EXPLORING UNIVERSITY-INDUSTRY KNOWLEDGE AND TECHNOLOGY TRANSFER: A CASE STUDY OF TWO AGRARIAN UNIVERSITIES IN KAZAKHSTAN

by

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I hereby declare that this submission is my own work and to the best of my knowledge it contains no materials previously published or written by another person, or substantial proportions of material which have been submitted for the award of any other course or degree at NU or any other educational institution, except where due acknowledgement is made in the thesis. This thesis is the result of my own independent work, except where otherwise stated, and the views expressed here are my own.

Signed: Zhanar Mazbulova

Date: June 26, 2023

Acknowledgments

I wish to dedicate this thesis to my parents, Zhangyrkhan and Gulnafis. My three children were born during my Ph.D. studies. Without my parents' enduring love, help and support, I would not have been able to study in the Ph.D. program and complete my doctoral thesis.

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Abstract

This qualitative case study explored the role of two agrarian universities in the knowledge and technology transfer (KTT) process to the agricultural industry in Kazakhstan. The rationale for choosing this industry sector was its strategic, social, and economic importance for Kazakhstan. A focus on agriculture, in this research, provided an opportunity to collect rich data on university-industry KTT. A multiple-case study design was implemented, with two universities considered as individual cases. Using purposeful sampling, sixteen faculty members from the universities agreed to participate in the study. Data were collected from documents and individual semi-structured interviews at each university. Within-case and cross-case thematic analysis was used to analyze data, form propositions, and answer the research questions.

A comprehensive model of KTT in agrarian universities in Kazakhstan was developed and presented to capture the findings generated by this study. The model identifies key actors and products in the process of KTT. Foreign universities offer advanced higher education knowledge to update higher education curricula and modernize laboratories, while technology knowledge is adopted and adapted for higher education and research, and for application in the agricultural industry. The university faculty are more involved in informal channels of KTT than formal ones. In terms of factors, funding, university-industry collaboration, personal connections, and networking with the industry is the most important factors for engaging in KTT.

This study contributes to understanding agricultural KTT in Kazakhstan, which is the basis for economic and social stability, food security, and the social transformation of the country. The knowledge from this study will enable improvement in university policy and practice to strengthen the KTT process. Moreover, the findings of this study can be transferable to agrarian universities in Central Asia and other CIS countries, as they have similar socio-economic contexts and agricultural production risks.

***Keywords**: Knowledge Transfer, Technology Transfer, Research and Development, Innovation, Agriculture, Agrarian Universities*

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Acronyms

ADB	Asian Development Bank
EU	European Union
GDP	Gross Domestic Product
GII	Global Innovation Index
HEI	Higher Education Institution
KazATU	Kazakh Agro-Technical University
KazNAU	Kazakh National Agrarian University
KTT	Knowledge and Technology Transfer
MESRK	Ministry of Education and Science of the Republic of Kazakhstan
NAREC	National Agricultural Research and Education Center
NASRK	National Academy of Sciences of the Republic of Kazakhstan
NIIP	National Institute of Intellectual Property
NSIID	National Strategy for Industrial Innovation Development
OECD	Organization for Economic Cooperation and Development
SPED	State Program for the Development of Education and Science
SPIID	State Program for Industrial and Innovative Development of Kazakhstan
UC	University of California
WIPO	World Intellectual Property Organization
WUR	Wageningen University and Research

CHAPTER 1. INTRODUCTION

1.1 Introduction

During the last few decades, the global context of higher education has dramatically transformed. Researchers have extensively discussed the link between the transformation of higher education and the rise of neoliberalism and the knowledge economy in the context of globalization (Huisman, et al., 2018; Marginson & van der Wende, 2007; Rizvi & Lingard, 2006; Torres & Schugurensky, 2002). The transformation of higher education in areas such as funding, governance, academic and non-academic activities is moving in a similar direction across different countries. In particular, post-Soviet countries, are taking a similar path to transformation by adopting mainly neoliberal policies in order "to "normalize" their higher education systems" (Smolentseva et al., 2018, p. 2).

The shift towards an innovation-driven, knowledge-based, globalized economy has changed the role of higher education institutions (HEIs). HEIs are increasingly moving from the periphery towards the center stage of societies. They have four key roles, including teaching, research, transmission, and dissemination of knowledge (Organization for Economic Cooperation and Development [OECD], 2008). They build human capital and promote social inclusion and mobility. They create new technologies and innovative solutions for challenges that societies are facing (European Commission, 2017). They collaborate with the civil society, public and private sectors to "strengthen the economic, social and cultural fabric of the localities and regions where they are located" (European Commission, 2017, p. 2). HEIs drive economic growth and development by commercializing new ideas and technologies (Bradley, Hayter & Link, 2013; Cunningham et al., 2019).

Kazakhstan represents a unique case to study as it is the only country in Central Asia that has a history of nomadic culture, with no higher education institutions before the establishment of the Soviet regime (Ahn, Dixon, & Chekmareva, 2018). The country survived the traumatic transition from a nomadic lifestyle to collectivization and communism, and the dramatic transition from communism to capitalism in just a century (Brown, 1998). Kazakhs did not experience a capitalistic free market economy before the independence in 1991. And in the 30 years since gaining independence, Kazakhstan has not yet built capitalism with a free market. Rather, like other post-socialist countries, the government of Kazakhstan chose "state-led capitalism" or "capitalism with communist characteristics" (Bolesta, 2022, p. 3). Considering the unique historical, political, and socio-economic context of the country, it is interesting to explore the influence of globalization of neoliberal capitalism and the knowledge economy on higher education in Kazakhstan.

In this introduction, I will define key concepts that are employed in this research study. I will articulate the research problem, explain the research purpose, and the central and guiding research questions. Subsequently, I will present an overview of the methodology, a summary of the findings, and the significance of my research study. Finally, I conclude the chapter by summarizing key points and presenting the structure of the whole thesis.

1.2 Key Concepts

Three concepts underpin this research: Knowledge economy, innovation, and knowledge and technology transfer. Each of these terms will be defined to support understandings of the terms used throughout the thesis.

Knowledge Economy

The term 'knowledge economy' means the "valorization and application of knowledge as a key driver of the economic efficiency, competitiveness, profitability or effectiveness of the private, public and third economic sectors, of good governance and an enhanced quality of life" (Jessop, 2017, p. 854). The dominant discourse of the knowledge economy is that economic development and productivity are now dependent on the knowledge and skills of individuals. Therefore, education is important for the global knowledge economy as it develops human capital and innovation (Spring, 2009).

Innovation

Innovation is "the implementation of a creative product or process and its perceived novelty once it has been evaluated by a critical audience" (Tierney & Lanford, 2016, p. 3). A working definition of innovation comprises the interconnected terms, "creativity, novelty, implementation, and entrepreneurship" (Tierney & Lanford, 2016, p. 3). The difference between innovation and invention is that an invention should be commercialized in the market to turn it into an innovation (Schumpeter, 1939; Smith, 2006).

