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North South Knowledge Transfer Between Sweden and Nicaragua

A Case Study of a Gastric Cancer Research Collaboration

Master's Thesis in the Master Degree Program Entrepreneurship and Business Design

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Abstract

This master thesis investigates the challenges of knowledge transfer between Sweden and Nicaragua within a multinational research collaboration, referred to as the NGC project, focusing on gastric cancer research. The NGC project aims to discover the causes of gastric cancer and identify biomarkers of early stage gastric cancer development. The thesis will cover not only the challenges of knowledge transfer, but also dig into the concept of knowledge and also discuss how the results of the research can be utilized in the collaboration in a fair way, not only to benefit Sweden but also a developing country as Nicaragua.

The research group in Sweden has identified cancer-inducing mutations in the stomach mucosa from patients suffering from the bacterium helicobacter pylori, tobacco smoking and poor dietary habits. Patient tumor samples are collected at a hospital in Nicaragua, where gastric cancer is a common health issue, to create of a biobank for further research. The results will provide important information regarding the mechanisms of gastric cancer development, which will aid development of future prophylaxis or therapy of gastric cancer. There are six different institutions involved worldwide, contributing to the research with their own respective field of research.

The major challenges in knowledge transfer within the collaboration are the differences in organizational culture and the lack of communication. The existing knowledge base and the way of acquiring new knowledge differs between the parties, making it difficult to transfer knowledge on the same basis as it is hard to absorb knowledge with the lack of mutual understanding. In Nicaragua in general, policy making is not always based upon knowledge, which leads to failure in the absorption and adaption to new knowledge. By having a coherent knowledge base and continuous, transparent communication some of these issues could be solved. Therefore, this thesis recommends the decision makers within the collaboration to see to the challenges there currently is regarding the knowledge transfer and try to overcome them.

As the project aims to aid the development of therapy of gastric cancer the vision of the project is to develop a biomarker, which is a complex and long process regarding regulatory issues. Most importantly, if a biomarker is developed it needs to be accessible to the Nicaragua market by having a price that is affordable. This thesis concludes that it is important that the knowledge transferred in the collaborations is fairly traded in regards to the results that the research may lead to, for all parties.

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This study has been carried out within the framework of the Minor Field Studies (MFS) Scholarship Programme, which is funded by the Swedish International Development Cooperation Agency, Sida. The MFS Scholarship Programme offers Swedish university students an opportunity to carry out two to three months of fieldwork in a developing country resulting in a Master's dissertation or a similar in-depth study. These studies are primarily conducted within areas that are important for development and in a country supported by the Swedish programme for international development assistance.

The main purpose of the MFS programme is to increase interest in developing countries and to enhance Swedish university students' knowledge and understanding of these countries and their problems. An MFS should provide the student with initial experience of conditions in such a country. A further purpose is to widen the Swedish personnel resources for recruitment into international co-operation.

Chalmers University of Technology administers MFS scholarships for students from all educational programs at Chalmers. The department of Technology Management and Economics is responsible for a small number of MFS scholarships for studies related to the field of industrial engineering & management.

Sverker Alänge
Coordinator for MFS Scholarships
at the department of Technology Management and Economics

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Marika Källman

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1 Introduction

This chapter first introduces the context in which knowledge transfer is increasing in importance, followed by the difficulties that follow from this in collaborations between north and south. The case of international research collaboration is presented, where these difficulties are deemed a problem, which will be used as a field study. From this a purpose is formulated, followed by research questions that will answer the purpose of the report. To make a feasible study this chapter will end with a section that delimitates the study and overviews the outline of the report.

1.1 Background

The interest in Knowledge Management has increased due to the knowledge-based society, first introduced by Bell (1976) as the post-industrial society in which knowledge became a valued form of capital. It was argued that knowledge had become the most utter source of competitive advantage among firms and institutions. Knowledge Management involves the processing of knowledge from its creation, its transfer and then its utilization. In a monogenic organization there would not be a need of transferring the knowledge, but due to amplified organizational collaborations the focus on knowledge transfer has increased. During the past years research has been focusing on knowledge creation and the power it has when shared within the organization. It is still not a fully explored field of research and the trends are moving from the power of knowledge to the actual transfer and utilization of knowledge (McInerney, 2002), which will be the context of this thesis.

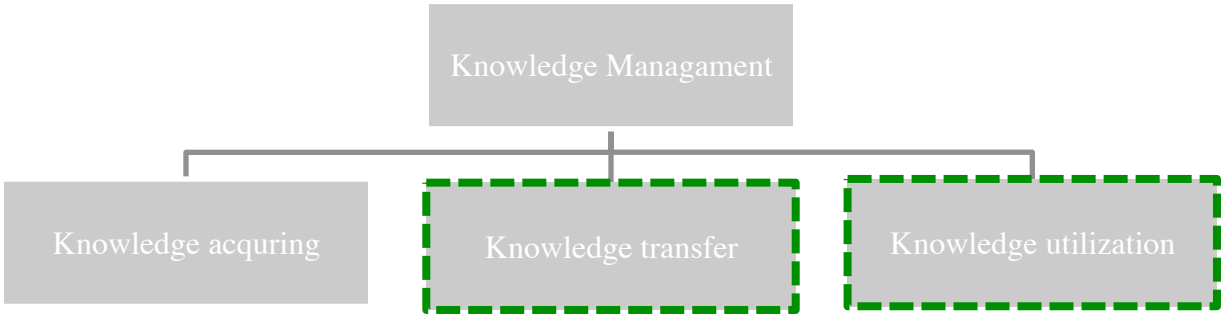

Figure 1: The blocks of Knowledge Management.

Structured knowledge sharing among organizations is increasing, not only internally, but also externally in collaboration with other partners (Knoke & Todeva, 2005). The university-industry collaborations have intensified during the past years as several areas such as computer science, molecular biology and material science have advanced and are serving as a source of

technological development of the industry. The elements of technological development are transferred through transactions between academia and the industry, in terms of licensing agreements and sponsorships, as intellectual assets (Berkovic & Feldman, 2006). Therefore it is an increasing need for universities to implement strategies to handle intellectual assets (Petrusson, 2002), not at least in collaborations if they are going to commercialize on it somehow in the future. To be able to extract value it is important to control the intellectual assets to be able to utilize them, and especially in collaborations where it might be an ownership dispute.

Due to globalization there is an increased transnational flow of technology (Parthasarathy, 2006). The markets are growing due to reduced trade barriers, which is encouraging international collaborations. This combined with the still emerging knowledge based economy contributes to the increased transfer and exchange of both technology and knowledge worldwide, especially with the developing world due to their cheap labor and resources. However, there currently exist barriers regarding technology and knowledge transfer in development countries due to the lack of legal structures and institutional support (Davidson & Metz, 2000). The success or failure of technology transfers depends not only on the technology itself and the scientific objectivity, but also on regulatory frameworks and the organizational cultures of the parties (Segerstrom, 1990). Unfortunately there is often a focus on the scientific objectivity and therefore some projects fail to achieve its purpose due to the lacking of organizational structure. (Harris, 2004)

Due to the increase dependence of research within the business life and society, the greater role may the universities have in the future (Brennan, King & Lebeau, 2004). Companies are to some extent acting as university in terms of learning and spreading knowledge at the same time as universities are acting as a knowledge-based company. This entangles the business life with the universities to a larger extent (Person, 2007). Due to this there is an increased need to manage assets in university collaborations, the same way it is important in firms.

There is a challenge in how knowledge is utilized and controlled during research projects due to the fact that knowledge, as an intellectual asset, is harder to control compared to a physical product. It is also harder to declare ownership to it, if jointly developed. This creates issues when parties less experienced and with less resources enter collaborations. There is a challenge in mastering collaborations with uneven partners and it requires clear communication and strong mutual gains (Gaillard, 1994).

Knowledge transfer and building scientific capacity is in every way a two-way street, beneficial for both parties. Scientists and researchers from developed countries can contribute to colleagues in developing countries in terms of knowledge, technologies and resources, but there is much to be gained in the other direction as well. (Harris, 2004) Local expertise and local knowledge are invaluable as are the tremendous fountains of innovation at all levels. Therefore, even if the parties contribute with different capability, there should still be an even share of the results. (Gaillard, 1994)

1.1.1 Case Study: The NGC Project

The Nicaraguan Gastric Cancer Project, referred to as the NGC Project, is a research collaboration between Canada, US, Sweden, Italy and Nicaragua where a biobank is created to store patient samples for doing research on gastric cancer. The sample gathering is done at a Hospital in Managua, which is the capital of Nicaragua. The hospital have limited amounts of resources and funding and therefor is dependent on the contribution of the other parties, hence the requirements for not only funds but also knowledge and technological transfer between the parties for the project to be successful. An overview of the collaboration and its partners is illustrated in figure 2.

The collaboration has faced challenges in terms of lab confiscation, lacking institutional support in Nicaragua and the collaboration is experienced as inefficient. To be able to exchange samples and data there are legal regulations, ethical frameworks and ownership of intellectual property to take into consideration. In a setting with multiple actors are involved, as in the NGC Project, this is difficult to achieve. The biobank has been established but there are both internal and external barriers for the success of the project. The external problems occur due to the limitation of resources, funding and governmental support. The internal problems are due to lack of an organizational setup and communication among the parties. So far no contracts or modes of ownership have been set up and there is no clear leadership unit of the project that assures progress.

1.1.1.1 Gastric Cancer

Gastric cancer is the second most common cause of cancer death in the world and a global health problem of the poorest. Around two thirds of the 700 000 yearly deaths in gastric cancer occur in low- and lower-middle-income countries. The complexity of gastric cancer is to a large extent related to the symptoms since they are complex to distinguish from a generic feeling of illness with symptoms such as dyspepsia, pain, nausea, anemia and early satiety. When people in socio-

economically challenged regions suffer from these symptoms they often lack the opportunity of basic health care and the cancer will stay undetected, often resulting in death.

The main risk factors for gastric cancer are chronic infection with the bacterium helicobacter pylori, tobacco smoking and poor dietary habits. The researchers in Sweden have found that patients suffering from atrophic gastritis and intestinal metaplasia in the corpus mucosa, two consequences of helicobacter pylori infection and predisposing conditions for gastric cancer development, have defects in several protective systems of the stomach. The defects might lead to a loss of protection against ingested carcinogens such as tobacco smoke compounds and/or carcinogenic mold toxins. This loss of protection allows development of cancer-inducing mutations in the stomach mucosa.

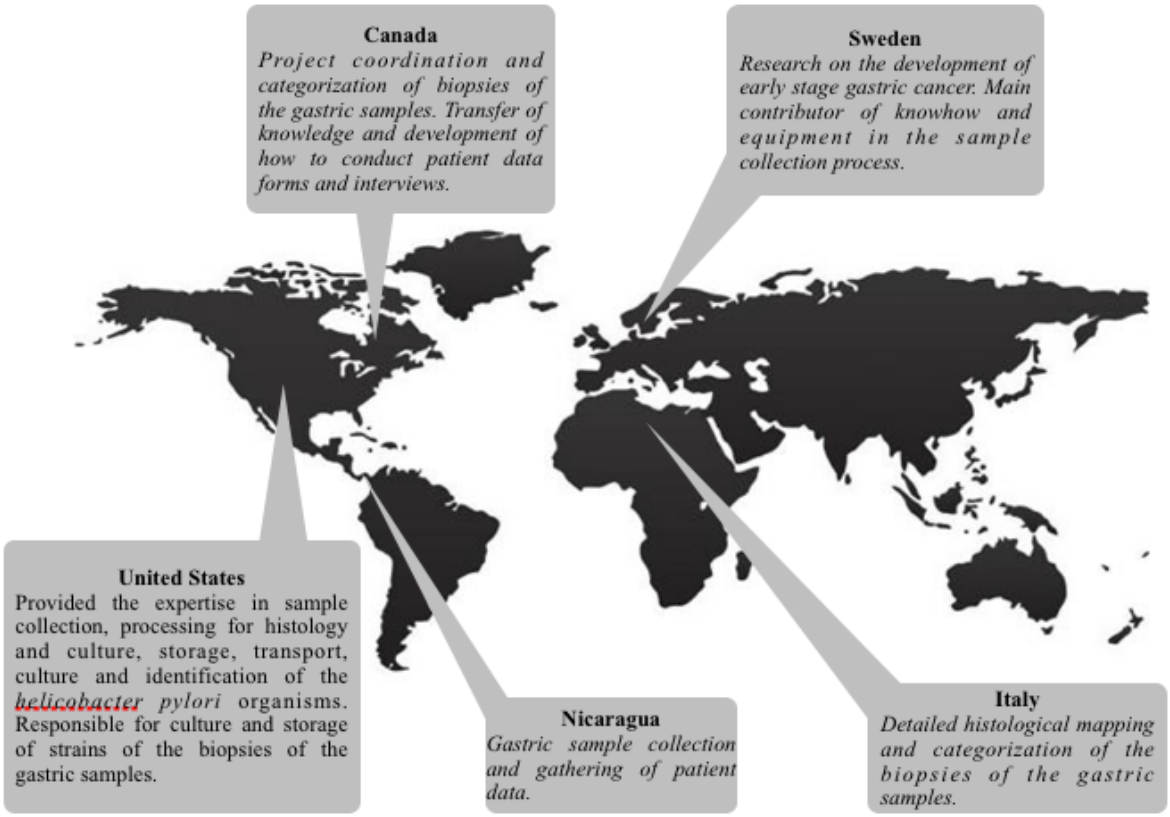

Figure 2: Overview of the collaboration and its partners.

1.1.2 Problem Statement

The increased knowledge transfer within the globalized knowledge based society creates new opportunities for research to be utilized globally. Within the medical field, utilization of medical research is often adopted to the northern market, disabling development countries to afford some of the newest medications and tools. In Nicaragua the lack of knowledge and funds contributes to the country offering ineffective medicine. In more developed countries we often have an opposite problem. We have knowledge that expensive treatments are of little benefit but pay for them anyway, which creates a mismatch. If the goal was to develop a solution that was affordable to both southern and northern countries, the distribution of resources would be more even and there would be a higher collective benefit. Considering the NGC Project, due to the mismatch it is of importance to secure access for all collaborative members to the results for a potentially future developed solution.

1.2 Purpose

The purpose of the thesis is to, by using the case study of the NGC Project, suggest relevant commitments for the group in terms of ensuring efficient transfer of knowledge as well as evenly distribute the output of both research result and potential commercial solutions between the parties.

