a surprising find that was not present in the literature. In larger collaborations, the adoption of more formal management methods became necessary as the collaboration grew. There was no empirical evidence that suggested that task conflict had a positive influence on the collaboration. There was also no empirical evidence indicating the necessity of having an evaluator present in the collaboration.

It did not appear that institutional spheres needed to possess certain traits for there to be a successful collaboration. This is likely because it is a framework developed for macro level being applied at the meso-level. Complicating matters further is the absence of explicit guidance within the Triple Helix framework regarding the specific traits that each sphere must possess to qualify as a Triple Helix institution. Consequently, it is more appropriate to consider the traits of institutions as guiding principles rather than strict requirements. While the institutional spheres did possess most of the traits described in the literature, most of the time participants did not explicitly express a need for them. There are exceptions for the government in which the traits (2) be present as a moderator rather than control and (3) make policies that support innovation.

In the smaller collaboration, the knowledge institute did not exhibit three out of the five traits outlined in the literature. However, this did not hinder the quality of the collaboration. Conversely, in the larger collaboration, both the university and knowledge institute exhibited all of these traits, which also appeared to impact the success of the collaboration. This disparity is likely attributable to differing objectives and scale between the two collaborations. Meaning that depending on the objective and scale the traits of a university or knowledge institute will vary.

The trait of the industry did appear necessary as the development of innovation and application is often the things the collaboration centres around.

5.2 Framework evaluation

This thesis had one main contribution which was to create an overview of the factors of importance for a successful Triple Helix collaboration in the Netherlands. By creating an overview of the factors of importance using both literature and empirical methods, practical guidelines are created which were missing in the literature. These practical guidelines can be used by any institution wishing to partake in a Triple Helix collaboration.

The success factors were derived from a combination of a literature review and empirical research. The two case studies that were used were both successful collaborations. This indicates a survivorship bias, where researchers focus only on the group or individuals that passed a selection process, ignoring those who did not pass (Shermer, 2014). Survivorship bias can lead to incorrect conclusions by studying only a subset of the population (Shermer, 2014). It is possible that failed Triple Helix collaborations shared some factors with the successful cases. Future research should focus on failed cases to identify overlapping factors and adjust the framework accordingly.

This study may also be susceptible to a generalization bias, where individuals make broad assumptions or draw conclusions based on limited information or experiences, since only two successful cases were used (Peters et al., 2022). Future research should aim to incorporate a broader spectrum of successful cases to mitigate the influence of generalization bias.

It should also be noted that Triple Helix, NIS and Triple Helix systems are all frameworks applied on the macro level being applied in this study on the meso-level. Meaning applying the frameworks becomes difficult and certain aspects of the frameworks become lost in translation, since certain traits do not apply at this level. An example of this is the concept of the entrepreneurial university it was partly included in the traits of the university. However, the entrepreneurial university was a fundamental part of the original Triple Helix framework but its presence was significantly reduced in this study. This is also why society is underrepresented in this study. Since the role of society in the Triple Helix framework takes place on the macro level, it is not represented well when applied on the meso-level.

Triple Helix is a framework that faces criticism, especially regarding its ability to address societal problems, as society's interests are not adequately represented (Cai & Lattu, 2022). While the government and university partially represent society, their immediate influence on societal needs is limited within the Triple Helix Framework. The newly developed framework focuses just on the success factors not tackling this criticism.

The Triple Helix framework is primarily centred around economic growth, which can have adverse effects on human health, nature, and climate due to consumption, production, and resource use. As criticism mounts against economic-centred innovation frameworks, concerns arise about developing technologies sustainably within a framework that prioritizes economic growth. Despite its potential limitations, Triple Helix remains widely adopted framework by many countries to promote innovation within regions.