Knowledge and Technology Transfer (KTT)

Knowledge transfer refers to the systems, processes, and activities that enable the flow of knowledge from higher education and research institutions to industry and other user communities (Ferreira & Carayannis, 2019; Kelly, 2008; Rossi & Rosli, 2015) to stimulate economic development and innovation (Thomas & Paul, 2019). Knowledge transfer is "a voluntary and conscious act between individuals and organizations and results in the joint acquisition of intellectual property between the source and the recipient" (Teixeira, et al., 2019, p. 450). The concepts 'knowledge transfer' and 'technology transfer' are often used interchangeably. However, according to the World Intellectual Property Organization (WIPO, 2020), technology transfer (TT) refers to the transfer of intellectual property rights (for example academic spin-offs, patenting, and licensing activities to commercialize universities' intellectual

properties), whereas knowledge transfer is a broader term incorporating technology transfer and transfer of knowledge from research, such as training, consultancy, contract research, and collaborative research.

These definitions provide a foundation for the thesis, however, the concepts will be elaborated further in the literature review.

1.3 Research Context

This section provides an introduction to the research context by describing the field of research and the specific area of study within the field. The first sub-section presents innovation policies and frameworks in Kazakhstan, whereas the second sub-section discusses the importance of agricultural research and innovation in the country.

1.3.1 Innovation Policies and Frameworks

Intergovernmental organizations, national and regional governments across the world are developing and implementing innovation policies where higher education institutions are expected to play a major role. They are promoting and investing in innovation, knowledge, creation and transfer as it leads to higher productivity and economic performance, and enhances growth and social welfare (OECD, 2010). As an example, recently the European Commission has developed several innovation policies and programs, including *A Renewed EU Agenda for Research and Innovation* in 2018, *A Renewed EU Agenda for Higher Education* in 2017, and *Strengthening Innovation in Europe's Regions: Strategies for Resilient, Inclusive and Sustainable Growth* in 2017, *Horizon 2020* in 2014, and *Horizon Europe* in 2021. These innovation policies and programs place knowledge creation, application and transfer at the heart of economic and social development. Thus, the European Union (EU) "has become more active and assertive in its efforts to influence the behavior of higher education and research organisations" (van Vught, 2009, p. 3). For example, a new EU research funding program *Horizon 2020* was launched in 2014 to facilitate the innovation and competitiveness of the EU. Furthermore, the program *Horizon Europe* was adopted for 2021-2027 as a continuation of *Horizon 2020*. The program was designed to enhance "the impact of research and innovation in developing, supporting and implementing EU policies while tackling global challenges. It supports creating and better dispersing of excellent knowledge and technologies" (European Commission, n.d., para. 4). These policies and programs show that higher education and research have been given an important role in the innovation policies of the EU over the last decade.

Kazakhstan has also been actively initiating ambitious policies to promote innovative development of the country to enter the list of the top 30 competitive countries in the world. Five laws have been introduced between 2006 and 2015, with associated frameworks and strategies, to facilitate this strategic goal. A summary of the laws is provided in Table 1. As an example, *the*

Concept of Innovation Development of the Republic of Kazakhstan until 2020 articulated that the country's innovation policy would be aligned with the strategy adopted by the OECD. The country's innovation policy is considered the basis for the future development of national identity, competitiveness, economic viability, and the welfare of citizens. The policy was developed to support the training of qualified human resources (including innovation managers); adapting research and development to the requirements of modern innovation systems; promoting research and development of small and medium-sized businesses; developing competitive innovative industries and infrastructure favorable to innovators; integrating into the global innovation system; and building the innovative potential of the regions (Government of Kazakhstan, 2012).

Table 1. Legislative and Policy Framework for the Innovative Development of Kazakhstan

Laws	Strategies	Programs
Law "on State Support for Innovative Activities" (2006)	*National Strategy for Industrial Innovation Development (NSIID) for 2003-2015*	*Program on formation and development of the national innovation system of the Republic of Kazakhstan for 2005-2015 (2005)*
Law "on Education" (2007)	*Concept of Innovation Development of the Republic of Kazakhstan to 2020 (2012)*	*State Program for Industrial and Innovative Development of Kazakhstan (SPIID) for 2015-19*
Law "on Science" (2011)	*Concept on Formation of Promising National Clusters of Kazakhstan till 2020 (2013)*	*State Program for the Development of Education and Science (SPED) for 2016-2019*
Law "about the Innovative Cluster 'Park of Innovative Technologies'" (2014)	*Concept of the Development of Higher Education and Science in the Republic of Kazakhstan for 2023 – 2029*	*State Program for Industrial and Innovative Development of Kazakhstan (SPIID) for 2020-25*
Law "on Commercialisation of Results of Scientific and/or Technical Activities" (2015)		*State Program for the Development of Education and Science (SPED) for 2020-2025*

In the government policies and strategies for innovative development, central importance is placed on the relationships between the government, industry, and higher education. These policies highlight the significance of the transfer of knowledge and technologies from higher education institutions to industry for the Kazakhstan government (OECD, 2017). According to *the State Program for the Development of Education and Science for 2016-2019 (SPED)*, the policy in the field of higher and postgraduate education was developed to encourage the integration of education, research, and innovation, and provide the economy with competitive human resources. *The Concept of the Development of Higher Education and Science in the Republic of Kazakhstan for 2023 – 2029* prioritizes the support of research, particularly support

of science and technology parks at universities with the allocation of targeted grants. The Concept states,

> Within the framework of program-targeted financing, support will be provided to seven scientific and technological parks and engineering centers at universities for the functioning of design bureaus, engineering centers, business incubators, innovation centers, regional centers commercialization and transfer of technologies, design bureaus, and other infrastructure elements. (p. 45)

The Minister of Science and Higher Education of the Republic of Kazakhstan, Sayasat Nurbek, has recently stated that the government is transforming research into an applied format and focusing the efforts of researchers on specific areas where it is possible to commercialize the results. He also added that currently, it is important to transform universities into research universities (KazInform, 2023). The implementation of these state innovation policies will be examined in the context of agricultural knowledge development and technology transfer in Kazakhstan in this thesis.

1.3.2 Agricultural Research and Innovation

The sector for exploring university-industry knowledge and technology transfer, in this study, is agriculture. The rationale for choosing this sector of industry is its research, strategic, social, and economic importance for the world and Kazakhstan. It is expected that the world population will be 8.5 billion by 2030 (UN, 2019). On the global level, agriculture is important for food security, peace, and stability. The rising world population will lead to a significant increase in demand for food, and this increased demand will have a huge impact on the environment and climate. This major issue requires significant advances in knowledge and technology. Investing in agricultural innovation and improving sustainability will help to solve such global issues as poverty and climate change (Kazakh National Agrarian University [KazNAU], 2019).