1.3 Research Questions

To be able to answer the purpose, the following research questions are formulated and will be answered during the report to support the aim of the purpose:

1. What are the main challenges facing North-South knowledge transfer in Nicaragua in general and the Gastric Cancer project in particular?

2. How is the Gastric Cancer knowledge transfer project organized and how could it be improved?

3. How can the research results of the project be utilized and controlled to benefit all parties in the collaboration and at the same time contribute to increased resources of Nicaragua?

1.4 Delimitations

Knowledge transfer between north and south countries is a two way street, beneficial for both. Though there are multiple literature taking the perspective of transfer both north/south and south/north, both equally interesting. In this thesis though, the focus will be on north/south knowledge transfer and how that effects the collaboration of the case study.

The collaboration involves Nicaragua, Sweden, Canada, USA and Italy but the focus will be on the link between Sweden and Nicaragua for the scope to be feasible.

1.5 Thesis Outline

The thesis will be divided as shown in figure 3. Followed by the introduction, the methodology and theoretical framework will follow as a foundation for the empirical data gathered and the analysis made. The thesis will end with a conclusion formally answering the research questions and thereby also the purpose. Finally, recommendations for the NGC Project will be given.

1. Introduction	Introducing the concept of technology transfer in connection to the knowledge based society. The importance of the concept in academic research today and also the problems that might occur in north/south collaborations are questioned and compared to a multinational collaboration, which will be used as a case study. From this the purpose and research questions are derived
2. Methodology	Presents the research strategy of the report as well as how the purpose and research questions are going to be answered. The validity and choice of method is also discussed.
3. Theoretical Framework	The theoretical framework that builds the foundation for the analysis and also how the empirical data was gathered. The framework includes the understanding of knowledge itself and how knowledge transferred can be captured in frameworks in different angles. A section about the ownership and commercialization of research results ends the chapter.
4. Empirical Findings and Data Reflections	Data gathered from interviews with people within the collaboration and also people knowledgeable within the scope of the subject of the thesis.
5. Theory-Based Analysis	Connects, reflects and discusses upon the theoretical framework and the empirical data.
6. Conclusion	Formal answering of the research questions and thereby also the purpose of the report.
7. Recommendation	Recommendations for the collaborations used as a case study based on the analysis and conclusions.

Figure 3: Overview and structure of the thesis.

2 Methodology

This chapter will explain the methodology used in the thesis starting with describing what data that is required to answer the purpose and the strategy for acquiring the data. The choice of context will be described to anchor the research in a realistic setting. The relevance of the study will also be motivated as well as a detailed description for collecting the different data needed. The chapter will end with critics regarding the research quality and the implications it might have.

2.1 Required Data

To fulfill the purpose of the report there is a substantial amount of data that has been gathered, both from already existing research and new empirical data related to the case. The project has been thoroughly studied involving all parties of the collaboration in the different countries with a special focus on the Nicaraguan and Swedish relation. A deep literature review has been done to grow the basis on which the analysis is made. It has been done as extensively as possible to increase the trustworthiness as well as credibility of the report (Bryman & Bell, 2011).

Below in figure 4, the required data based upon the research questions is shown. The data gathering is done in three phases, which were done somewhat stimulatingly. Phase 1 is the study of the case through interviews and observations of the case with the aim to overall understand the project and its challenges. Phase 2 will include a literature review to build the foundation on which the interview questions will be built. The interviews in phase 2 were more extensive and deep compared to the general ones in phase 1. In phase 3 the material gathered was analyzed based on the sub questions listed in each phase. It was meant for the study to start broader but later be narrowed down using the interviews, as suggested by Bryan & Bell (2011).

Phase 1 *Field Study & Interviews*	**Phase 2** *Literature review & Interviews*	**Phase 3** *Analysis & Conclusions*
RQ 1		
The knowledge that has been transferred in the project.	Study the nature of knowledge, the absorption of knowledge and the creation of knowledge. What knowledge transfer frameworks exist today in different contexts? (Look at approx. 10 frameworks)	How can the nature/absorption/creation of knowledge be applied to this project to create a better understanding? Which framework or combined framework would be the best?
The challenges with knowledge transfer today within the collaboration and in Nicaragua	Study Nicaraguan country and culture barriers that exist today.	How can the barriers be overcome, both country wise and in general.

RQ 2		
The organizational structure of the project.	How do international collaborations work today and what main issues/challenges there might be? What are the challenges with knowledge transfer in Nicaragua specially?	How can the organizational issues be overcome? How can they be minimized, eliminated and avoided?
The setup of the other bio bank collaboration in Leon.	Compare the project in Leon with this one in Managua. Compare with other successful north/south medical or unit-to-unit project collaborations.	How can the collaboration be better structure based on best-case scenarios and learning from other projects?
How is the knowledge utilized today.	Intellectual asset management in Nicaragua.	How can IP help? How can intellectual asset management work in international research collaborations to generate value for all stakeholders within the collaborations?
RQ 3		
The goals and intentions of each of the members of the group.	The experience from others of working north and south. What needs to be done for the Nicaraguans to benefit from it?	How can incentives for making Nicaragua better be achieved?
What everyone think is the long-term goal of the cooperation?	What is required to develop a biomarker?	How can a business model be adapted to this? How can we commercialize it? What is required for the research to turn into innovation?

Figure 4: Data required for all phases of the project.

To be able to answer the first research question the collaboration was studied in regards to the institutional issues in Nicaragua. Based upon this, the second research question was answered by understanding both the collaboration itself on a macro but also on a micro level; both the organizational structure and also the incentives of all the people involved in the study. Based upon literature and a study of the project in Leon a comparison was be made between the NGC Project and best practice examples. To be able to answer the third research question the future goal of the project was investigated and how the results could be commercialized based upon the knowledge of biomarker development and other commercialization alternatives.

2.2 Research Design

The design of the research will constitute of a case study research, where the NGC Project will be used as the case study. A case study research is based upon thorough analysis of one single case that later can represent the context it is connected to. Case study research has shown itself useful in business management research and has contributed to some of the best-known studies (Bryman & Bell, 2011). Furthermore, in political science analysis, case studies of policy-making processes have been seen as one of the most important methods and have also been used in many decisions (Yin, 2003).

For the most part a qualitative method will be used for gathering data through observations and semi-structured interviews. The use of research questions to answer the purpose has been used to strengthen the quality and avoiding poor research (Bryman & Bell, 2011). During the study, theories and frameworks will be studied and applied to the findings found simultaneously throughout the research.

2.2.1 The Choice of Case Study

Gastric Cancer is one of the most frequent causes of death from cancer in the world. The complexity of gastric cancer is to a large extent related to the symptoms since they are complex too distinguish from a generic feeling of illness with symptoms such as dyspepsia, pain, nausea, anaemia and early satiety. When people in socio-economically challenged regions suffer from these symptoms they often lack the opportunity of basic health care and the cancer will stay undetected, often with a fatal result as outcome. The World Bank (2007) states that lives and welfare are dependent on the dissemination of technology and significant knowledge in the fields of improving public health, among all, hence the relevance of the subject.

As one of the key vehicles of modern economic development is an advance in technology, the transferring of the technology of the right terms is important for global development (Chen, 1994). As the research tradition in Nicaragua used to be non-existent, there is a mutual need of research to be established there, as well as knowledge to be exchanged with foreign countries. Both knowledge exchanged to and from Nicaragua. As this project serves an important purpose in finding biomarkers and future development of therapeutics for gastric cancers and involves many larger research institutions, it functions as fair representative project of a north south research-intensive collaboration. Furthermore, if this study can help the NGC Project and similar

collaborations to more efficiently use their resources and foster economic growth, this study will serve its relevance and purpose.

2.3 Data Collections Methods

The data was collected using a literature review, study of theoretical concepts and through interviews. The get an understanding of the subject a literature review of the nature of knowledge and knowledge management was made. To understand the collaboration and its challenges, interviews with people internally in the project was made. It was also necessary to get an understanding of the research and business climate in Nicaragua, why interviews with the medical university in Leon and other universities in Managua was made as well as interviews with governmental institutions and the hospital management.

2.3.1 Literature Review

In parallel with gathering data about the project, the initial step of the research process was to conduct an extensive literature study to broaden the theoretical basis of the thesis. Fundamental literature as the nature of knowledge, absorption knowledge and the creation of knowledge was first gathered. Other interesting and essential fields of literature include knowledge transfer frameworks, technology transfer frameworks connected to development countries, fundamental understanding on how research work in development countries and especially Nicaragua and also the ownership of knowledge in terms of intellectual asset management.

As mentioned above, the literature review was of abductive nature. The literature collection was focused around digital academic databases such as Google Scholar and Chalmers eLibrary. To make sure that the literature was up-to-date and regarded significant, references from persons known in the field were used. Guidance from professors within appropriate areas was used to find these fundamental works and to give initial guidance. In order to gain credibility and trustworthiness of the study the literature review needs to be extensive (Bryman & Bell, 2011), which it was aimed to be.

2.3.2 Interviews

The interviews will be divided into two studies; one internal and one external. The internal study involved persons participating in the NGC Project and the external study involved people that are knowledgeable within research and business in Nicaragua. In total, thirty organized

interviews were made, distributed as shown in figure 5. Other data was gathered through observations and unexpected meetings.

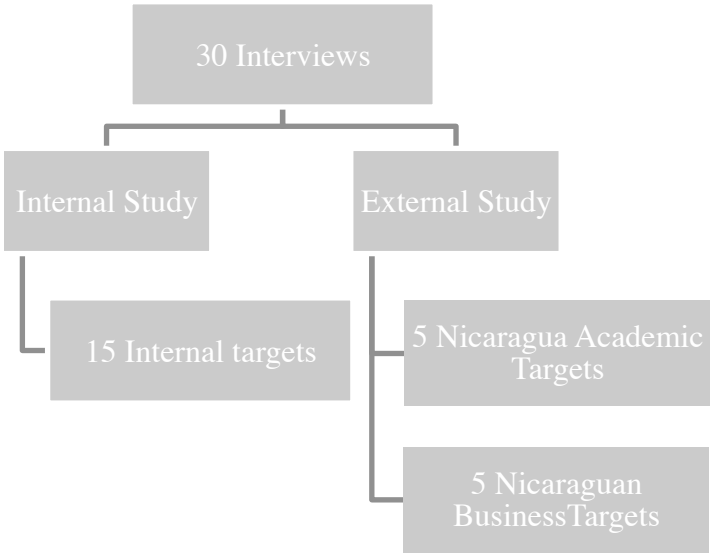

Figure 5: Distribution of interviews.

2.3.2.1 Internal Study of the NGC Project

The internal study was based upon information gathered from interviews with the participants in the NGC Project, generating data on their view on the development of the project. Persons of the hospital's board of directors was contacted and asked for interviews to communicate their views on the value of the project from the hospital setting. The interviews will follow the same structure as described in Appendix 1. The persons input in terms of his/hers area of expertise will serve as the basis for the questions asked, where the output will be compared to the other persons with the same kind of input parameter.

2.3.2.2 External Study of Nicaraguan Research and Business

The external study was based upon information gathered from persons skilled in the field of the study. For the legal considerations people working with international IP questions will be interviewed as well as local institutions working with legal issues. Universities and research centers in Managua and León was also contacted for the ability to ask how they generally handle collaborations in terms of IP and knowledge transfer. There are also various international researchers within the field, where the most relevant will be asked to participate in interviews. This research project is based in Managua, but there is a similar biobank setup in León, which also is going to be studied to be able to give a comparative study and to be able to validate the result.

Person	Institution	Contribution to the thesis	Mean of contact
Managing Director	Industrial Property Office Nicaragua	Knowledgeable of the IP management in Nicaragua	Personal interview
Head of the Nicaraguan Academia Organization	Universidad Central Americana	Knowledgeable in university research and utilization of knowledge.	Personal interview
Doctoral Student	Universidad Centralamericana	Her knowledge about the hospital system in Nicaragua and the challenges it faces.	Personal interview
Doctoral Student	Stellenbosch University	Specialized in Technology Transfer between industrialized and developed countries.	Email Interview
2 Professors and the Managing Director	Medical University of Leon	Responsible for a similar biobank research project in Léon, who can give their perspective on their collaborations as a minor comparison.	Personal interviews
3 Advisers	Ministry of Development, Industry and Commerce	Knowledge about trade and business in Nicaragua.	Personal interviews

Figure 6: External contributions to the empirical findings.

2.4 Research Quality Concern

The validity of the research, to which extent the statements are well founded and correspond to the real world (Bryman & Bell, 2011), is continuously investigated through the report. To be able to increase validity of the project another biobank collaboration was studied at another research institution for a comparative study. The thesis will be based on a structured research methodology with clear incentives to increase validity throughout the study. It is important though to remember that there are no correct answers and the truth is subjective in qualitative research as reality can be seen from different perspectives (Bryman & Bell, 2011).

During the entire process triangulation has tried to be used to ensure validity and internal reliability as suggested by Bryman & Bell (2011). Persons with different backgrounds have been asked the same questions to try to get a fair perspective. Generally, Nicaraguan medical statistics is hard to find, why public statistics rarely will be referred to, which is a quality concern of this research. Also some of the literature is based on the suggestions of the interview objects, hence the review could therefore be a bit narrow and angled towards their field of interest.

Due to the cultural difference of the author and the interviewees, there might be difficulties in understanding and interpretation of results as both the language and the educational background differs. To avoid the language barrier translators have been used and to avoid the educational background the author has studied the basic medical theory around gastric cancer. All interviews have also been done anonymously to be able to collect as honest answers as possible. This might later be a quality concern regarding to the sources, as they cannot be questioned again or support their answers.

Regarding the study in whole, the data collected have been critically reviewed and discussed with the persons involved so that the aim of the thesis is well understood to increase the ability to collect as honest and pure data as possible.

3 Theoretical Framework

This chapter begins with describing the nature of knowledge and how it is put into a business context, first generally but later focusing on the academic setting in north/south collaborations. Frameworks describing ownership of knowledge and the transfer of knowledge with different focuses will contribute to a large part of the theoretical framework, which will later be used in the analysis.

3.1 The Nature of Knowledge

Multiple articles have been published on the topic of knowledge management and especially in the corporate setting. This has increased due the nowadays generic concept of the knowledge based society and the statement from Grant (1996) as knowledge as the most sustainable competitive advantage. What used to be natural, sharing knowledge, has now become the concept of *Knowledge Transfer* developed as an invention by the industry. (Berkovic & Feldman, 2006) Putting knowledge in a context is complicated due to its dynamic characteristics. It is therefore important to dig deep into knowledge and its characteristics to better understand the complexity of knowledge management, knowledge transfer and knowledge ownership and how it can be controlled to be able to later analyze the situation of the NGC Project.