The original creators attempted to address some of these issues by developing the Triple Helix Twin framework and proposing separate models for sustainable development and innovation. However, in an era where sustainability is crucial, the need for a separate framework appears counterintuitive, potentially undermining the original framework's benefits of being easily applicable in diverse contexts. Triple Helix Twin shares with the original frameworks the lack of practical implications for managing such collaborations. Making this research also for a large part applicable to that framework.

Although the Triple Helix framework was not originally designed with sustainability in mind, it can be used to tackle societal challenges. The Triple Helix framework and as a consequence this study can be employed for the development of green technologies. The development of green technologies depends on externally developed resources and collaborations (Cainelli et al., 2015). Therefore, Triple Helix collaborations could be leveraged for the development of green technologies.

5.3 Practical implications

These findings offer practical insights for institutions seeking to engage in Triple Helix collaborations, providing guidelines for their implementation. Firstly, clear directives for the starting phase and partner selection phase enhance the likelihood of the collaboration forming and progressing to the next phase. Secondly, practical recommendations for factors crucial during the execution phase ensure the longevity of the Triple Helix collaboration.

5.4 Limitations and avenues for future research

The main limitations of this study are mainly related to the research methodology or on the focus on Triple Helix literature.

This study could possibly suffer from multiple research biases. This study may also be susceptible to a generalization bias, where individuals make broad assumptions or draw conclusions based on limited information or experiences (Peters et al., 2022). This bias arises when people generalize from specific instances or situations to broader categories, disregarding variations or exceptions within those categories (Peters et al., 2022). Consequently, it can lead to inaccurate beliefs or judgments by oversimplifying the diversity and complexity of real-world phenomena (Peters et al., 2022). As outlined in the methods, the two cases differ in several aspects, including size, participating actors, quantity of actors, location, and objectives. However, other Triple Helix collaborations may vary in different aspects, implying that not all findings from this study may be universally applicable to all Triple Helix collaborations. Future research should aim to incorporate a broader spectrum of successful cases to mitigate the influence of generalization bias.

By only selecting successful cases in this thesis there is a survivorship bias present. Because of the survivorship bias, it would be best that in future research the factors of failed and successful collaborations would be compared. Due to time constraints failed collaborations could not be added to this study.

Semi-structured interviews were used for the empirical research. Semi-structured interviews are susceptible to the researcher's biases (Salazar, 1990). The questions can influence the answers the respondents might give and analysing the interviews leaves a lot of room for the researcher bias (Salazar, 1990). This could potentially result in the misinterpretation of results. The choice for semi-structured interviews was made so there could be an in-depth exploration of the topic and it offers flexibility, allowing for clarification or exploration of unexpected themes or insights.

The insights of this study are about the Netherlands. Future research could expand on this by including case studies from other countries. Including other countries could offer valuable insights into whether country-specific factors played a role in the success of the collaborations, such as variations in working culture.

Triple Helix and innovation systems theory are both frameworks much applied in the field of innovation studies. The combined framework of Triple helix systems is much applied by Nordic countries (Brännback et al., 2008). However, not all Nordic countries that apply it have a lot of innovative capabilities (Brännback et al., 2008). This means that other factors also likely contribute to innovation that were not mentioned in the Innovations systems theory, Triple Helix and Triple Helix systems framework. Future research could explore what additional factors outside of these frameworks contribute to having good innovative capabilities.

The present study provides valuable insights into the practical factors crucial for successful Triple Helix collaborations during the starting and partner selection phases. However, future research should focus more on the execution phase, particularly as collaborations scale up. Interview data highlighted that collaborative leadership cannot be used for larger collaborations, warranting further investigation into what formal management methods could prove effective in larger collaborations.

This study examines Triple Helix collaborations, primarily because of the Dutch government's emphasis on this framework. However, it is conceivable that alternative frameworks such as quadruple or quintuple Helix models may be more suitable, particularly considering Triple Helix's limited focus on sustainability and other societal challenges. Future research should investigate whether quadruple, quintuple, or other innovation models can effectively address these collaboration types while also tackling societal challenges such as climate change.