For Kazakhstan, agriculture is important due to the country's huge land resources and geographical position. Although about 75% of the land is suitable for agriculture, only about 30% of the territory is used for agricultural production. Agriculture is one of the key economic sectors that contributes to about 4% of gross domestic product (GDP) (OECD, 2021). It is one of the largest employment sectors nationally. According to the Bureau of National Statistics, 1.1 million people, or 12% were employed in the agricultural sector in 2022 (Bureau of National Statistics, 2023). About 56% of the total population of the country lives in small towns and rural areas where agriculture is the main employment sector (Bureau of National Statistics, 2021). Most meat and dairy products are produced by rural households (OECD, 2021). Kazakhstan is among the leading ten grain exporting countries in the world. The most common type of crops

that are produced are wheat, barley, rice, and cotton, whereas main livestock products include dairy goods, meat, leather, and wool (OECD, 2021).

Agriculture has a critical importance for the national security of Kazakhstan. According to the World Bank report on *Agricultural Sector Risk Assessment* (2016) and the OECD report on *Agricultural Policy Monitoring and Evaluation: Addressing the Challenges Facing Food Systems (2021),* agriculture is one of the sectors prone to production risks in Central Asia, such as droughts, flood, diseases, and pests. In Kazakhstan, "crop production is more vulnerable to risk than livestock due to the high dependence on dry land wheat production for export" (World Bank, 2016, p. ix). The reports suggested ways to address production risks in agriculture, including wheat productivity improvement, agricultural diversification, and improved livestock productivity (OECD, 2021; World Bank, 2016).

The events within the last century have exemplified the impact of agricultural risks in Kazakhstan. Almost a century ago, during the early years of the Soviet regime, Kazakhs experienced a national crisis, the Kazakh famine of 1930-33, when more than a third of the Kazakh population died (Cameron, 2016). It was a disaster, a genocide, caused by the violent policy of the Soviet regime to collectivize and transform the Kazakh society. Before the famine, Kazakhs were mainly nomadic, relying on livestock as the main source of food. However, the Soviet policy of collectivization forced Kazakhs to become sedentary and give up their livestock to the state. During that period, Kazakhs lost about ninety percent of their livestock (Cameron, 2016). The Kazakh famine is a historical lesson about the importance of agriculture for national security, and the importance of the diversification of agricultural products for food security and social stability.

Besides the critical importance of social stability and food security, agriculture is also an essential part of the government's strategy to diversify the economy and reduce its dependence on mineral and fossil fuel resources (OECD, 2015). The Asian Development Bank (ADB) 2018 Report *Kazakhstan: Accelerating Economic Diversification* states that "Kazakhstan has enormous underutilized agricultural potential that can help to make economic growth more diverse and inclusive" (p. 21). The government policy is now focused on substituting the import of high value-added agricultural products with local products. As an example, the government is implementing the *Sustainable Livestock Development Program* to develop an export-oriented beef sector. This program has the potential to "promote green growth and sustainability policies with climate-smart practices for beef cattle production, reduced greenhouse gas (GHG) emissions and improved agro-environmental outcomes of beef support" (OECD, 2021, p. 385). Moreover, the country has huge land resources for diversifying agriculture, as only about 1.5% of the total land is cultivated for organic crop production (Government of Kazakhstan, 2021).

This suggests that there is a huge potential for the country to become competitive as organic agricultural products grown and produced with green technologies are highly demanded worldwide.

The OECD 2019 *Report on Innovation, Productivity, and Sustainability in Food and Agriculture* highlighted the importance of research and innovation in facilitating "the development of a more productive and environmentally sustainable food and agriculture sector" (p. 22). According to the ADB 2018 Report, to enhance agricultural productivity the innovation system should be developed and revived. Due to the risks related to the climate, "agricultural productivity growth is especially dependent on developing drought-tolerant varieties and climate-optimized cultivation practices" (ADB, 2018, p. 57). Agricultural science is the basis for the economic and social transformations of the country. One of the seven priority fields of research development in Kazakhstan for 2018-2020 has been the sustainable development of agriculture and the security of agricultural products (National Academy of Sciences of the Republic of Kazakhstan [NASRK], 2019). To promote the innovative and technological development of agriculture, the government launched a new program in 2020 that refunds 80% of the expenses of farms that use the services from local research organizations (OECD, 2021).

A focus on agriculture in this research provides an opportunity to collect rich data on university-industry knowledge and technology transfer in agriculture. Agrarian universities and research institutes provide a flow of knowledge and innovation as they conduct research and transfer agricultural innovations to industry. Different regional agro-ecological conditions require adapting innovation to their peculiar climatic characteristics (WIPO, 2019). Moreover, agriculture is an industry where the highest share of patents is granted (OECD, 2017). Agricultural universities and research institutes in Kazakhstan received the greatest number of patents for inventions, utility models, and animal and plant breeders' rights in 2019 (National Institute of Intellectual Property (NIIP), 2019). Thus, agricultural science and industry are closely interconnected, as innovation increases crop and livestock productivity. Research in the field of agriculture in the Republic of Kazakhstan is carried out by research institutes and organizations, the National Agricultural Research and Education Center (NAREC), and HEIs. NAREC includes three universities, 14 research institutes, 18 experimental farms, and three service centers. In addition, over the past years, three demonstration sites and 60 model farms were created. The staff of the NAREC consists of 9480 specialists: about 3,000 researchers, of which: 246 Doctors of Science[1], 913 Candidates of Science, 229 Ph.D. doctors and 915 Masters.

[1] This is a qualification associated with the Soviet legacy of Kazakhstan. The hierarchy of advanced scientific degrees in Russia traditionally includes Doctor's degrees of two levels: Candidate of Sciences (Kandidat Nauk) and Doctor of Sciences (Doktor Nauk). The Candidate of Sciences degree normally requires three years of study after

The training of personnel is carried out by three specialized agrarian universities, eight regional universities with agricultural departments, and 12 multidisciplinary universities. In addition, 56 agricultural colleges train specialists in technical and vocational education (Government of Kazakhstan, 2021).

The Ministry of Agriculture, starting from 2009, has implemented a knowledge dissemination system. There are currently 25 knowledge dissemination centers (Government of Kazakhstan, 2021). This system was created to ensure direct access for agriculture entities to advanced research achievements and knowledge, as well as the accelerated implementation of research developments in agricultural production. The system is based on the best world practice - the Extension system, which exists in many foreign countries with developed agriculture. The main functions of the extension system are disseminating information through mass media and other channels; short-term training seminars demonstrating how to apply innovation in production; and consulting farmers and entrepreneurs (Kazakh Agro-Technical University, 2020). The extension system aims to increase the competitiveness of the agricultural sector of Kazakhstan, reduce production costs, increase crop yields and animal productivity, process agricultural raw materials, and modernize the means of production through the integration of education, research, and production (Government of Kazakhstan, 2018).