3.1.1 Knowledge as a Dynamic Process

There has always been a focus on information sharing within firms and organizations and the importance of communication has also been stressed. By adding information and communication together, the transfer of knowledge gets more complex. The difference between knowledge and information is that knowledge is context dependent and tacit. This is why knowledge transfer is trickier and problems cannot just be solved with an information transferring processes. To be able to transfer knowledge it is necessary to understand the nature of knowledge, its attributes and knowledge as a dynamic process. (McInerney, 2002)

By looking at the definition of knowledge in the Oxford Dictionary (2014) is says that knowledge is ”Facts, information, and skills acquired through experience or education; the theoretical or practical understanding of a subject”. The definitions tells us that even though the word is a noun it is defined by verbs in terms of ‘acquired’ and ‘understanding’. From this it can be concluded that the nature of knowledge is based on a process showing its active state. Knowledge is changing with the human experience. It changes through education and learning,

hence it is never static. (McInerney, 2002) Therefore knowledge can be seen as a process in relation to its attributes.

3.1.2 Attributes of Knowledge

Due to the dynamics knowledge is personal, subjective and conceptional. It is highly dependent on the sender and the receiver of the knowledge, their previous experiences and their personal nature of processing information given to them. There is a difference between the attributes of knowledge compared to the context of transferring it, but the attributes will be highly dependent on how the knowledge is going to be transferred from the sender to the receiver and also how it should be interpreted.

Michael Polanyi (1958) was a physical chemist who dedicated ten years of his life on his signature project *Personal Knowledge*. He maps out an intellectual landscape and is showing that knowledge has little value without any personal involvement. Polanyi separates knowledge into the categories tacit and explicit, based upon its form. The explicit knowledge is referred to as a knowledge artifact where knowledge is captured and documented somehow, like recorded or written. Explicit knowledge is easier to transfer than tacit knowledge, which is more subconsciously captured in the mind of the possessor, unspoken and hidden. The characteristics of tacit and explicit knowledge respectively are shown in figure 7 below.

Implicit or tacit knowledge	Explicit knowledge
Subconscious	Formally articulated
Perceived	Elucidated
Unaware	Aware
Difficult to articulate or unspoken	Fixed
Experience based	Codified
Transferred through conversation	Documented (written, taped, recorded, digitalized, etc.)
Embedded in stories and narratives	Stored in repositories (databases, files, etc.)
Escapes observation	Can be viewed or heard
Held within self	Shared with others
Personal	Organizational
Insights and understandings	Pushed or pulled
Judgments	Reports, lessons learned
Assumptions	

Figure 7: Characteristics of tacit and explicit knowledge.

The idea of documenting all knowledge could be tempting, but Polanyi (1958) argues for the ideal state of explicit knowledge is self-contractory as it contains components of tacit knowledge and if formulated it is meaningless as it always is going to be some tacit component still hidden for full understanding.

Regarding knowledge management, there are problematic aspects that resides due to that knowledge originates and resides in the mind. You can't separate the mind and the body why understanding sometimes are connected to feelings and emotional factors. This isn't always a bad thing, and it is what knowledge sharing is built upon. It is a social meeting between the sender and the receiver, why trust is very important. Knowledge could be considered a social value that can't just be transferred by itself without building some kind of relation between the parties that will absorb the knowledge.

3.1.3 The Absorption of Knowledge

Kogut and Zander (1992) state that "sharing and transfer of knowledge within the firm is more efficient than the replication of the same process through market transactions." This means that it is more profitable to spread best practice solutions by learning how to solve a problem rather than buying the solution. Simonin (1999) argues for this as the main driver of knowledge transfer and the urge to absorb knowledge.

Absorption of knowledge is a process takes place in the mind (McInerney, 2002). It is not strictly an intellectual activity because it depends not only on mind activity but also physical activity, sensory experience and mindful cognition. Knowledge comes out of consciousness, which can only be rationalized and analyzed as an activity by the mind. Therefor the absorption of knowledge is dependent on the combination of the physical and mental parts of the body. Hence, it is argued for the importance of physical meetings and face-to-face interaction in knowledge transfer. The understanding of the mind-body connection is therefore essential, involving intuition, emotions and experience. Speaking of knowledge as only mind-residing therefore ignores the aspects of the whole human integration within knowledge transfer.

There is a difference of absorption between individuals and within organizations and collaborations. Knowledge sharing within groups is referred to as common knowledge and is also tied to competitive advantages of organizations. Quoted by Thoreu (1949) "knowledge is to be a acquired by a corresponding experience". This means that the experiences of the individuals in the group are what create knowledge, and if shared and used, it will contribute to an advantage over another organization. Since knowledge is transferred within the network of people, the human interaction contributes to how the knowledge will be sent and received. Then considering

knowledge as a social value it needs to be treated as such, increasing the importance of physical meetings with a positive vibe within the group for it to be absorbed in the fullest.

The absorptive capacity of knowledge within an inter-organizational knowledge transfer context is dependent on both the individuals as well as the group, containing of the essential determinants in figure 8. First of all, a basic determinant is the emotional atmosphere in the relations (Nieminen, 2005). Mutual trust is important in the regards that behavior needs to be consistent both now and in the future. Mutual trust is therefore also needed for the transparency of the parties, which is a key factor in successful knowledge transfer. Therefore there is a need for support structures that can help to maintain the transparency and also work towards backing up the goal of the relationship. The mutual intent of the relationships includes the willingness to learn and share for a mutual benefit, which is a part of the dominant logic that needs to be clear for all parties.

The ability to receive knowledge is also dependent of the organizational receptivity of the parties. It is the ability to identify, understand, process and transfer knowledge. It includes the organizational and individual characteristics that support inter-organizational learning and knowledge transfer. The organizational receptivity of a group and its characteristics decides how efficiently it will absorb new knowledge; prior knowledge base, shared identity, national cultures and organizational cultures. (Nieminen, 2005)

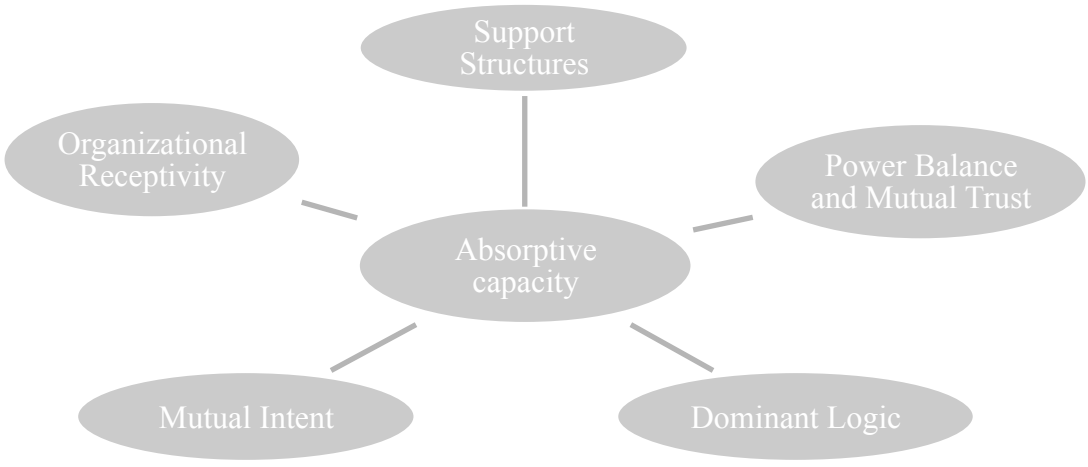

Figure 8: Components of absorptive capacity.

The prior knowledge base of the parties is an important foundation in the groups for them to be able to evenly share knowledge under the same circumstances. If one party is lacking necessary knowledge, their absorptive capacity has a chance of being not as efficient making it hard to process new knowledge. To be able to integrated new knowledge, there needs to be a certain amount of prior knowledge to be able to understand the further developed knowledge. (Nieminen, 2005)

A shared identity within the collaboration is also essential since it lowers the cost of communication. Coordination, communication and learning reside mentally within an entity forming a social identity. If the social identity between partners differs much, the cost of communication and collaboration will be higher due to certain tacit rules of coordination. If the organizational environment and perceived values differ a lot, it will cause challenges in knowledge transfer. (Nieminen, 2005)

The differences in national cultures are partly a cause of the tacit rules for communication, coordination and learning. Often difficulties regarding national cultures occurs when one party is unwilling to adapt to another's values, manners and ways of procedure due to comfortability. Cultural differences is generally a problem in relationship management, but is important in knowledge transfer due to opportunism and the need of mutual trust. (Nieminen, 2005)

The challenges within the cultures in organizations themselves are affecting the compatibility of the learning intents of the parties. It can have implications on inter-organizational knowledge transfer in the dimensions of how the perceive cooperation as a way of operating, the way learning is encouraged and the operational level of interaction and cooperation. There are challenges in the supportive structure of organizations to efficiently adopt, interact and learn from other organizations, which are all essential parts in knowledge transfer and the adoption of knowledge. (Nieminen, 2005)

3.2 Transfer of Knowledge

Knowledge transfer increases in importance as the sharing of knowledge and technology between organizations is growing. It is dependent on both how the organization is responsive to acquire new knowledge and also how they will manage the knowledge that already exists within the organization. Below, frameworks regarding knowledge transfer itself and challenges

organizations face is described with a focus on the difficulties due to the nature of knowledge as well as internal structure within the organization.

3.2.1 Understanding Organizational Receptivity in International Collaborations

Within collaborations, the organizational receptivity measures the ability to identify, understand and transfer valuable knowledge. The organizational receptivity differs among teams internally within one organization and differs even more regarding external teams. In multinational collaborations the organizational receptivity is one of the largest factors for successful knowledge management and is dependent on the following according to figure 11. (Nieminen, 2005)

In knowledge transfer the challenges is to develop new competencies by transferring and integrating knowledge from external sources into the organization's knowledge base. This is even harder if the knowledge base differ, not only from organization to organization, but country to county. It creates barriers when transferring knowledge based upon different bases due to limited prior related knowledge, which in a knowledge transfer setting is used to process newly acquired knowledge. (Nieminen, 2005)

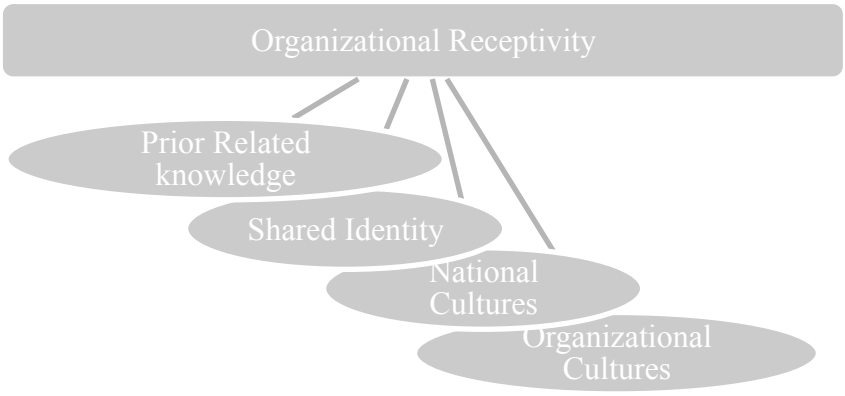

Figure 9: Components of organizational receptivity.

The organizational receptivity can be divided into 4 components, where all affects an organization's ability to transfer and absorb knowledge. In a north-south setting, due to different history and origins, the factors can differ more compared to countries that can offer the same conditions. Prior related knowledge, as discussed before, has an impact in the ability to absorb

new knowledge depending on the level of understanding that can be gained based upon what is already known. (Nieminen, 2005)

The social factor when transferring knowledge contributes to the union between the sender and the receiver and affects the ability to both transfer and adopt new knowledge. The social identity among organizations, the fact that coordination, communication and learning reside mentally within an entity, lowers the cost of communication if shared. It also sets tacit rules and values regarding learning and coordination. If the social values differ between the organizations or countries, it naturally creates challenges in the transfer of knowledge. (Nieminen, 2005)

Therefore it is necessary of improving the shared social identity in order to increase the ability to communicate the essence of tacit knowledge efficiently. This is related to trust and mutual understanding by the parties. If a strong enough identity resides in the parties separately, there might be a strong resistance of adapting to other ways of learning or absorbing knowledge, which is used by the other party. By having a common language, norms, values and procedures that is co-developed of everyone involved the social identity can be strengthened. This is more important the more diverse the background of the group is. (Nieminen, 2005)

Apart from the social identity, other identities like the professional and national may also sometimes differ creating barriers in knowledge transfer. For example in countries where the educational system differs may contribute to different professional identities in multinational group where individuals have gained different knowledge. Cultural values might also differ as time management, depending on the national culture. Hence, a shared identity in terms of both social, professional and national is desired to avoid or minimize challenges in knowledge transfer. (Nieminen, 2005)

The dependence of both the national and organizational culture has impact on the relationships within and between organizations because “people are more comfortable in working with others with similar values and manners” (Child & Rodrigues, 1996). This is often related to traditional relationship management and is important especially in knowledge transfer since knowledge is tacit (Nieminen, 2005). As the relationship matures and the shared identity is more distinguished, the challenges in knowledge transfer are minimized.

3.2.2 The Casual Ambiguity of Knowledge

Causal Ambiguity can broadly be defined as the unclearity in interpretation and understanding information and knowledge. Simonin (1999) was first to introduce this factor as the main challenge in knowledge transfer and also made different hypothesis of factors that might cause casual ambiguity. His framework has been built upon by other researchers within the field, where all agree to acknowledge the centrality of causal ambiguity in the transfer process within the firm. He argues, "when the degree of ambiguity associated with a partner's competence is high, chances of effectively repatriating and absorbing the competence are rather limited". From this he states the first hypothesis, and later the following seven attributes of ambiguity.

- **Ambiguity**

H1: Ambiguity is negatively related to knowledge transfer.

- **Tacitness**

H2: Tacitness is positively related to ambiguity.

Tacitness can be defined as the accumulated amount of experiences and skills that results in learning-by-doing experiences. It is hard to transfer due to the form in which it resides. It is often hard to communicate, as associated with Polyani (1958) who argues that we know more than we can tell. Hence tacitness is positively related to ambiguity.

- **Specificity**

H3: Specificity is positively related to ambiguity.