While the Triple Helix framework may be considered outdated by some scholars, it remains a much-applied framework by governments wishing to improve their innovative capabilities. It has spawned a series of subsequent frameworks within the field of innovation studies, including the Quadruple, Quintuple, and N-tuple Helix frameworks (Cai & Lattu, 2022). These related frameworks are likely more future-proof. Where the Triple Helix framework emphasizes the concept of the 'knowledge economy,' the quadruple helix framework delves into the notions of the 'knowledge society' and 'knowledge democracy'. Emphasizing the shift away from innovation frameworks only looking at encouraging economic growth.

Seeing as these frameworks are closely related, understanding the Triple Helix framework also provides valuable insights into collaborations of these related frameworks. This is also what is recommended for future research, to look at the factors defined in this study and compare whether these factors also apply to a Quadruple or Quintuple Helix collaboration.

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7. Appendix I: Interview guide

This is one version of the interview guide that was used. During the interviews the interview guide had changed.

Introduction

This research is being conducted to learn what is essential for successful Triple Helix collaborations. I am conducting this research as part of my master's thesis at the Technical University in Eindhoven, as part of the master innovation sciences. I am especially interested in the opinions of participants who were active in Triple Helix collaborations. The questions I would like to ask you are related to collaborations between universities, industry and government. The particular collaboration I am referring to is collaboration (X). Everything you tell me will only be used for my master's thesis, the eventual report will be open to everybody, but personal information will not be shared. Your name etc, will not be mentioned in the final report. You have already consented to the interview with the consent form. Do you have any questions before we begin?

Background information

Number of the interview:

Company/ institution participant:

Position within collaboration X:

Introduction questions

- As mentioned before this is about collaboration (X). How long were you active in the collaboration?
- What was the total run-time of the collaboration? (Only asked in first few interviews)

General questions

- How did you experience collaboration (X)? How do you feel about it? (Why?)
- Who was responsible for creating the collaboration? (If they name one of the spheres, for example, government, continue with the question under the government)
- How did your expectations align with the reality of the collaboration? (And why?)
- Were incentives in place to stimulate the collaboration? (And why?)
- Where did the partners in the collaboration meet most often? And by whom was this location owned?

Management

- Who was responsible for managing (organizing) the collaboration? How did you experience that?
- How were the goals decided on? And how was your experience with that?
- How was the communication during the collaboration? Why?
- How did the decision-making in the project take place? And what is your opinion about it?
- Who was the key actor making the collaboration possible?
- What were the constraints of the project? And how were these communicated?

Trust

- Did you have experiences with the different partners prior to this collaboration?
- Was the willingness to cooperate with the different partners high? (And why?)

Conflict

- Who profited the most from the collaboration? (And why?)
- Who was responsible for most of the knowledge created? (And why?)
- Which partners executed most of the project? (And why?)
- How were the financial burdens shared during the collaboration? (And why?)
- Were all partners equally involved in the collaboration? (If no, Why? And how did you experience it?)

- What are the learning points for the next collaboration? (And why?)
- How were conflicts managed during the collaboration? (And why?)

University/knowledge institute

- How did you experience the role of the university/knowledge institute in the collaboration? And why?
- Did you receive any support from the university/knowledge institute during the collaboration? If yes, how did you experience that?
- Did the university fulfil its needed role? Why?
- What role should the university/knowledge institute take when entering such a collaboration?

Industry

- How did you experience the role of the industry in the collaboration?
- Did the industry fulfil its needed role? Why?
- What role do you think the industry should take when entering such a collaboration? Why?

Government

- *How did you experience the role of the government organization (X) in the collaboration? (Repeat the questions for every government instance)
- What role did you think the different government instances tried to take?
- Did the government fulfil its needed role? Why?
- What role do you think the government should take when entering such a collaboration?

Closing

- Was every question clear?
- Do you maybe have anything else to add?
- Do you have any questions for me?