Since independence, higher education and research systems in Kazakhstan have been dramatically transformed. During the Soviet period, there was a divide between teaching and research. Universities in the country were solely focused on teaching, while institutes of the Academy of Sciences and other research institutes were exclusively performing research. However, the Soviet system of higher education has been reformed to integrate teaching, research, and innovation by merging universities with research institutes. As an example, the universities specializing in agriculture, particularly, Kazakh National Agrarian University were merged with “KazAgroInnovation” and Kazakh Agricultural Technical University with the “National Center for Biotechnology” (OECD, 2017a). Moreover, the number and share of researchers have increased in universities, whereas it has declined in government research institutes (OECD, 2017a). Thus, the system of higher education and research has been significantly transformed to place universities at the center of agricultural research and innovation.

There are three agricultural universities in Kazakhstan: Kazakh National Agrarian University (KazNAU), Kazakh AgroTechnical University (KazATU), and West Kazakhstan AgroTechnical University (WKATU). According to *the State Program of Agricultural*

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the award of Specialist or Master degrees. The Doctor of Sciences degree can be earned after a period of further study following the award of the Candidate of Sciences degree.

Development for 2017-2021, the gradual transformation of the Kazakh National Agricultural University and Kazakh AgroTechnical University into research universities, and West Kazakhstan AgroTechnical University into an entrepreneurial university is ongoing. The role of agrarian universities is being reconsidered and their programs are being updated to disseminate advanced knowledge and best practices and to provide the agricultural sector with qualified specialists, who have practical knowledge and skills. University transformation is carried out in partnership with the world's leading agricultural research universities, with the invitation of foreign professors to modernize educational programs and teaching (Government of Kazakhstan, 2018). In addition, the integration of production, education, and science was ensured to synchronize the development and implementation of domestic scientific developments, transfer of successful foreign technologies, and training and retraining of personnel with innovative competencies (Government of Kazakhstan, 2018).

To increase the quality of agrarian education, agrarian universities focus on educating competitive specialists in the agricultural sector. This objective includes introducing standards of world-class universities. For example, KazNAU learns from Dutch Wageningen University and Research (WUR), which is the number one agrarian university in the world, while KazATU learns from the University of California (UC) Davis, which is the number two agricultural university in the world (Government of Kazakhstan, 2018). Since 2015, KazNAU and KazATU have been educating specialists to implement the projects of the *SPIID for 2015-2019*. Moreover, in the frames of transforming universities, KazNAU will specialize in increasing the efficiency of arable lands, fruit growing and potato growing, agricultural cooperation, and dairy cattle breeding. KazATU will become the center of digitalization of the agro-industrial complex for all regions. WKATU will become the center of livestock development. These measures will improve the quality of agricultural education and provide agriculture with the necessary specialists with high-quality practical knowledge and skills required in the 21st century (Government of Kazakhstan, 2018).

1.4 Research Problem, Aim, and Research Questions

Given this context of agricultural research and the development of agricultural knowledge and technology transfer in Kazakhstan, this research has been developed in response to the problems outlined below.

1.4.1 Research Problem

The initiatives and policies implemented by the government of Kazakhstan emphasize that knowledge and technology transfer from higher education to industry is important for the innovative development of Kazakhstan. However, despite numerous laws, strategies, and programs, according to the *OECD Reviews of Innovation Policies: Kazakhstan 2017*, “the

performance of the research and innovation system in terms of commercialization of research results has remained weak and been concentrated in a few public institutions" (OECD, 2017, p. 70). Although the government has increased investment, "the level of R&D in Kazakhstan is low, compared to other countries in the post-Soviet region, especially those performing well in the GII" (Mussagulova, 2021, p. 10). This statement is supported by the results of the recent Global Innovation Index (GII), which globally ranks countries in terms of their level of innovation development. During 2018-2022, the overall innovation performance of Kazakhstan has been deteriorating (Table 2).

Table 2. Global Innovation Index (GII) Rankings for Kazakhstan (2018–2022)

GII YEAR	**GII**	**Innovation inputs**	**Innovation outputs**
2018	74	55	91
2019	79	64	92
2020	77	60	94
2021	79	61	101
2022	83	65	97

Sources: WIPO, 2018; WIPO, 2019; WIPO, 2020; WIPO, 2021; WIPO, 2022

In 2022, by overall innovation performance, Kazakhstan ranked 83rd among 132 countries, which is lower by 9 positions compared to 2018. By innovation performance at different income levels in 2022, Kazakhstan was below expectations for the level of development. The rating of Kazakhstan has significantly deteriorated in terms of inputs, falling to the 65th position in 2022, which is lower by ten positions compared to 2018. By innovation outputs in 2022, the country's rating has fallen to 97th place, which is lower by 6 positions compared to 2018 (WIPO, 2018; WIPO, 2022). This decline suggests that there are problems and challenges in innovation performance in the country.

Kazakhstan has become more dependent on foreign technologies. It imports more intellectual property rights than it exports, paying USD 141,320,590 for the use of the intellectual property and receiving USD 2,792,020 in return in 2019. In 2021, Kazakhstan paid $231 million for the use of intellectual property, whereas it received $2.86 million, which is almost 80 times lower (World Bank, 2021). While there has been a significant increase in the importation of intellectual property from 2019 to 2021, there has been only a marginal increase in the value of intellectual property being exported over the same period.

According to GII 2022, Kazakhstan best performed in relation to its Institutions, whereas the weakest performance was in its Creative outputs (Table 3).

Table 3. The Seven GII Pillar Ranks for Kazakhstan.

1	Institutions	52
2	Infrastructure	58
3	Human capital and research	60
4	Business sophistication	68
5	Knowledge and technology outputs	81
6	Market sophistication	90
7	Creative outputs	118

Source: WIPO, 2022

According to the GII reports, Kazakhstan has been performing below expectations to the level of development and producing less innovation relative to its level of innovation investments (WIPO, 2021; WIPO; 2022). This implies that the research and innovation system is not performing well.

The government admits that the share of research results transferred to the agricultural industry remains low (Government of Kazakhstan, 2021). According to the *SPED for 2020-2025*, research is not sufficiently focused on the urgent needs of the economy and society, which negatively affects the attitude to science in society, and reduces the potential for the commercialization of research results and the interest in business cooperation with science. There is weak cooperation between universities, research institutes, the business community, the state, and other interested parties (intermediary organizations, civil society, etc.) (Government of Kazakhstan, 2019). The State Program of Agricultural Development for 2017-2021 states that there is lack of demand for research from business and lack of funding research from business, "With the current funding mechanism, business does not finance and does not participate in determining research topics. For this reason, research developments are poorly focused on the demand of agricultural enterprises of the country, on increasing profitability and gaining competitive advantages" (Government of Kazakhstan, 2018, p. 56). The government also states that there are issues in the process of technology transfer, "Currently, the transfer of technologies is carried out separately, as part of individual investment projects. There is no systematic approach to the selection of optimal technological solutions, their approbation, adaptation, and distribution" (Government of Kazakhstan, 2018, p. 61).