Specificity refers to the value of assets in relation to investments. Due to the possibility of replication of products, processes and procedures the finite value of an asset is hard to define as it depends on the stakeholder of the asset. The specificity of asset valuation is therefor a challenge in knowledge and technology transfer, hence it is positively related to ambiguity.

- **Complexity**

H4: Complexity is positively related to ambiguity.

Complexity is related to the amount of interrelated processes, individuals, assets, technologies and resources that dependent on each other within corporations and collaborations. All competences and knowledge lays within multiple entities, hence the difficulty when transferring knowledge and the positive relation to ambiguity.

- **Experience**

H5: Experience is negatively related to ambiguity.

As knowledge is not static, it often requires a certain amount of skills and previous experience for the ability to absorb and process knowledge. This relation implies that the greater your amount of previous experiences and knowledge are the less risk of ambiguity of the knowledge that is going to be transferred.

- **Partner Protectiveness**

H6: Partner protectiveness is positively related to ambiguity.

Sharing information between parties is more easily said than done considering the secrecy among certain routines and processes of the corporations. The level of transparency differs. The willingness to put time and effort into the creation of a common knowledge base differs, the protectiveness of each party's resources; both tangible and intangible. This protectively is positively related to the ambiguity in knowledge transfer.

- **Cultural Distance**

H7: Cultural distance is positively related to ambiguity.

The difference in cultures contributes to more efforts put on communication and allocating common working routines and managerial approaches. Misunderstandings due to cultural differences minimize flows of information and learning within collaboration, hence cultural distance is positively related to the ambiguity of knowledge.

- **Organizational Distance**

H8: Organizational distance is positively related to ambiguity.

The organizational distance represents the differences in the party's business practice and organizational culture. The greater the difference is in corporate and professional culture between the partners, the more difficult the knowledge will be to transfer interorganizationally.

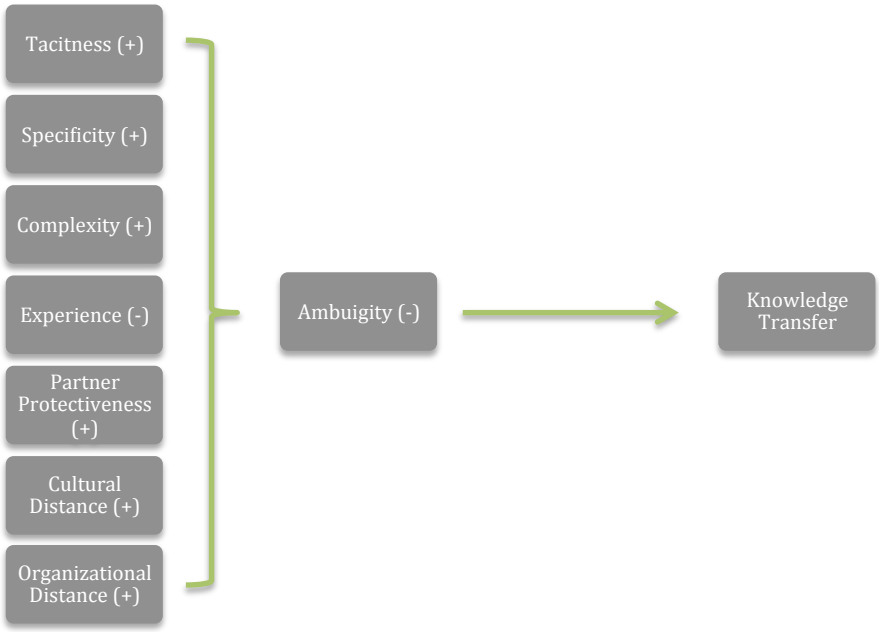

Figure 10: The seven attributes of casual ambiguity.

The framework is built upon the above-mentioned seven factors that either negatively (-) or positively (+) contributes to the complex transferability of knowledge. By testing hypothesis, Simonin (1999) tried to map what factors had the most impact on knowledge transfer and in if it was positively or negatively related. The sample was 143 mid and large sized US companies.

Testing the hypothesis, only ambiguity, tacitness, complexity, experience and culture and organizational distance was acceptable in a 99% confidence interval as having an effect on knowledge transfer. The results achieved where that "Ambiguity is a full mediator of the effects tacitness, complexity, experience and cultural and organizational distance on knowledge transfer. The effect on tacitness on ambiguity is consistently significant across analyses." (Simonin, 1999)

Managerial implications of the findings are to learn, share and protect knowledge. It implied to be cognizant of the role of ambiguity and its multidimensional nature. It requires the organizations to gestalt ambiguity within their context into its individual components to be able to tackle the challenges in organizational knowledge transfer.

3.2.3 The Mediating Role of Knowledge Transfer

Uygur (2013) has built upon Simonin's (1999) model but has reduced the factors to four. He argues that there are four attributes of knowledge that leads to transfer difficulties via the mediating role of causal ambiguity. He defines the difficulty of knowledge transfer as

complexity, tacitness, relevance of the existing knowledge case and the locality of knowledge all contributes to the causal ambiguity of knowledge, which are the main components of the difficulties in knowledge transfer. This is build upon existing literature by Winter (1987) and Zander & Knout (1995) who identifies a number of attributes that affects the transferability of knowledge such as; tacitness, casual ambiguity, relevance, carriers of knowledge and type of knowledge.

- **Causal Ambiguity**

Proposition 1: Causal ambiguity of knowledge is positively related to the difficulty of its transfer.
Causal ambiguity could be seen as the most essential attribute of knowledge transfer. It can broadly be defined as the lack of understanding and clarity in interpretation. This contributes to challenges in a business context. The unclairty that certain actions contribute to a certain successful business outcome can cause problems if not understood. The relationships between action and outcomes are not always clear. Previous studies prove a negative relationship of ambiguity and the transferability of knowledge, and so does Uygur propose.

- **Complexity**

Proposition 2: Complexity is positively related to the degree of causal ambiguity of knowledge.
Complexity of knowledge is in the terms of the different types of interaction that is connected to a knowledge asset. The relationship of complexity of knowledge is positive as the more complex the knowledge is, the harder it is to replicate. Thought the difficulty in the transfer itself due to complexity partly relies on the mediating factor. The casual connection of knowledge is harder to decipher the more complex the knowledge is, hence it is positively related to the ambiguity of knowledge transfer.

- **Tacitness**

Proposition 3: Tacitness is positively related to the degree of causal ambiguity of knowledge.
Uygur represents tacitness in a similar way as Simonin, though he stresses the focus on the lack of understanding for the causual connections of the tacitness of knowledge. As tacit knowledge is unspoken and sometimes not even the bearer is aware of it, the difficulty of the mediating role of tact knowledge contributes to its positive relations to ambiguity of knowledge transfer.

- **Relevance of the Existing Knowledge Base**

Proposition 4: The relevance to the existing knowledge base is negatively related to the degree of causal ambiguity of knowledge.

Knowledge within an organization is collective and it is not possible to localize in draw boundaries within the only one part of the organization. The practice of sharing knowledge will be of varying results within the organization. There is a common knowledge base of the organization, on which the transferability of new knowledge depends. The broader and the more extensive the current knowledge base is, the easier the transferability of knowledge. Though not always, as sometimes the ability to adopt new knowledge requires you to forget or ignore previous knowledge. Unproven knowledge is harder to transfer than proven knowledge. This is why the relevance of the existing knowledge base is negatively related to the ambiguity of knowledge.

- **The Locality of Knowledge**

Proposition 5: Locality of knowledge is negatively related to the degree of causal ambiguity of knowledge.

Four entities where knowledge resides can be identified; individual, group, organization and network. Knowledge residing in one entity is considered easier the to transfer compared to knowledge residing in multiple entities. Therefore the knowledge of an individual is easier to transfer if mediated efficiently. Knowledge residing in multiple entities will increase the ambiguity in knowledge transfer since individual-specific hazards will exist within the dynamics of the group.

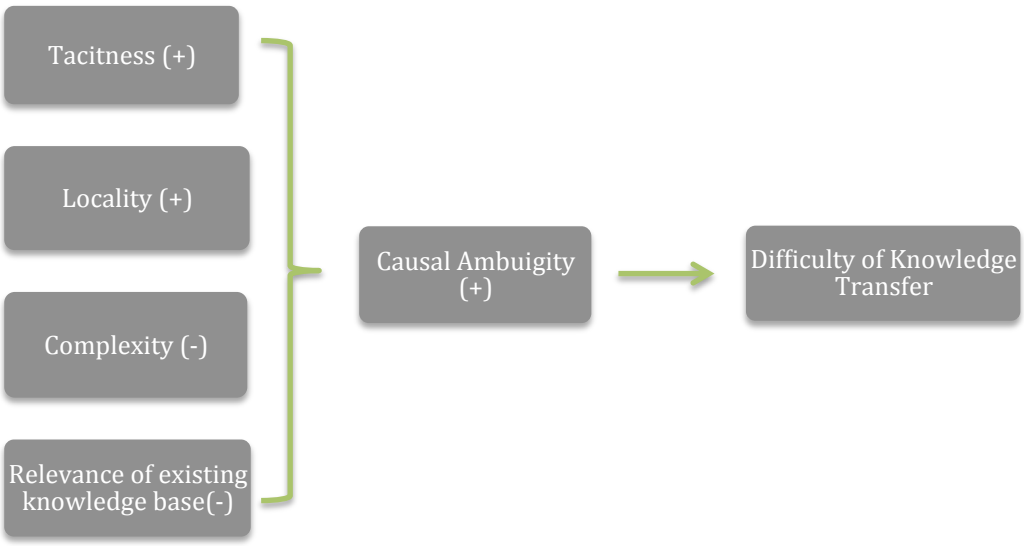

Figure 11: Components of knowledge transfer difficulties.

Uygur (2013) agrees with previous authors about complexity and tacitness as two of the main drivers for causal ambiguity in knowledge transfer. Though he argues for two other factors, similar to other research but not similarity defined, the relevance of the existing knowledge base and the locality of knowledge. "When knowledge is complex, tacit, not relevant to the receiving unit's knowledge base, and not locally identifiable within a small group of people, it is more difficult to transfer." This leads to managerial implications when there are problems replicating practices within the collaborations. All the above-mentioned challenges are amenable for managerial actions if identified within the knowledge transfer process and within the organization.

3.2.4 The Roles of Organizational Culture, Leadership and Employee Engagement

A supportive and positive collaborative culture within firms where employees can help each other can enhance knowledge transfer. Therefor the social factors in knowledge transfer are important for the ability to absorb knowledge from fellow colleagues. Three main factors can be strongly related to knowledge transfer in organizations; organizational culture, leadership style and employee engagement. (Javadi, 2013)

- **Organizational Culture**

The way things are being done in an organization and the expectations of the employee behavior is referred to as organizational culture. The organizational culture can come either from the founder, emerging over time within the organization or actively developed to increases the organization's performance. The organizational culture forms social values and norms, which can ease knowledge, transfer in terms of shared self-perceived values, which make it easier to relate to information that is given as it is given in a way that is considered natural for the adopter.

- **Leadership Style**

Leadership can be understood as the role of encouraging and guidance to achieve a certain goal that is set up. Often group dynamics require a leader to function efficiently according to psychological studies. Leadership is about coping with relationships, change management and getting everyone on the same page within the vision of the organization. The leader will help create and maintain the organizational culture desired, why the style of leadership is important to efficient knowledge transfer.

- **Employee Engagement**

The engagement of individuals is put in relation to their efforts and performance within the organization. It can also strategically be used to push employees to achieve greater goals as employee engagement has been developed as a quite new management concept. If there is an ability to be able to engage employees to perform better within the organization, it is related to the ability to want to absorb new knowledge enabling knowledge transfer and integrating with the organization.

3.2.5 Integration as the Fire of Technology Transfer

Many academic groups have a record of developing technology, but not managing it properly (Badawy, 1989). The core of effective management of innovation is to not just manage operations in the lab, but also commercializing the technology and/or spreading the knowledge. Badawy (1989) means that "managers must recognize that just doing research is not enough - they must accept responsibility for integrating all the functions of an organization in order to bring developments out of the lab to commercial realization."

The most common problem in efficient technology and knowledge transfer is the lack of communication. Transferring knowledge between organizational entities within an organization is harder due to the lack of understanding for each other's management. Therefore there is a need for someone who can serve that role as a communicator between the parties to enhance transparency and understanding among the parties. Badawy (1989) argues that there is a need of an interfacer who can help integrate the functions within an organization and thereby help reduce the challenges in knowledge transfer.

An interfacer would serve the purpose of identifying the boundaries of groups and help to integrate the functions within the organization. The tasks of the interfacer should be built upon routine work so that integration of the organization structure is done on a daily basis. Regular meetings and information sessions are crucial for the efficient transfer of knowledge and technology. The interface could be combined with another task within the operations, but it is necessary that the interface acquires great communication skills and thereby can mediate with all parties in the organization and thereby be a part of the knowledge transfer. This has been proven to be giving increasing returns in terms of increased efficiency in knowledge transfer.

3.2.6 Sender Receiver Asymmetric Information

In multinational collaborations there are a national, organization and individual difference between the parties where the involved have different background knowledge, share different language and act in different cultural norms. The differences organizationally creates a gap in the knowledge base of the parties involved, hence it creates difficulties in knowledge transfer. Asymmetric information occurs when parties does not share the same knowledge background, hence the transfer of knowledge will not be efficient. There are four types of structures that can exist within collaborations illustrated in figure 14 (Geng, Lin & Whinston, 2005);

- Symmetric complete information
- Sender advantage asymmetric information
- Symmetric incomplete information
- Receiver advantage asymmetric information

For the information to be complete it requires both the sender and the receiver to have the same information access and that they also have absorbed the given information. Often this is assumed in other knowledge transfer frameworks, but it is not always the case. There is often an asymmetric access to relevant info. In the case of the structure of incomplete information neither the sender nor the receiver are aware of the value of its information. There are also cases in between where either the sender or the receiver has an advantage over the other since they know the value of their information as well how it can be most applicable to the other party. This might also cause adverse selection. (Geng, Lin & Whinston, 2005)

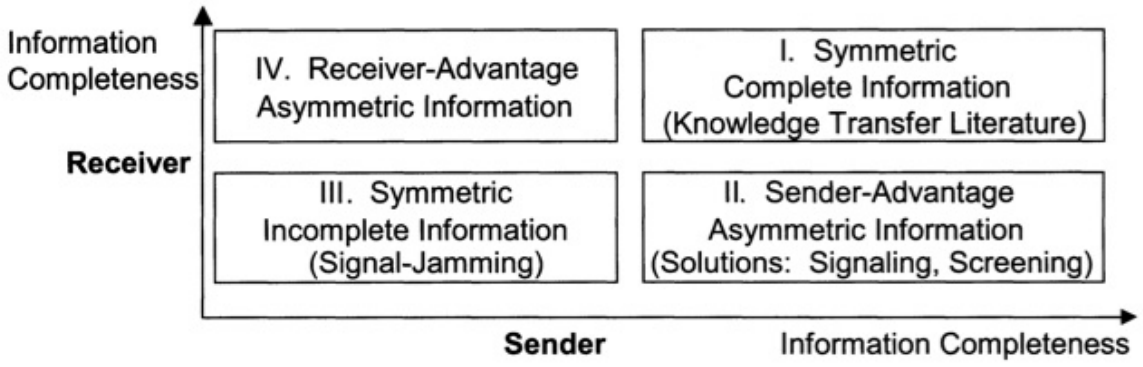

Figure 12: Sender-Receiver advantages in relation to information completeness

Knowledge transfer can be seen as a market of knowledge where the sender and receiver are the buyer and seller of knowledge. For an adequate price the seller needs to be aware of the value for the buyer, as well as it needs to correspond to the value the buyer feels it has. In a perfect market

this would be the same, but due to limited access of information either party sometimes have more info about the value, hence asymmetric information problem as well as the risk of making a adverse selection. To solve the problem of adverse selection and asymmetric information, third parties can be involved to secure the right value, such as certifications, which can be an option to avoid problems in knowledge transfer. (Geng, Lin & Whinston, 2005)

3.3 Utilization of Knowledge

To utilize knowledge there is a need of packaging it in a way it can be used and this is usually connected to commercialization. Often are commercialization of research results seen as an opportunity and not an obligation (Petrusson, 2007). It is seen as an extra income for the researcher or the university, but it is never discussed as a morally responsible decision to make. Research in terms of missionized research where funding is given earmarked for a certain cause is not necessarily seen as commercial business. The need of new sources of funding has lead to that researchers always look for new alternatives of acquiring funding. Internationally, commercialization is getting more common where the universities develop strategies on how to commercialize academic results. The risk with commercialization of results is the increased focus on money, and the not the research itself (OECD, 2013). To see the research as a commercial unit in a system where the moral and ethical values of knowledge creation and spreading is put aside for the interest of financial gains. However this issue will not be overcome by not enabling the utility of the research, rather to tackle the issue today and find structural ways of keeping research values and at the same time utilize results. One way to start may be to study different models of how the research can be owned before it is utilized.

3.3.1 Research Ownership Models

The need of determining ownership within research collaborations is necessary. Due to the different regulations worldwide and the involvement of different actors, the diffusion of rights to the commercialization of research results and the rights to the future income needs to be declared in relation to the contribution of each party. In an academic setting, where management is not profit oriented, this must be decided mutually by all parties. There are different ownership structures of results evolving from academic collaborations (Petrusson, 2007) with their own benefits and drawbacks, which will later be discussed in the analysis.

Commercializing academic results in general, there are different models applicable depending on the specific legal system and university structure within the country. This could be described and summarized as follows.

Possible owners	Ownership model	Commitments regarding knowledge transfer	Supportive institutions
No ownership	Open science model	Independent, critical and accessible research	Information spreading parties
Industry	Involving industry model	Sponsored research Missionized research Research collaborations	Technology partners Contractual parties Particular researcher
Researcher	Researcher's model	Transfer of technology Contractual research on consult basis	Researcher owned holding ventures External licensing experts
University	Licensing model	Licensing	Technology Transfer Office at university
Government	Government ownership model	Utilization of knowledge in benefits for the people	Governmental institutions
Venture	Venture creation	Incubation of venture	University holding and incubator departments

Figure 13: Ownership models of research.

3.3.1.1 Open Science Model

The open science model is a model without any ownership, and is built upon the idea that science, technology and knowledge should be developed and not utilized. The researchers should publish academic articles based upon their findings where the results should be as widely accessible as possible. The researchers are servants of the pubic and should not be involved in management working towards market mechanisms, even though the researchers do note own the results, they still control them. The purpose of this model is to create independent researchers who are not doing research with targeted goals towards the industry, rather freely choosing their scope of research. Nowadays this model is outdated, even though some think that is theory it is ideal and should be strived for. (Petrusson, 2007)

3.3.1.2 Involving Industry Model

The involving industry model is a model where the industry is offered to utilize the research results. The model is, as the open science model, built upon that the researcher should not access intellectual property rights of the research results. Though should the results be available to the

business community and therefor there should be the ability of waiting to publish research results for a certain company to make patent applications. The control of the results is still in the hands of the researcher and not in the possession of neither the university nor the industry. (Petrusson, 2007)

3.3.1.3 Researcher's Model

The researcher's model is model where the ownership of the research is given to the researcher. The researcher then has the rights to utilize the innovation and gain financial contributions for their research. The rights to commercialization are a matter of responsibility for the researcher. Even though funding might be given from the government, the researcher is still in charge of putting a price on the academics efforts made from his or hers side. This model is preferable for most researchers but still questionable due to the different views on how, in the case of publicly funded research, the results should be utilized. (Petrusson, 2007)

3.3.1.4 Licensing Model

The licensing model is a model where the university is offered ownership and the researchers are given clear restrictions in how to utilize the results. The responsibility of patenting inventions is in the interest of the university and also their responsibility. There are regulations on the reporting responsibility of the researchers as well of how they deal with the results. This model is particularly common among American universities, as they have developed such models due to the Bayh-Dole Act. In Sweden such a model would be possible, but today the university probably lack organizational structure to achieve this. (Petrusson, 2007)

3.3.1.5 Government Ownership Model

In some countries where there is a lacking organizational structure to handle the utilization of research results, the government could step in as owner. It could be regulated that the government should own governmentally funded research by law. There could be a national technology transfer function country wise to handle utilization. In a structural level the ownership could be distributed somewhat among the government, university and researcher. (Petrusson, 2007)

3.3.1.6 Venture Creation Model

Combined with the above-mentioned ownership types this model is built upon the more commonly innovation system of the university taking care of the ownership. The development of science parks and incubators are commonly occurring enabling a utilization path of research for universities by venture creation. In phase with the development of the model, the researchers will also become partly owners of the venture, which will change financial incitements of their research. (Petrusson, 2007)

3.3.2 Commercializing Biomarkers

For a biomarker specifically there are special requirements to consider before commercial adaption due to its medical applicability. The National Cancer Institute has established the Early Detection Research Network (EDN) for the development of early detection cancer biomarkers. EDN has based upon the three phases of clinical trials for cancer therapeutics also developed a five-phase guide on how to go by when getting a biomarker out to the public. (Sullivan Pepe et al., 2001)

Preclinical Exploratory	**PHASE 1**	Promising directions identified.
Clinical Assay and Validation	**PHASE 2**	Clinical assay detects established disease.
Retrospective Longitudinal	**PHASE 3**	Biomarker detects disease early before it becomes clinical and a "screen positive" rule is defined.
Prospective Screening	**PHASE 4**	Extent and characteristics of disease detected by the test and false referral rate are identified.
Cancer Control	**PHASE 5**	Impact of screening and reducing the burden of disease on the population is quantified.

Figure 14: The five phases of commercializing a biomarker.

Explaining briefly, the first phase includes preclinical studies where tumor tissues are compared to non-tumor tissues to identify characteristics of the tumor sample, which might generate information that can be used in a future clinical test. The primary goals of phase one is to identify and prioritize leads for potentially useful biomarkers. (Sullivan Peep et al., 2001)

Phase two include a clinical assay on specimen where results should be given as an immune response to a certain protein that is uniquely expressed for a tumor. The clinical assay must distinguish the non-tumor samples from the tumor samples in a promising way. Later, the primary aim of phase two is to estimate performance measurement curves (True Positive Rate, False Positive Rate & Receiver Operating Characteristics) for the clinical biomarker assays and their ability to separate subject with and without cancer tumors. (Sullivan Peep et al., 2001)

Phase three compares cancer subjects before the clinical diagnosis with control subjects with no cancer tumors to prove and provide evidence of the capacity of the biomarker to detect preclinical cancer development. The primary aim of the phase is to evaluate the capacity of the

biomarker to detect preclinical disease as a function of time before clinical diagnosis. (Sullivan Pepe et al., 2001)

Phase four investigates the nature of cancer and in which state it is in before the clinical diagnosis, compared to phase three that only distinguish whether a tumor can be detected. The primary aim of phase four is therefore to establish the operating characteristic based on screening test of the biomarker as well as its detection rate and false referral rate. (Sullivan Peep et al., 2001)

Phase five investigates weather the biomarker screening reduces the burden of cancer on the tested population as even if it contributes to early detection it might not have an overall benefit. The primary goal is therefor to evaluate and estimate the reduction in mortality of cancer by those who took the screening test. (Sullivan Pepe et al., 2001)

Finally, biomarker studies are complex and there are additional issues to be addressed. The choice of case study and control subjects are often complex and need careful consideration before deciding as well as the statistical methodology used also needs development and consideration. (Sullivan Pepe et al., 2001)

3.3.3 Biobank Ownership Issues

Biobank ownership claims are trickier due to the involvement of human samples. The ethical aspect of the value extracted from the data of human genetic samples and patient records are sensitive. The balance of the sometimes conflicting interests of the stakeholders of the Biobank could be hard to meet. There are multiple persons who could claim rights; including the patient, the researcher or the institution involved. There is a tension between two of the stakeholder's interests, where the balance often needs to be maintained. (Mauron & Bernice Biller-Andorno, 2008)

The first tension often occurs between the patient and the researcher. There could be disputes regarding the fact that what was once a part of their body now belongs to a third party. Even though a participant in a biobank gives away his or her tissues and it belongs to the biobank, a possible tension still exists. Sometimes it is also a governmental issue if human tissue actually should be owned by a third party – conceptualized as a value-creating asset, which combined with thorough records could be extremely valuable. In a possible dispute, who would get the

rights. The one the sample originally belongs to or the manager of the biobank. (Mauron & Bernice Biller-Andorno, 2008)

The second tension is territorial nation-wise. In Sweden there are restrictions regarding samples that circulated outside the country (Dillner, 2011). In southern countries this is most commonly not regulated by law. There is a moral issue if human samples should be transferred and somewhat traded among countries. There are arguments against though; science is global and one finding in one country may benefit more people than just the local population. The value stored in biobanks is in the data from of human genetic samples and patient records and there are multiple stakeholders claiming the benefits of the samples both in a scientific and in a financial way. It should be accessible anywhere. If you would like to use research based upon samples from another country, you should also share. (Mauron & Bernice Biller-Andorno, 2008)

3.4 North South Research Partnerships

Guilliard (1994) has investigated north south research partnerships among unequal partners to find if they somehow can find any symbiosis. He found that there are clear difference in functioning scientific activity between north and south, but he argues for an attempt to reduce the barriers in favor of the developing country. The collaboration will still be unequal, but the partnership can work towards having clear minimum conditions so that the inequality is reduced. There are certain points that are necessary for the success of such north south research partnerships where the partners initially have different resources and abilities.

Success factors for a north south partnership should involve a strong mutual interest in the aim of the collaboration for both parties to gain from the collaborations. Mutual involvement should when possible involve both parties in decision making, policy drafting and planning as well as the activities themselves. By involving the same number of researchers, or even more, from the southern countries it can compensate for the less amount of resources based on a monetary value that they can contribute with. Regarding the organization of north south partnerships a clear communication is important for an efficient collaboration. Research should be done together and therefor all papers should be jointly written if equal contribution has been made. This to increase the research capacity in the country and also give the ability to value all contributions as equal. For the progress of the project it is important for the project to continue after the partnership has terminated. (Guilliard, 1994)

In the Millennium Development Goals set by the United Nations there is a growing focus on "getting research into use", which need to be done by executing research programs to increase research capacities (Migot-Adholla & Warner, 2005). To be able to realize this objective there needs to be a collaboration of research institutions in both north and south as well as governmental agencies and somewhat also the private sector. Migot-Adholla & Warner (2005) describes five success factors for north south partnerships in relation to working towards to goal of better utilizing research.

- **Satisfy Individual, as well as Shared, Objectives**

Research partnerships are often driven from northern institutions where there are requirements set by a higher principal funding actor. Naturally, different institutions will have different goals and therefor it is necessary to try to consider the goals for all the partners and not just the individual ones of the funding institution.

- **Develop Internal Partnership Brokering Skills**

When negotiating research partnership an internal broker, someone who can negotiate in the perspective of all partners, could be used to neutralize and enable a fair distribution of potential research outcome. This role is not assigned, rather encouraged by an individual with the proper negotiation skills.

- **Select the Right Person to Negotiate**

Research partnerships often involve academic individuals who are motivated strongly into the particular field of research and who might not always be the optimal person to negotiate partnerships due to their will of exploring the research field. This might overcome the shared objective of the partnership, hence a person with good human relation management skills would be better suited in negotiations.

- **Clarify the Purpose of Capacity Building**

If the goal of a research capacity building collaboration differs among the partners, there needs to be consideration of all parties' desire of fulfilling their goals in relation to the others. By clearly stating this for the different partners will decrease the risk of problems regarding unnecessary quarrel.

- **Negotiate With Sustainability in Mind**

There might be diversified views in a partnership regarding the effort and the time span of the collaboration. For it to be successful there is a need of having sustainability in mind for the partnership to survive during the agreed period of time. Sustainability can be considered in terms of financial sustainability, institutionalization and outcome sustainability where both the monetary requests must be fulfilled by everyone as well as coherence of the partnership working as an institution towards a long term sustainable goal. It is necessary for all parties to share the same sustainability strategy for a partnership to be successful.

4 Empirical Findings

This chapter summarizes the findings from the empirical gathered data from both internal and external interviews. The chapter will start to introduce experienced challenges with knowledge transfer in Nicaragua in general and later within the collaboration in particular. The chapter will describe the collaboration more in detail and will end with input from a similar medical research collaboration in Leon, which will be used as a comparative study later in the analysis.