Although Kazakhstan is rich in land and natural resources, the country is underutilizing its potential for innovative and technological development. The weak performance of research and innovation systems, low levels of research commercialization, and technology transfer and other related issues in the country require immediate attention. These issues should be investigated from a range of perspectives, including from the perspective of higher education institutions, industry, and government, as each sector might experience challenges during the knowledge and technology transfer process. However, there is a lack of research on the role of

agricultural universities in improving innovation and productivity in agriculture in Kazakhstan. There have not been any studies on the role of agricultural universities in disseminating and transferring knowledge and technologies to the industry, and on mechanisms and channels used for university-industry knowledge and technology transfer. Given the importance of research in the innovative development of the country and the gap of knowledge on this issue in Kazakhstan, it is urgent to explore the role of universities in knowledge and technology transfer from the perspective of universities. It is also urgent to explore the channels and mechanisms that universities are using and to understand enabling and inhibiting factors that affect the process of knowledge and technology transfer.

1.4.2 Research Purpose

Based on the problems presented, the purpose of this study is to explore the role of universities in the process of agricultural knowledge and technology transfer in Kazakhstan from institutional and faculty perspectives. The study aims to examine the specific mechanisms, channels and pathways of knowledge and technology transfer that are used in Kazakhstan. The study also seeks to investigate challenges that universities face during the process of knowledge and technology transfer and the practices that facilitate the process.

1.4.3 Research Questions

The central research question that this study addresses is: What is the role of universities in the process of agricultural knowledge development and technology transfer in Kazakhstan?

The exploration of this question was guided by three sub-questions.

Guiding Question 1: How do universities understand the purpose of knowledge and technology transfer in Kazakhstan?

Guiding Question 2: What are the specific mechanisms, channels, and pathways of university-industry knowledge and technology transfer in Kazakhstan?

Guiding Question 3: What are the inhibiting and facilitating factors for university-industry knowledge and technology transfer in Kazakhstan?

1.5 Overview of the Methodology

This research study used a qualitative case design to explore innovation in the context of higher education, focusing on university-industry knowledge and technology transfer in the field of agriculture. The study aimed to explore the role of universities in the process of knowledge and technology transfer in Kazakhstan with a specific emphasis on knowledge and technology transfer from agrarian universities to the agricultural industry. A multiple case study design was implemented, with each university considered as an individual case. Purposeful sampling was employed to identify sixteen participants from the university faculty members at the two sites. Document analysis and individual interviews with university personnel were conducted to collect

data for this study. Within-case and cross-case thematic analyses were used to answer the research questions. The methodology will be described in detail in Chapter Three.

1.6 Overview of the Findings

This thesis argues that Kazakh agrarian universities have become the treasurers of agricultural knowledge, restoring and accumulating knowledge lost after the collapse of the Soviet regime. At the same time, Kazakh agrarian universities are trying to modernize agrarian knowledge by adopting foreign knowledge and technology. This study argues that agrarian universities play a key role in knowledge production and dissemination, and human capital development for agriculture. However, research commercialization and technology transfer are not well understood and consequently are underdeveloped, as the country has recently transitioned to the market economy.

This research study argues other key factors influence the overall innovation performance of the country and the innovative and technological development of agriculture. Most participants at the two selected university cases understand knowledge and technology transfer as the transfer of foreign knowledge and technology that is adapted to the local conditions and transferred further to the industry. However, some faculty believe in their capacity to produce local knowledge. They tend to have more experience in research and development and higher academic positions.

University faculty are more involved in informal channels of knowledge and technology transfer (publications, conferences, networking, and training) than formal channels. The main channels of formal knowledge and technology transfer at both universities are patenting and providing consultations. The most important enabling factor affecting the process of knowledge and technology transfer is personal networking/cooperation with industry, whereas the key inhibiting factor at both universities is the lack of funding. These findings will be fully presented in Chapter Four.

1.7 Significance of the Study

This study contributes theoretical understandings to the field and makes recommendations for policy and practice in higher education. It contributes to national and international research on university-industry knowledge and technology transfer. The gaps in the field of knowledge on university-industry knowledge and technology transfer in Kazakhstan provide an opportunity to study whether the Western mechanisms, channels, and determinants of university-industry knowledge and technology transfer apply to the agricultural industry in the context of Kazakhstan. As there is a scarcity of studies on university-industry knowledge and technology transfer in Central Asia, this study will contribute to the international literature on university knowledge and technology transfer from within a non-western context.

The study has policy and practical relevance for government policymakers, university management, individual researchers, entrepreneurs and other stakeholders in Kazakhstan, as well as in other countries, who are undergoing political, economic and social transition. This research raises the issue of declining innovation performance in Kazakhstan and explores the factors that determine the effectiveness of knowledge and technology transfer. The research studies the role of agrarian universities in the innovative and technological development of the agricultural industry of the country. The study also explores the strategic policies and practices of transforming agrarian universities into research universities to respond to global and local challenges.

By developing an understanding of how universities perceive their role and their existing processes for supporting knowledge and technology transfer, the study will be able to generate new knowledge and recommendations to improve the process of university-industry knowledge and technology transfer. The findings of this study will be helpful for the development of future policies aimed at facilitating university-industry knowledge and technology transfer and fostering innovation. Findings will be transferable to other universities, particularly those specializing in agriculture, and provide insights into how to more effectively implement innovation policies to facilitate successful knowledge and technology transfer.

1.8 Structure of the Thesis

The thesis is structured to elaborate on the information presented in this introduction. This chapter presented the research problem, purpose and questions. In Chapter Two the key literature and conceptual framework are discussed. In Chapter Three the research design, methods, data collection instruments, data analysis, quality issues and ethical considerations are presented. Chapter Four presents the findings through a within-case and cross-case analysis of documents and interview data. Chapter Five discusses the findings of this study in relation to the research questions, the conceptual framework, and the literature on the topic. The thesis concludes in Chapter Six with the summary of the thesis, implications for policy, practice and research, limitations of the research and a summary of the significance of the study.

1.9 Summary

This section introduced the topic of my doctoral research study, which is focused on university-industry knowledge and technology transfer in Kazakhstan. The purpose of this study was to explore the role of two universities in the innovative and technological development of agriculture, particularly in the process of knowledge and technology transfer to the agricultural industry in Kazakhstan, and to examine specific mechanisms, channels and determinants of university-industry knowledge and technology transfer. Although the government has initiated several policies and strategies to stimulate the innovative development of the country during the

last decade, the overall innovation performance of Kazakhstan has been deteriorating. Moreover, Kazakhstan is highly dependent on importing foreign knowledge and technologies. This implies that research and innovation in the country are weak, and university-industry knowledge and technology transfer is not successfully implemented. The share of research results transferred to the agricultural industry remains low. There is a gap in knowledge on mechanisms, channels and determinants of university-industry knowledge and technology transfer in Kazakhstan. Therefore, to address this urgent issue, it is timely to shed light on the challenges that impede the process of university-industry knowledge and technology transfer and inform government policy and decision-makers, university management, individual researchers, entrepreneurs, and other stakeholders.