4.1 Challenges with Knowledge Transfer in Nicaragua

Nicaragua is the second poorest country in Central America except from Haiti. From being one of the riches countries in Central America in the seventies, the civil war along and nature hazards devastated a lot of the country resources and challenged its future growth potential (World Bank, 2014). The geographical location of the capital, Managua, has also contributed to complete demolishment of the city three times during the past every 40-45 year (Nicaragua Dispatch, 2014). This means historically that a lot of resources have been spent to be able to rebuild the city over and over again. Naturally, this has contributed to waning pace of economical development as the focus has been on satisfying the basic needs for the inhabitants (World Bank, 2014). Therefore, many of the challenges the country faces today are the result of the history of a poor population in an exposed area. With increasing economic activity in the country the decision makers are currently changing the focus of a controlling crisis to long-term commitments of reducing poverty (World Bank, 2014)

Health of the people in Nicaragua has improved over the past years. Maternal mortality has dropped drastically and about fifty years ago most people died before they were fifty but now the life expectancy is seventy-five (World Stat, 2014). Therefore, more people are living longer to develop the chronicle diseases of the high age and naturally cancer has become an increasing problem. Comparing with countries where most people die before forty, this does not make cancer a problem there. The challenge of cancer illness is greater in Nicaragua partly because the increase in life expectancy and a longer living population (Professor at the Institute of Health Policy Management and Evaluation in Canada, 2014).

4.1.1 Poverty and Tax Management

There is a large gap between rich and poor people in Nicaragua. In the 1980, 60% of the total county income was distributed to 20% of the population (Library of Congress Country Studies, 1993). There is an unevenly distribution of income and in the crossroads you will see the horse

carriage beside the Mercedes Benz. Though from being one of the countries en Central America with the highest level of inequality in income in 90th, now in 21th century it is one where the difference is lowest (Gindling & Terejos, 2013). The high poverty makes north/south knowledge transfer in Nicaragua harder (President of the Nicaragua Academy of Science, 2014). He argues that the decision makers investments in reducing poverty is made on a short term basis as the social programs can offers a poor family a new roof but it does not provide any new jobs or more long-term sustainable solutions.

There is a governmental system built upon tax, but is ranked the 153 out of 175 worst in the *Paying Taxes Indicator* (ViaNica, 2014). The number of people in Nicaragua that pay income tax is unofficially about 1%. Most of the people that should pay taxes do not and many are too poor to have a registered income. This is a part of the reason the basis of taxation does not provide enough money for the public sector to do much development (Advisor, Ministry of Development, Industry & Commerce, 2014).

In absence of the decrease in poverty proper knowledge transfer is very difficult. If it is the cause of corruption is hard to say as rich countries might work because they are rich and not because of the decision makers per se.

4.1.2 The Health Care System

There are three main health priorities in Nicaragua; clean water, maternal infinite health and prevention of violence against women. The government is actively working with health improvements in combination with developing the public health system that offers all Nicaraguans free healthcare (Professor at the Institute of Health Policy Management and Evaluation in Canada, 2014). The government has tried to develop a functional social security system, though it has been given poor support regarding the high medical taxes the hospital pays in regards to what is given back (Finance Manager, Hospital Management). The country tries to prioritize the health of its people, even though the system is disorganized and thereby can't always provide the health it is supposed to (Foundation for Sustainable Development, 2014).

Nicaragua is built upon a public health care system with limited resources. Legally, all people should be provided free healthcare at the public hospitals. Though due to limited governmental funds of the hospitals, care can only be given to a few and proper diagnosis cannot always be done because of the lack of both resources and/or proper knowledge and quality control of diagnosis. Therefore the public system is not always a reliable source of medication for the

people. In some cases the hospital pay for the medical treatment, but the decision on which medications that should be used is based upon what is available. The persons in charge of deciding what medication should be available do not always have the appropriate knowledge for making those decisions. It is usually the Ministry of Health that is granting the rights for a new drug to be developed and use the funds of the public medical system, even though they sometimes lack the medical knowledge about the new drug developed. (Professor at the Institute of Health Policy Management and Evaluation in Canada, 2014)

4.1.2.1 Policy Making

Due to bad policy making good opportunities can get spilled. The allocation of resources and preparation before for a health action is not always considered, which is a disadvantage that can contribute to an undesired result. An example of a poorly made policy decision by the government, though by the good consent, is a Pap smear campaign that was available to all women in Nicaragua. Initially it was a good thought but in the end it was only a political gesture, and not an action to help the poor. In Nicaragua, civil service does not exist, so the politicians have power to enforce their will even without the consent of the population.

The Nicaragua government decided to give a pap smear cancer screening to 50 000 women within 30 months as a counter-act towards the increasing cases of cancer patients in the country. According to WHO, which stated a number of principles regarding screening in 1970, there are three steps to follow. First you need a good test for the first screening. Then you need a good second test to exclude the possibility of measuring wrong to be able to provide an effective treatment and reduce death for the infected patients. Thirdly you need to do a third screening on those in the high-risk group of the second screening to give effective treatment. And all of these steps require you to have a detailed documentation of the women tested, including the contact info to get back to the women. (Professor at the Institute of Health Policy Management and Evaluation in Canada, 2014)

What happened was that the nurses gathering the information about the women did not collect all their contact info so they were unable to get the infected women in for the second screening. As they could not get back to the women, the ones needed treatments were unable to get it. This would seem as the most obvious thing that they missed and you cannot resist wondering how they actually planed to execute this, it they planned it at all.

4.1.2.2 Adapting to New Knowledge

In Nicaragua the lack of knowledge and funds contributes to the country offering ineffective

medicine. In rich countries we often have an opposite problem. We have knowledge that expensive treatments are a little benefit but pay for them anyway. There is a mismatch. You can see the trend as for example, El Salvador and Costa Rica are richer compared to Nicaragua and they don't have the same problem to as a large extent. Nor has Panama, which has quite well-developed free public health care system, according to an American professor that has worked a lot in Central America. Hen also argues that one of the largest issues lies in the poverty of people and the disability to utilize funds efficiently within the government.

In Nicaragua there are very basic problems in knowledge transfer. The best-case scenario of knowledge transfer is that the benefits of the knowledge are being enjoyed in the population. This does not happen in Nicaragua unless the knowledge can be enjoyed and used to the benefit of the government. There are many issues within politics, leadership, administration, expertise and money that usually conspire jointly to block the transfer of knowledge.

Regarding the spreading of knowledge, there is an issue in Nicaragua where people go out of the country doing their doctors degree and never come back. A small minority of people actually is coming back. This contributes to that there are not many doctors that can do research and the transfer of knowledge gets limited to the ones that are left in the country. The ones left do usually not have the ability to absorb new knowledge as easily due to their disability to expose themselves to new knowledge. Traditionally, doctors have a high ranking and have learned everything they know by the books. Trying to make them open their mind can sometimes be a challenge if they have not been exposed to that environment. (Hospital Employees, 2014)

4.1.3 Intellectual Property Trends

In Nicaragua, the Intellectual Property Office is a part of the Ministry of Development, Industry and Commerce and they handle all applications of intellectual property rights regarding Nicaragua. According to them, they have a new system of working with Intellectual Property and are happy to see that there are more local firms that apply for patents, even though the majority of the applications are from northern countries (Advisor, Ministry of Development, Industry & Commerce, 2014).

Today, there are around 240 medical patent applications per year where none is from any local firm or venture. Local firms do not have the financial ability of protecting their innovation by patents and especially the medical field it is quite unexplored locally in terms of innovation. The

most popular field of application within the area of medicine is within the field of cancer (Advisor, Ministry of Development, Industry & Commerce, 2014).

4.2 The Collaboration

What was first meant as a vacation for a Canadian professor, later came to be the start of a multinational collaboration. When the professor came in contact with the National Cancer Radio Therapy Center during his vacation in Nicaragua and they pointed out the high incidence of gastric cancer in the country, the professor helped initiate foreign support for the development of a research base for gastric cancer in Nicaragua. The project was then set off in 2008.

By combining people surrounded in his personal network, the professor extended the collaboration and searched for the competences needed. He put together a team comprised of diverse competence in microbiological and immunological research in order to build a well-characterized biobank of samples that could be used to perform research on the causes and epidemiology of gastric cancer in general and also more specifically in a high-risk area such as Nicaragua. Two local public hospitals in Managua were involved initially, but the labs were later confiscated and the activity was moved to another privately owned hospital where the collaboration takes place toady.

The ambition of the project is, by creating a gastric cancer biobank; identify a biomarker showing early stages of gastric cancer from only a blood sample instead of expensive procedures as gastroscopies and biopsies. Aside from the biobank and biomarker, the partners had the complementary, yet not official, objective to improve medical conditions for the underserved population of Nicaragua and to increase the research capacity in the country. Especially the latter was done by training Nicaraguan Pathology Residents in conducting this type of research and, through that, inspire them to continue and create further research projects. Below are the phases of the project are illustrated as well as the desired progress.

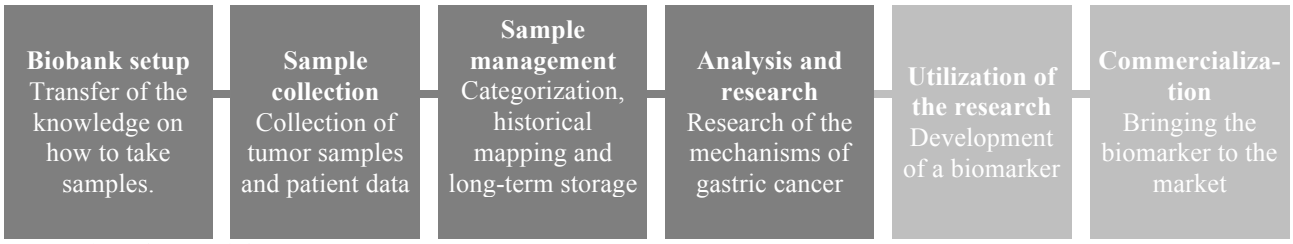

Figure 15: Phases of the project.

4.2.1 Knowledge Transferred

The university in Sweden and in Canada have had a mutual exchange of personal experiences and visits while the American and Italian universities only contributed with their competence and know-how to be able to publish articles on the subject for their own research.

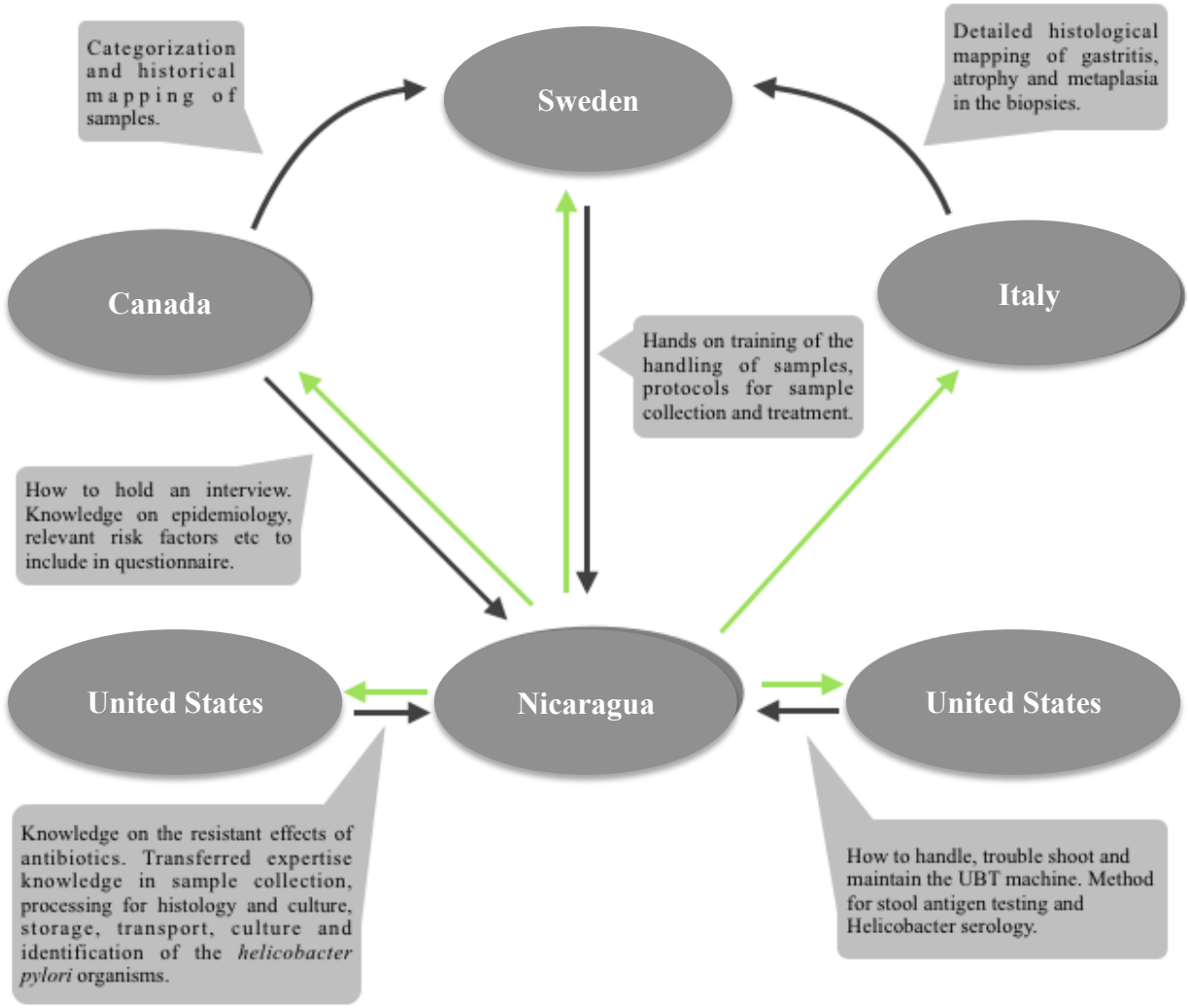

Figure 16: Blocks of intellectual assets.

The pathologists in Nicaragua would want more transparency regarding the progress of the project and the knowledge transferred in for example a blog. Without the personal meetings that happen less than once every year, there is not much update on the progress, which is desired by more than one. The picture below illustrates the know-how transferred between the involved parties.

4.2.2 Intellectual Property Rights

There are currently no intellectual property rights developed from the collaboration due it its early research phase. What is created is the foundation to an extensive research base to continue research on gastric cancer and aid development of future prophylaxis or therapy of gastric cancer, if the sample collection will progress. Know-how and data have been transferred between the parties to be able to increases the future research capacity. The know-how include the causes of gastric cancer, how to collect, store and analyze samples and how to conduct patient surveys to be able to correctly conduct further research based on the samples. In exchange for this know-how and required equipment the other parties accessed patient samples of gastric cancer tumors from patients in Nicaragua with information about the patients medical conditions. The informal setup of the project contributes to no clear ownership rights nor contracts stating ownership within the collaboration.