CHAPTER 2. LITERATURE REVIEW

2.1 Introduction

This chapter reviews six interrelated streams of literature of relevance to this study: globalization, knowledge economy, and higher education; academic capitalism; academic entrepreneurship; the entrepreneurial university; knowledge management in higher education; and university-industry knowledge and technology transfer. The literature on academic capitalism, academic entrepreneurship and the entrepreneurial university helps to understand the changing nature of higher education due to the shift towards an innovation-driven, knowledge-based economy. The literature on knowledge management in higher education and knowledge and technology transfer presents reviews of the main concepts of the study. The literature review positions this study within conversations about the role of universities in globalized knowledge economies, entrepreneurship, innovation, and knowledge and technology transfer. These key concepts are the basis for the conceptual framework of my study which is presented in section 2.5. Table 4 below provides a summary of the literature streams, their representative literature and their relevance. Each of these streams will be discussed.

Table 4. Streams of Literature

Stream	Representative Literature	Relevance
Globalization, Knowledge Economy, and Higher Education	Altbach, 2013; Brown et al. 2008; Marginson, 2009, 2010; OECD, 1996, 2008; Olssen & Peters, 2005; Peters, 2003, 2007; Peters & Humes, 2003; Scott, 2011, 2016, Ward, 2008; World Bank, 1998	Conceptualizes knowledge economy, types of knowledge, discusses the link between globalization, knowledge economy and higher education.
Academic Capitalism	Cantwell & Kauppinen (2014); Jessop (2018); Slaughter & Leslie (1997); Slaughter & Rhoades (2004)	Conceptualizes academic capitalism, discusses the origins of the rise of academic capitalism, demonstrates the strengths of academic capitalism as a concept and theory in understanding the changing nature of higher education and research.
Academic Entrepreneurship	Abreu & Grinevich (2013); Jessop (2018); Siegel & Wright (2015); Wadhwani et al. (2017)	Conceptualizes academic entrepreneurship; describes the evolution of academic entrepreneurship in higher education and research.
Entrepreneurial University	Clark, (1998, 2004); Etzkowitz (1983); Etzkowitz & Leydesdorff (2000); Kirby (2006)	Conceptualizes the phenomenon of entrepreneurial universities, demonstrates theoretical models to understand entrepreneurial universities.
Knowledge Management in Higher Education	Ahmad et al. (2015); Iqbal et al. (2019); Moss et al. (2007); Petrides & Nguyen (2006); Quarchioni et al. (2022); Veer-Ramjeawon & Rowley (2019)	Conceptualizes knowledge management, discusses importance of knowledge management in higher education, and key research concepts of knowledge management in higher education.

University Knowledge and Technology Transfer	Bradley, Hayter & Link (2013); Link et al. (2007); Grimpe & Fier (2010); Hayter, Rasmussen, & Rooksby (2020); Schaeffer et al. (2018)	Conceptualizes university knowledge and technology transfer, describes university technology transfer ecosystems, models, mechanisms and determining factors.

2.2 Globalization, Knowledge Economy, and Higher Education

There is extensive literature linking globalization, the knowledge economy and education, particularly the role of higher education in the modern globalized knowledge economy (Altbach, 2013; Brown et al., 2008; Marginson, 2009, 2010; OECD, 1996, 2008; Olssen & Peters, 2005; Peters, 2003, 2007; Peters & Humes, 2003; Scott, 2011, 2016; Ward, 2008; World Bank, 1998). The most important policy documents that emphasize the link between knowledge, education and the global economy are reports by international organizations such as the OECD and World Bank. These reports, *The Knowledge-based Economy* (OECD, 1996) and *Knowledge for Development* (World Bank, 1998) define knowledge economy, types of knowledge, the role of knowledge in innovation and economic development, and provide policy recommendations for governments on how to measure knowledge and address issues related to knowledge. According to the OECD (1996), knowledge-based economies are "directly based on the production, distribution and use of knowledge and information" (p. 7). Today, most countries, including OECD countries, invest in education, science, and technology to boost economic growth and productivity. This trend is also reflected in the World Bank (1998) report as it states,

> For countries in the vanguard of the world economy, the balance between knowledge and resources has shifted so far toward the former that knowledge has become perhaps the most important factor determining the standard of living—more than land, than tools, than labor. Today's most technologically advanced economies are truly knowledge-based. (p. 16)

The OECD and World Bank clearly link knowledge and economic development and differentiate between kinds and types of knowledge. The OECD (1996) identifies four types of knowledge, "know-what, know-why, know-how and know-who" (p. 12). Know-what is knowledge of facts, know-why is knowledge of laws and principles of nature, know-how is about procedural knowledge, and know-who refers to knowledge about people with the means to act. The World Bank (1998) identifies two different ways of conceptualizing knowledge, such as *knowledge about technology*, and *knowledge about attributes*. *Knowledge about technology* is also called technical knowledge, similar to the OECD's know-how, whereas *knowledge about attributes* is knowledge about facts or know-what.

These concepts, Peters (2007) argues constitute a "knowledge culture" which is important for a knowledge economy. Knowledge cultures are "based on shared epistemic practices, they embody culturally preferred ways of doing things, often developed over many generations" (Peters, 2007, p. 23). In other words, cultural preconditions including "trust, reciprocal rights and responsibilities between different knowledge partners, institutional regimes and strategies" influence the process of generating and disseminating knowledge (Peters, 2007, p. 23).

The OECD (1996) states that science systems have a key role in the knowledge economy and identifies three major functions: "i) knowledge production – developing and providing new knowledge; ii) knowledge transmission – educating and developing human resources; and iii) knowledge transfer – disseminating knowledge and providing inputs to problem solving" (OECD, 1996, p. 21). In another report, *Tertiary Education for the Knowledge Society*, the OECD (2008) argues:

> The widespread recognition that tertiary education is a major driver of economic competitiveness in an increasingly knowledge-driven global economy has made high-quality tertiary education more important than ever before. The imperative for countries is to raise higher-level employment skills, to sustain a globally competitive research base and to improve knowledge dissemination to the benefit of society. (p. 13)

In this OECD report, four key missions of higher education are identified: human capital development (through teaching); knowledge base development (through research); knowledge dissemination and using (through interactions with knowledge users); and knowledge maintenance (inter-generational storage and transmission of knowledge). These missions are represented in Figure 1.