4.3 Challenges Within the Collaboration Disabling Efficient Knowledge Transfer

Nicaragua faces challenges in corruption and bureaucracy, which are creating obstacles for an efficient working collaboration. This has been experienced in multiple situations during the project where money, which has been transferred for the aim of the project, has disappeared in corrupt systems of institutional governance. External factors as well as internal have put sticks in the wheel. The lack of leadership and transparency contributes to slow decision processes and slows down the speed of the potential progress of the collaboration. All this fails to support efficient knowledge transfer.

4.3.1 Lack of Support From Involved Organizations

In the beginning universities in Managua was a part of driving the project together with the university in Canada. As they were the ones pushing their part in the collaboration you would think that they wanted to contribute as much as they possibly could to the project. When funding was secured for the aim of doing research, the problem was that the university did not want to increase their staff to do research. Basically they wanted research but didn't want to hire people to do it. They tried to use their original work force but as they had other tasks they could not put their complete efforts into it. This is ended up not being a sustainable solution as the university did not allocate their human resources and the project fizzled out. This generalizes some of the collaboration partners, even loose ones, which do not always feel commitments to the collaboration and not keeping promises.

4.3.2 Internal Organizational Challenges

Due to multiple focuses of the researchers and the lacking initial organizational structure the collaboration is experienced as inefficient. There is a lack of transparency in sharing information have contributed to a diverse and unsynced management where passiveness occurs due to miscommunication. By proper project management, transparency of information and a clear communication strategy, organizational issues the project now has can be minimized.

Due to trouble with funding the project suffers from a lack resources to continue on full speed. This information was held by the Swedish party and shared with the Canadian. Though when sharing with the Nicaraguan group there seemed to be some misunderstanding. All parties had different views on how to tackle the problem and how determent the trouble with funding was. The Nicaraguan group thought and acted as it was only a matter of weeks until it was solved when the actual situation was that there were no funds to continue with the sample collection on full speed. By unclear communication the problem was not dealt with contributing to confusion with the hospital. During this time, about six months, nothing was being done and the project was paused.

4.3.3 Confiscation of the Lab

Due to a change of governance at the hospitals in Managua where the project was initiated, the main driver of the project was put aside as the head pathologist in favor of the personal network of the new board. They decided not to conduct the same research and cancelled the project focusing on gastric cancer. The research group in Sweden had bought the equipment used for the gastric cancer research and even though the hospital board cancelled that research, they kept parts of the equipment and destroyed documentation. A new collaboration was soon set up at the private hospital where the samples currently are collected but new equipment needed to be bought which delayed the sample collection. Personal interests of the hospital board came in favor of the importance of the progress of gastric cancer research and the development of biomarker. This was a disappointment from all parties; especially form the Swedish side as they were paying for all the major equipment in the lab. This highlights the need of clear ownership of all equipment and also the outcome, to avoid similar problems in terms of loss of equipment and data.

Previously, there was more knowledge transferred in the previous collaborations than in the current one due to the difference in health insurance between the public and private hospital. The previous two hospitals that were involved in the collaborations were public, poorer and less

enabled to provide resources both for the research and the patients, but more samples could be taken. As the current hospital is a private hospital where operation is covered by a patient's hospital insurance and also by private investments, which means that there are less patient are treated and less samples can be collected.

Regarding the collaboration there is unfortunately an issue as the hospital in Nicaragua is not open to everyone. First of all, fewer samples are selected and secondly some money that is supported by the Swedish Gastric Association can only be used to treat patients if the treatment is available for everyone. This makes the collaborations suffer and also complicates sample taking. The fact that there are more poor people suffering from early state gastric cancer also makes it a quite large loss of the confiscation of the public hospital collaboration. The private hospital is covered by income from health insurance, which makes the gap between low and middle-income people high in terms of availability of medical care.

4.3.4 Failure in Knowledge Transfer

In the early research of the project, the team in United States discovered that the antibiotics, for a certain type of bacteria, used by the doctors in Nicaragua was not useful because the bacteria were resistant to that antibiotics. The study also included the discovery of which type of antibiotics that was efficient to the bacteria. This new knowledge was transferred to some doctors in Nicaragua, who ignored this fact and continued to recommend and sell the resistant antibiotics. The fact that the newly discovered antibiotics also were cheaper was overseen by the doctors without any given reason. The doctors were unwilling to work for compliance and try the new drug, even though it was proven cheaper and more effective. According to hospital administration, doctors suffer from superiorness and therefore many want to seek new knowledge themselves and not be told something by others, which seams silly when it is blocking the help of people suffering from the issue.

4.3.5 Unexpected Monetary Requests

Currently, the collaboration is in a pre-research and early research phase where samples have been collected and stored, but there are still organizational issues to be solved before the project is up and running continuously. Due to monetary requests of the hospital in Managua, funds are not large enough to cover all costs for salary and disposables of the sample collection. If not either more funds are raised or the monetary request is lowered, the sample collection won't continue at a satisfying pace. This situation is where the project currently is pending and the responsibility of the progress is unclear.

4.3.6 To Develop a Biomarker or Not, That Is The Question

The future plans in Nicaragua regarding the project is to continue collecting middle class patient samples and later collect from poor people when there is money to cover the insurance for the poor people to be able to send them to the current private hospital where the research is done. A fund has been created by the university in Sweden where Swedish companies can contribute for the cost of the treatment of poor people and the progress of the project. Unluckily the collection of money has been successful.

The results from Italy are important for the Swedish group in terms of developing a biomarker. It is the role of the group in Sweden to develop the biomarker. Though there is a lack of samples for the research to be truly extensive. Developing a biomarker is expensive and for it to be verified it needs much more tests than just the ones from Nicaragua. From a research context what is needed is blood samples, information about the persons tested and a good hypothesis. There also needs to be a geographical spread of the samples, which makes the development harder. The biomarker could differ dependent on the geography. The main problem is money and coordination and there are special issues to address in development countries when developing a biomarker:

- If to were used in development countries, do they work there in all regions?
- Is there a cheap enough way to measure and to be able to adopt into a therapeutic tool?

4.4 Medical Research in Leon

The medical university of Leon has various international collaborations, mostly with the United States but also a long lasting collaboration with the Karolinska Institute in Sweden. For 30 years they have had collaborations with Swedish SIDA, but it terminated a few years ago. Now they are working closely within a research collaboration, which includes a program where they have exchanges between PhD students coming and doing research in Sweden and Nicaragua respectively. The universities within the collaboration are; The Karolinska Institute, Uppsala University and Linköping University. Most professors at the medical faculty have studied in Sweden at some time of their PhD, why there is a mutual cultural experience making the collaboration easier. (Project Leader, National Autonomous University of Nicaragua-Leon, 2014)

The research they are doing is on diarrhea. The goal is to find genetic markers on why one of the mandatory children's vaccines does not work in Nicaragua. The first cause of early age deaths of children is pneumonia and the second one is diarrhea. Is it a problem, and as the only existing vaccine is not efficient enough as some of the children are not affected by it, they wants to find the genetic markers for that as well as a new vaccine to be developed from that.

This department published the most papers in Nicaragua last year. Asking the people in León for the reason their collaboration is well functioning, you got the following answer. According to the managing director of the collaboration (2014), for success you need:

- Rules
- Agreements
- Communication structure
- If you want change then co-developing is necessary and keep everyone up to date
- Rights to use samples
- Control the process to be able to ensure quality of the research
- Not support routine work but more research

4.4.1 Quality Control

Within the collaboration, the team in León stresses the need of control the research process in the whole value chain. Everyone in their collaboration is involved in meetings so they know that what they contribute with is important. This applies for both the Swedish and the Nicaraguan part. They have learned by experience the need for control within their work. In one previous project a nurse who controlling children's results in a field study did sloppy work so one year of studies needed to be thrown away. Therefore, control in the whole process is essential to ensure quality. (Project Leader, National Autonomous University of Nicaragua-Leon, 2014)

4.4.2 Communication

Communication is important within the León collaboration and they have regularly weekly, monthly and yearly meetings both internally and with the Swedish team. It is very important for all parties to be included in the progress, challenges and issues regarding the project for everyone to be one the same page. The meetings are both in person, but also by skype or conference setup. (Project Leader, National Autonomous University of Nicaragua-Leon, 2014)

4.4.3 Material Transfer Agreements

One important part of the collaboration is the material transfer agreements signed by all involved in the project. The agreements say that if a lab does research on a sample from León, the León team needs access to the results. They always sign agreements for everything on a three-year basis. The León team also needs to be included in every paper that is based upon the sample collection and research results developed in Nicaragua. They always used contracts and agreements before going in to the collaboration. The university has a policy for that in order for a professor to get a salary. This solves the issue of the university being used for only sample collection as they have the ownership rights of the samples to take into negotiation. (Project Leader, National Autonomous University of Nicaragua-Leon, 2014)

4.4.4 Negotiation Points

Co-development is important for the development of the research base in Nicaragua. To transfer technology back to Nicaragua is important but it also hard, but in collaborations it is necessary to take it back. When entering a collaboration you need to be clear from the beginning and communicate clearly that you intend to bring the technology back, so that both parties will benefit from the collaboration. When entering collaborations, HR and knowledge can be negotiated as samples in exchange of participation in research with of university persons to learn the routine. (Project Leader, National Autonomous University of Nicaragua-Leon, 2014)

5 Analysis

This chapter ties the theoretical data and the empirical findings together. The challenges of health knowledge management in Nicaragua in general and in the collaboration particular will be discussed. The theoretical frameworks will be adapted and used on the empirical data to analyze the challenges with the knowledge transfer in the project as well as organizational commitments for improvement. An ownership model as well as commercialization strategy will also be discussed and recommended.

5.1 Health Knowledge Management in Nicaragua and the NGC Project

Polanyi (1958) divided knowledge into tacit and explicit knowledge based on its form of residence; if it resides only in the mind or if it is also documented. He stresses the importance of documentation even though it is impossible to document everything and make documentation in a format that enables it to be used. In Nicaragua an issue with documentation can be identified. Files, data and information is taken very lightly upon and in several cases important documentation has been lost due to poorly performed work. In the confiscation of the lab for example, a lot of documentation was lost which could not be accessible again.

In the example of the pap smear campaign, the transformation of knowledge and information that resided in the head of the nurses was not explicit enough as they did not care to write down all relevant information. They did either not see the value of it themselves or they were not told to do so. Either way the lack of documentation and communication of the importance of it is why that project failed. In the end a lot of money was spilled on what first seems like sloppy mistakes, but looking further into it you can notice the failure of knowledge transfer as a part of the reason.

Within the collaboration there is the same issue. Between the parties within the collaboration there are no major issues, but between the doctors that take the patient samples and the pathologists there are an issue in terms of failure in knowledge sharing. The doctors won't always fill out the journals with all the relevant information, why sometimes the wrong diagnosis is done or some issue stays undetected. Even though this discussion has been up on the table during several times, some doctors feel superior the pathologists and will do as the like and not see the importance of knowledge sharing among all parties.

Within collaborations, organizational aspects of knowledge are important, but they are often disregarded. Proper documentation is sometimes seen as unnecessary or there is no

understanding of the point of making knowledge explicit. The problem also lies in sender-receiver asymmetry where the parties have different social and organizational identities. If one of the parties is sharing knowledge, the other party does not successfully absorb it.

5.1.1 Knowledge Absorption

There needs to be an understanding of the difference in acquiring new knowledge and information by doctors in Nicaragua. Their knowledge is based upon their textbooks and information from other sources is not always considered reliant. The power structure is making the transfer of knowledge hard as some doctors are unwilling to cooperate due to their appearance of superiorness. This needs to be taken in consideration when trying to implement new ways of procedures based on new knowledge. Some doctors are new-thinkers and don't apply to this stubborn group, but for some it is a slow change.

In the collaboration this had lead to failure in knowledge transfer in one clear example. It is not to the favor of the Nicaraguan people that available crucial knowledge for their wellbeing is ignored. The project failed with transferring the knowledge about the resistance of the used antibiotics and also the building scientific expertise as it was ignored. The power balance and mutual trust as in the model of Niemen (2005) was not equal; hence there is need of co-development to make everyone feel they are a part of the team. This has also been argued as one of the success factors in north south collaboration by Guillard (1994).

This challenge is one of the biggest to overcome due to the long-term cost of the country. As Kogut and Zander (1992) meant; it is better to learn and acquire the knowledge by transfer then buying it as a market transaction. Ignoring some knowledge is just pushing the problem forward. If the public prescription of antibiotics have not change now, larger costs of patient treatments will come in the future. If Nicaragua is also keeping to their health goals they will try to improve the public health care system and to do that efficiently, it would be a good suggestion to try to impact the medical care with knowledge accessible. Perhaps the right way is not to approach doctors, but looking at other institutions to go through.

Some ordinary market describing mechanisms doesn't work for the health care industry, like the cycle of adoption. Looking at the cycle of adoption in healthcare, the adoption curve doesn't apply, as there are very few early adopters of health technology in southern countries due to the extreme poverty. Rich countries can make their own decisions to a large extent on adapting new

technology or medicine. The poor countries though cannot make those decisions. The market is too regulated which contributes to large barriers of adoption.

Generally healthcare consumers are less informed, compared to for example buying a car. It is hard to be an informed consumer due to the prior knowledge base that needs to exist for the ability to be able to absorb all new knowledge completely. Most countries adopt fairly early but low-income countries adopt last. There are many things that are working against the adoption of health knowledge in development countries. For example is carbonated beverages are cheaper than milk and the knowledge about healthy food is lacking. There is an economies of scale with food production and fast food is getting cheaper and cheaper. Nicaragua is a farmer's country, but there is not as a large of a business in that unfortunately. Comparing the salary of working in McDonalds towards picking coffee beans in a coffee farm, the difference is huge.

5.2 Key Considerations in Knowledge Transfer

Considering the theoretical framework and the empirical data collected, some main considerations regarding the challenges and future opportunities can be identified to help improve the efficiency in both the collaboration and their way of operating. First, the difference in prior knowledge base between the parties in the collaboration contribute to that knowledge transferred is not as efficient as it could be and the casual ambiguity playing a larger role than it should. Secondly, the lack of integration and sender-receiver asymmetric information creates obstacles in communication, which can be overcome by an assigned communicator and clear routines in who should access all information. Thirdly, the need of a social, national and organizational shared identity will help overcome some challenges due to that all parties in the collaboration are put on the same page.