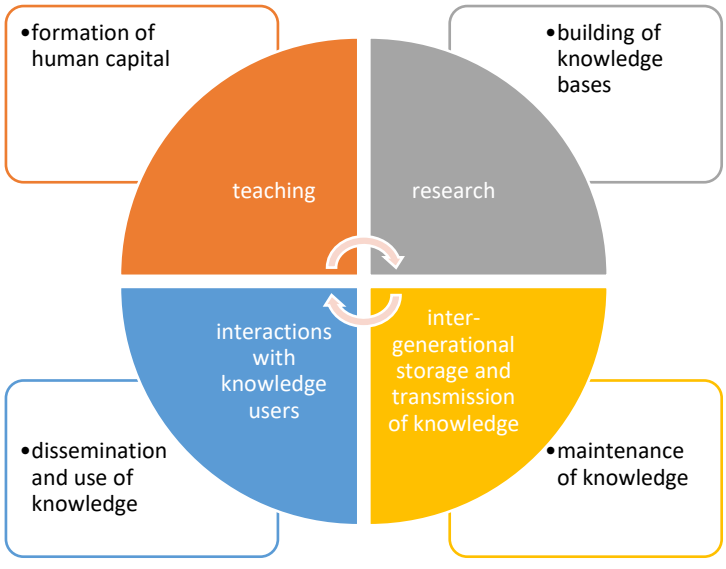

Figure 1. Key Missions of Higher Education.

(Source: OECD, 2008, p. 13)

This discourse held by supranational organizations reflects the national policies on higher education of governments around the world. As knowledge and education are viewed as the key drivers of economic growth, the number of students enrolled in universities has increased (Brown et al., 2008). Moreover, the functions of higher education institutions are widening as they are "encouraged to develop links with industry and business in a series of new venture partnerships" (Olssen & Peters, 2005, p. 313). Governments are increasingly recognizing the importance of universities as centers of human capital development, research, and innovation (Ward, 2008). Ward (2008) argues that the link between higher education and the knowledge economy is clearly reflected in "revenues, linkages and capacities of large comprehensive research universities" (p. 260). In other words, research universities need huge amounts of funding to build research capacity (Ward, 2008).

The rise of research universities is linked to the shift to the knowledge economy at the global level. Altbach (2013) argues that "research universities are at the center of the global knowledge economy – and at the pinnacle of the national higher education system" (p. 316). Although they share common features, research universities vary by nation. For developing countries, research universities are particularly important to facilitate integration into the global knowledge economy as they "form windows to scientific information worldwide by providing opportunities for top-level scientific communication" (Altbach, 2013, p. 317). At research universities, academics and students are increasingly engaged in research, collaborate with international researchers, and communicate their research results in conferences and publications.

2.3 Academic Capitalism

One theory that explains the transformation of higher education as a response to the changes in the global economy is 'academic capitalism'. Universities are experiencing a second academic revolution by assuming a new mission of economic and social development. At the core of this new mission is the "capitalization of knowledge," which is "linking universities to users of knowledge more tightly and establishing the university as an economic actor in its own right" (Etzkowitz, 2008, p. 27). Cantwell and Kauppinen (2014) believe that the theory of academic capitalism has two premises. Firstly, it is a conceptual framework that helps to understand higher education policy change "from social welfare regimes to private welfare and competition regimes" (p. 5) and secondly, it can be used as a methodological tool to track how relationships are built and rebuilt between academia, nonprofit organizations, private and public organizations (Cantwell & Kauppinen, 2014).

The concept of academic capitalism was first introduced by Slaughter and Leslie (1997), to demonstrate how "public research universities were responding to neoliberal tendencies to treat higher education policy as a subset of economic policy" (p. 154). They refer to academic capitalism as a phenomenon related to market and market-like behaviors of faculty and universities. Slaughter and Leslie (2001) define market-like behavior as a behavior of institutions and faculty competing for external funding, including "external grants and contracts, endowment funds, university–industry partnerships, institutional investment in professors' spin-off companies, student tuition and fees, or some other revenue-generating activity" (p. 154). Furthermore, Slaughter and Leslie (2001) define market behaviors as an institutional activity which generates profit through patents, royalties and licensing agreements, arms-length corporations, spin-off companies, and for-profit university–industry partnerships.

Initially, Slaughter and Leslie (1997) created the concept of academic capitalism by examining only those academics who were in science and technology and needed funding for their research; they further expanded the concept to explain behavior of other university actors. They argue that by expanding the concept of academic capitalism, they provided a "theoretical basis for better explaining the irregular moves toward the market by public research universities in the United States over the past 25 years than do theories of marketization, managerialism, institutional theory, and institutional isomorphism" (Slaughter & Leslie, 2001, p. 156).

Based on the concept of academic capitalism, Slaughter and Rhoades (2004) developed a theory to understand the integration of higher education into the new economy. They argue that universities are "shifting from a public good knowledge/learning regime to an academic capitalist knowledge/learning regime" (Slaughter & Rhoades, 2004, p. 28). In the new regime, knowledge is privatized and brings profit to inventors, academic institutions and private organizations.

Slaughter and Rhoades (2004) provide a working definition of academic capitalism. They state that university actors from various institutional segments, including managerial professionals, administrators, faculty, and students, use different state resources to function in the new economy. According to Slaughter and Rhoades (2004) these university actors:

> … form interstitial organizations that bring the corporate sector inside the university. They join organizations that intermediate among public, nonprofit, and for-profit public sectors. They build expanded managerial capacity to supervise new flows of external resources, to invest in research infrastructure for the new economy, and to expand programs to market institutions, products, and services to students and other customers in the private marketplace. Their individual decisions to engage in

> organized activities that promote market and market like activities consolidate the academic capitalist knowledge/learning regime. (p. 306)

In other words, the university actors capitalize on university knowledge and find new ways of funding, particularly through new circuits of knowledge, interstitial and intermediating organizations, and expanded managerial capacity (Slaughter & Rhoades, 2004). In summary, the theory of academic capitalism contributes to the understanding of the connection between higher education and the knowledge economy. The theory explains the new role of higher education in the knowledge economy where it produces knowledge as a private good and commercializes it to gain profit. In the case of Kazakhstan, it is particularly interesting to understand how academic capitalism works in a context where capitalism itself is still a developing concept. As a post-socialist economy, the government of Kazakhstan has adopted 'state-led capitalism', which might raise the question of whether the country has transitioned to a knowledge economy and academic capitalism.

2.4 Academic Entrepreneurship

Another concept related to the transformation of higher education through the shift to the knowledge economy is academic entrepreneurship. Jessop (2018) believes that the concept of entrepreneurialism is interrelated to academic capitalism as it captures "the spirit and content" (p. 106) of academic capitalism. Universities are increasingly becoming more entrepreneurial and integrating entrepreneurship into research and teaching as an academic mission. Schumpeter's model of entrepreneurial innovation in business suggests five areas where universities might be entrepreneurial, including the development of new products, new methods of teaching and research, new markets for their goods and services, new sources of supply of talented students, teachers, and researchers to enhance competitiveness, and new forms of organization in the 'education industry' and scientific research (Jessop, 2018). This is shown in Figure 2.