Looking at the most significant challenges, the organizational culture and prior related knowledge could be seen as the most significant challenges. As in the example above, due to a difference in knowledge based the doctors were unwilling to adopt the new knowledge. The organizational structure did not support the transfer either as the partners is not seen as equals. In figure 19 the blocks of organizational receptivity is presented and concluding the blocks that effects the challenges in knowledge transfer, with a special focus on the organizational culture and prior related knowledge as discussed above.

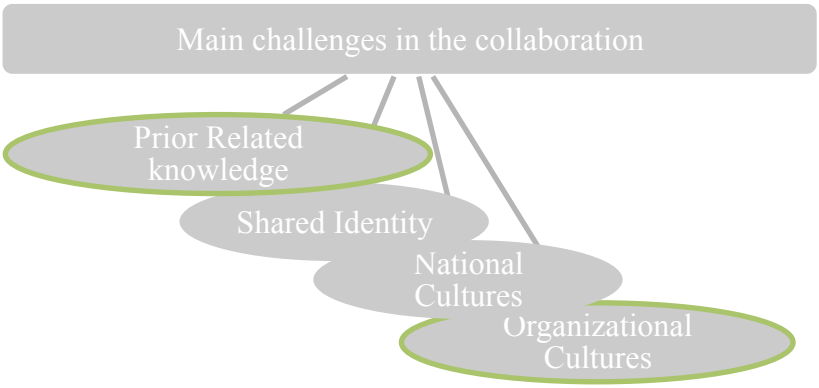

Figure 19: Main challenges of knowledge transfer within the collaboration.

5.2.1 Casual Ambiguity of Knowledge

Agreed with the previous studies by Simonin (1999) and Uygur (2013), the mediating role of causal ambiguity of knowledge and the causal ambiguity itself are affecting the efficiency of knowledge transfer. In this collaboration, the previous experience and the prior knowledge base plays a large part in the challenges of knowledge transfer. Seeing the differences in how the educational system works in terms of practical learning, which is not as sufficient for the Nicaraguan doctors, affects the ability to absorb the knowledge and relate to it. In Nicaragua traditional medicine is commonly used, which differed from Sweden as it is not that commonly used. The fact that the knowledge is complex does not have that much of affect due to that the actual academic knowledge is pretty much the same. The difference lies in the accumulated experiences and skills that make the learning-by-doing process. Comparing pathologists in Sweden with pathologists in Nicaragua, the practical research based understanding is not the same making the knowledge transfer harder. It is not necessarily bad one way or the other, but it is a mutual responsibility to catch up on the same page.

5.2.2 Social, Cultural and Organizational Differences

Simonin (1999) saw cultural distance and organizational culture as two significant contributors of challenges in knowledge transfer. As the world is getting more globalized, the latter can be considered more significant due to that there is an understanding for the pure cultural differences, but the organizational is harder. The both are tightly connected though. The differences in time management, how to address people with higher rang than you and how much you may think yourself differs in culture between Sweden and Nicaragua. You can recognized

the need of a shared identity, as argued by Nieminen (2005), to put all participants in the project on the same page and start working as a coherent team.

5.2.3 The Need of a Shared Identity

To solve the problems of a non-common existing knowledge base, a shared identity is important both socially, organizationally and nationally. For example, in Leon most professors at the medical faculty have studied in Sweden at some time of their PhD, why there is a mutual cultural experience making the collaboration easier. This requires increasing funds but can be beneficial in the end. The way to integrate and unite all parties is essential and to learn how to manage the difference that exists. By working more together such a union can be reached.

5.2.4 Integration and Communication

As Badawy (1989) argues for the importance of communication in relations to knowledge transfer and also the need of a communicator in organizational co-operations. As the NGC project does not have a clear leader, there are occasionally misunderstandings due to the lack of communication. The need of an interfacer or communicator would solve that. It doesn't necessarily need to be a leader, but someone that can be responsible of transferring knowledge and making sure the collaboration is transparent to all parties, which is desired by the pathologists working in the collaboration in Nicaragua.

Transparency is important as it will contribute to equality between the parties, argued by Lin, Geng & Whinston (2005). If the information is asymmetric between the sender and the receiver there will be challenges in the knowledge transferred as due to the difference in prior knowledge base. To avert this there is a need for organized communication, which all parties are responsible for as to assign a communicator or official project leader if necessary.

5.2.5 Success Factors of the Project

More practically, for the success of the project there is a need to include people from the government. Even though the government might be a bot hard to deal with they need to be included if the treatment for cancer was supposed to be suited here and also being available to the public. This is important for the long-term goal with the collaboration and future plans of bringing a biomarker to the market.

The initial goal of the collaboration from both sides was that people should be participating more in research in Managua. To continue with the success of the project, more expertise needs to be included the things that have failed needs to be improved. This is something the initiator of the project argues for and that the pathologists working within the collaboration also desires.

These issues in knowledge transfer can either be seen to lay within the individuals themselves, or the institutions. Governmental organizations and hospital management does not have a system of managing and acquiring new knowledge and therefor it might be harder to go trough those. Other ways of reaching out might be necessary as approaching other non-governmental organizations and working with them for a change. As the government has a lot of power in Nicaragua they often needs to be involved, but the actual change management could be easer to do with other organizations more flexible.

5.3 Comparing the Collaboration in León with the NGC Project

In Leon, another major city in Nicaragua, there is medical collaboration between Nicaragua and Sweden. This collaboration has been running for a long time and can be used as inspiration for the NGC project. One difference comparing the projects is that many of the people in Leon have been trained in Sweden, and Swedes were trained in Nicaragua. Due to the exchange program there is a natural exchange of knowledge in the project regarding the research and also on a cultural and organizational level. In Sweden they have special expertise but all the research is done in León, which integrates the two teams in their common field of research.

In Leon they have a good exchange of knowledge every year due to the exchange of Swedish and Nicaraguan researchers meet both in person as well as digitally. They try to have transparent and communicative relationship, which the NGC project could adopt. Continuous meetings take time and efforts but by doing it efficiently this will unit the team and make unwrinkled differences within the team.

The team in León has also negotiated their rights to the samples and their participation in research. They are aware of the value they can contribute to the project, and it is important the Nicaraguan group do it also. To be able to increase the research capacity in Nicaragua, such collaborations must bring knowledge back to their institutions as well as not being afraid of sharing their valuable knowledge they posses with others.

5.4 Deciding for an Ownership Model

Due to the lack of ownership structures within the collaborations there is a need of one functioning beneficial to all parties. Though considering the different resources of the parties in terms of support from the leading institutions, a model where ownership to the hospital or government is excluded. Considering the previous events of corrupted actions, the ownership must lie at those who wont use it to their own advantage. The alternative where no one owes the results are no solution as, due to globalized collaborations, it is hard to find funding using this models, especially in worldwide collaborations. Hence, the model where the researcher owns the research would be best suitable for this case.

Possible owners	Ownership model	Commitments regarding knowledge transfer	Supportive institutions
Researcher	Researcher's model	Transfer of technology Contractual research on consult basis	Researcher owned holding ventures External licensing experts

Figure 21: Ownership Models.

There should be an agreement where the ownership of the samples in the biobank is the property of the research group in Nicaragua, a similar agreement that was set up in León. This way the group in Managua can control that the samples are only used for the specific research of gastric cancer biomarkers and if not they will get to be a part of the other research results or get money from it as they will then license the right to use the samples for research.

A general thought about sharing research results and biobank data. It can be seen as a similarity of the organ donation system. If you are willing to receive an organ in case of an accident, you should also fairly be willing to give. The same can be applied to research. If you would like to use research based upon samples from another country, you should also be willing to share.

5.5 Deciding for a Commercialization Strategy

Often research is done on the cause of things and not to find a solution to a problem, which makes the question regarding the commercialization of knowledge important. To develop a biomarker takes a long time with a long regulatory process, which should not be an obstacle for the biomedical knowledge to be utilized. For the case a biomarker is developed there needs to be

a way it can be commercialized so that poorer countries, like Nicaragua, will be able to use it. There are different ways and business models looking at other field of business. The main options are though either by developing a biomarker to an affordable price for Nicaragua or by finding another business solution from which Nicaragua will benefit, reducing the prices of the biomarker secondary. Preferably, a solution where the biomarker is affordable right away would be desirable. Biomarkers are a good option to develop in southern countries as they later easily can be adopted to the north.

6 Conclusion

This chapter concisely and formally answers the research questions based upon the analysis.

Research Question 1: What are the main challenges facing North-South technology transfer in Nicaragua in general and the Gastric Cancer project in particular?

Due to the history in Nicaragua, the amount of poor people, the still-in-development health system and the governmental resistance is a challenge within north/south transfer in Nicaragua in general. Examples show that policy making is not always based on knowledge, which is a result of the challenges in adopting knowledge.

The main problems with health knowledge transfer within the project can be summarized as the lack unity both regarding background knowledge and how to utilize it, but also social and organizational values that differs.

- Confiscation of lab and lack of tools and knowledge of the system to preventing that or work pro-actively.
- Lack of communication leading to assumptions of the progress of the project that are not true.
- Lack of a shared identity why the understanding on the progress of the project is not the same between all parties.
- Knowledge is created in Nicaragua, but still not utilized and adopted. There needs to be a mutual transfer from both parties.

Research Question 2: How is the Gastric Cancer technology transfer project structured and how could it be improved?

As currently the parties of the NGC project are also involved in multiple other projects it is hard to give this project the top priority. Sometime the coordination of the project is experienced as unclear and the organization is quite flat with no clear leader.

Basic improvements in communication and transparency within the entire group in an essential block of gaining advantages of the diversified knowledge within the partners. Even without leadership, there can be better use of communication tools such as Skype to be able to talk directly to ensure that everyone is understood in how things are. Better coordination of the group would lead to easer communication and then also smoother relationships.

Research Question 3: How can the research results of the project be utilized and controlled to benefit all parties in the collaboration and at the same time contribute to increased resources of Nicaragua?

First of all, ownership needs to be applied within the collaboration with clear rights of utilization between the parties, which mutually should be decided for. The benefits of today are equipment of the lab but it can be more utilized in terms of the intangible assets. There has been a large focus on the tangible assets that are lacking for the collaboration to work, but there has been a less focus on the intangible assets. Today the group needs to get ownership of the research they have now. Contracts can be setup, as well as policies so that confusion can be avoided. Material Transfer Agreements could be organized and later also be used as a tool for financial negotiation with the hospital in terms of the high monetary requests they have which currently stops the project.

Future wise, results need to be commercialized by developing a solution of cheap diagnostic tools, which are developed for the Nicaraguan market. This can later be transferred to northern countries as it has been done in other countries. This should be a mutually agreed goal within the collaboration if the research will lead that far.

7 Recommendations

This chapter shortly describes the managerial commitments the project can enhance to make the collaboration more efficient as well some suggestions for further research to take the subject forward.

7.1 Managerial Commitments

Shortly, based upon the findings in thesis the following managerial commitments are recommended for increasing the efficiency of the project:

- **Clear communication using online project management tools and online media**

  Create a project blog where everyone has access to and where research can be posted as well as new and interesting articles that is relevant for the progress of the project. It is also good to make sure that everyone feels apart of the project and accesses information that can help improve the project. That way all individuals employed in the collaboration can be invited to contribute with suggestions of improvements.

- **Transparency using online project management tools**

  Try to be transparent when communication and be sure that everyone that needs to have certain information are getting access to it. There is good project management tools free online where info can be posted to certain groups a people, which is an easy way of not missing persons in communication.

- **Assigning ownership using contracts and material transfer agreements**

  To avoid troubles in ownership between institutions, both local in Nicaragua but also between the partied, contracts can be used to ensure that equipment and know-how stays within the collaboration. Material transfer agreements can be used to ensure ownership to the Nicaragua group to protect them and to help increase a foundation for research capacity at their place.

7.2 Further Research

The next step also covers the managerial implications when trying to implement such strategies. It is often easier said than done, so there are many issues that practically need to be solved to be able to achieve the intended differences. Future scope could investigate what challenges that will bring into these kinds of collaborating where the geographical distance is far.

The focus on the report is not the commercializing of a biomarker itself, rather how to reach a point when it is time to bring it to the market. Further research could be to investigate the steps of bringing a biomarker that have been approved and more detailed how to actually package it as a commercial product and how to adapt the local market situation of the country, in this case Nicaragua.

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9 Appendix 1: Template for the Internal Interviews

The following questions will be used as a basis for discussion around the research collaboration involving the gastric cancer biobank. The interview will be semi-structured based upon the following questions but are also opening up for discussion.

Organization

- According to you, what have all the parties involved contributed with?
- How is the collaboration organized?
- Who do you see leading the project and who makes it go forward?
- Do you feel you have the ability to push the project forward?
- If yes/no, how and why?

Knowledge Transfer

- What necessary knowledge has been transferred from the other parties in the collaboration?
- What necessary technology has been transferred from the other parties in the collaboration?
- What have you transferred to the other parties?

Challenges

- What are the main obstacles?
- How should they be tackled?
- What institutions/parties are making it hard to tackle the challenges?

Goals & ambition

- What are the goals of the project as you see it?
- How do you think we can get there?
- What obstacles/problems do you see with health knowledge transfer in Nicaragua?
- How do you think they can be solved?
- What is your personal incentive/drive to be engaged in the project?

Future utilization

- How are the research results aimed to be used?
- How do you consider yourself have benefitted from this?
- What needs to be done otherwise for you to benefit from it?
- What would you want to achieve from the cooperation?
- If we have a biomarker what would be the best way for you and your group to commercialize on it?

10 Appendix 2: Explanations/Definitions

- Bah-Doyle Act

  Patent and Trademark Law Amendments Act (1980) in the United States permits a university to choose to peruse ownership of an innovation in favor of the government.

- Intellectual Assets

  Intangible assets in terms of valuable objects such as data, databases, instructions and knowledge that has somehow been documented or codified.

- Knowledge

  Facts, information, and skills acquired through experience or education; the theoretical or practical understanding of a subject. (Oxford Dictionary, 2014)

- Knowledge Transfer

  The sharing of transfer of expertise, skills, capabilities etc. between individuals and/or organizations.

- Millennium Development Goals

  Eight goals set by the UN to be reached in 2015 that involves reducing poverty, increasing access to health and also providing universal primary education. (United Nations, 2014)

- North South Collaborations

  Collaborations among development countries with less resources than more developed countries.