Figure 2. Areas for Entrepreneurship of Universities.
(Source: Jessop, 2018, p. 107)

Traditionally, the concept of academic entrepreneurship referred to "efforts undertaken by universities to promote commercialization on campus and in surrounding regions of the university" (Siegel & Wright, 2015, p. 1). However, recently several scholars have argued that the concept should be widened. Abreu and Grinevich (2013) believe that the concept of academic entrepreneurship should be expanded to "other commercial and non-commercial activities that are entrepreneurial in nature" (p. 419). They define academic entrepreneurship as "any activity that goes beyond the traditional academic roles of teaching and/or research, is innovative, carries an element of risk, and leads to financial rewards for the individual academic or his/her institution" (p. 419). Wadhwani et al. (2017) proposed a different definition of academic entrepreneurship as "the pursuit of future forms of value pertaining to academic knowledge production, application, and transmission" (p. 187). They argue that commercialization is only one form of academic entrepreneurship. There are other forms, including resource acquisition and legitimacy-seeking activities. Resources and legitimacy are needed for generating and transferring knowledge to industry (Wadhwani et al., 2017). These multiple definitions represent the various aspects of academic entrepreneurship and contribute to the understanding of the concept.

The success of academic entrepreneurship depends on the university entrepreneurial ecosystem (Audretsch et al., 2019; Hayter et al., 2018; Matt & Schaeffer, 2018; Morris et al., 2017; Siegel & Wright, 2015; Wright et al., 2017; van Rijnsoever, 2020). Siegel and Wright (2015) argue that previous literature on academic entrepreneurship has not encompassed "all

dimensions of the new entrepreneurial ecosystem, which has broadened out the rationale to reflect the wider social and economic benefits of academic entrepreneurship to the university ecosystem" (p. 4). Hayter et al. (2018) reviewed the literature to understand how academic entrepreneurship is conceptualized and the extent to which it adopts an ecosystem approach. They found that the literature consisted of mainly individual ecosystem characteristics and elements. Based on this analysis, they presented a network of ecosystem elements and their interconnection. They suggest that further research should be conducted to explore more academic entrepreneurship elements from an ecosystem perspective. Audretsch et al. (2019) focused on the key elements of an ecosystem, and "under what conditions entrepreneurial firms shape and influence economic, technological, and societal thinking within their ecosystem" (p. 313). According to van Rijnsoever (2020), the entrepreneurial ecosystem is conceptualized "as a set of actors that interact and exchange resources in a network under an institutional regime and an infrastructure" (p. 2).

The literature identifies two types of academic entrepreneurship, particularly faculty entrepreneurship and student entrepreneurship. The literature on faculty entrepreneurship focuses on the entrepreneurial identity development of university scientists (Hayter et al., 2021), research productivity and faculty entrepreneurship (Lowe & Gonzalez-Brambila, 2007), attitudes of the faculty to entrepreneurship and commercialization (Goldstein, 2010), why scientists use patents (Goktepe-Hulten & Mahagaonkar, 2010), factors that affect the engagement of the faculty in entrepreneurial activities (Haeussler & Colyvas, 2011), the contribution of the spin-off process to the development of academic entrepreneurs' social capital (Borges & Filion, 2013), the role of scientist characteristics, access to resources and key university conditions in driving the likelihood of a scientist to start a company (Aldridge et al., 2014), and the extent to which entrepreneurship at universities is driven by spatial proximity between university faculties (Goethner & Wyrwich, 2020).

Several factors affect entrepreneurial identity development and the activity of faculty. Hayter et al. (2021) developed a model that explained the process of identity development of academic entrepreneurs. The model "includes several factors such as agency and passion, liminal competence, social support, organizational and institutional support, and temporal factors that moderate the process" (p. 1469). Lowe and Gonzalez-Brambila (2007) revealed that the productivity of faculty entrepreneurs was higher than those who did not engage in entrepreneurial activities, and opening up a firm did not decrease the scientist's productivity. Goktepe-Hulten and Mahagaonkar (2010) found that scientists engage in patenting activities not for immediate personal financial gains, rather they expect to gain or increase their reputation and academic promotion. Haeussler and Colyvas (2011) also found that "the level of reputational

importance placed on scientific compared to commercial achievements matters in shaping commercial involvement" (p. 41). They revealed that productivity, professional security and advantage are factors that significantly influence the engagement of the faculty in academic entrepreneurship.

Discipline impacts the entrepreneurial activity of faculty in several ways. Goldstein (2010) explained that attitudes among faculty vary by academic discipline. He found that the faculty in the Humanities are less entrepreneurial than in the Sciences, Engineering, and the Social Sciences, whereas the faculty in Computer Science has the most positive attitude towards commercialization. Aldridge et al. (2014) revealed that the nature of the faculty startups was heterogeneous. They found that the type of research field, individual (social capital) and university variables (financial resources, support from the department) are important in the scientist's entrepreneurial activity. There is a high entrepreneurship rate in Computer and Network Systems, Civil, Mechanical, and Manufacturing Innovation, whereas there is ow entrepreneurial activity in Environmental Biology, Particle and Nuclear Astrophysics and Biological Infrastructure. According to Goethner and Wyrwich (2020), "the emergence of entrepreneurial ideas in natural sciences is positively affected by proximity to business schools" (p. 1016). They suggest that the flow of knowledge between business and science schools is a key driver of faculty entrepreneurship.

Compared to faculty entrepreneurship, student entrepreneurship is understudied as universities have only recently started to develop and implement policies to encourage entrepreneurship among students. Several studies have examined the importance of student entrepreneurship compared to faculty entrepreneurship (Åstebro et al., 2012; Boh et al., 2015; Boh et al., 2016; Hayter et al., 2017). Åstebro et al. (2012) discovered that the number of start-ups by recent graduates is higher than the number of spin-offs by their faculty, and that "a recent graduate is twice as likely as her Professor to start a business within three years of graduation, and that the graduates' spin-offs are not of low quality" (p. 663). Boh et al. (2016) found that students are more likely to stay involved in the venture longer than the faculty. Boh et al. (2015) revealed that graduate and post-doctoral students are important participants in university spinoffs. Hayter et al. (2017) also found that graduate students and faculty entrepreneurs play an equally important role in university spinoffs, "both in terms of making the initial establishment decision and in reconfiguring the organization for marketable technology development" (p. 1237).

A stream of research focuses on the impact of entrepreneurship education on the entrepreneurial outcomes of students (Ayob, 2019; Beyhan & Findik, 2018; Pruett & Şeşen, 2017). Beyhan and Findik (2018) studied the relationship between entrepreneurial education and

the number of start-ups that have been created by students and new graduates. They argue that "universities are heterogeneous in their resources and competencies, and these organizational competencies are influential on students in the development of entrepreneurial competencies and hence in the creation of start-ups" (p. 1346). Thus, student and graduate entrepreneurial skills vary due to university differences in competencies and resources (Beyhan & Findik, 2018). Ayob (2019) also revealed that entrepreneurial culture and high-level entrepreneurship education positively influence student startups. Pruett and Şeşen (2017) found students have different views of the university environment, entrepreneurship motives and barriers than the faculty. More importantly, students "consistently see themselves as more entrepreneurial than the faculty perceive" (Pruett & Şeşen, 2017, p. 105). Morris et al. (2017) investigated the impact of the university entrepreneurial context on student start-up activity. They revealed that students' involvement in entrepreneurship-related curricular programs positively influences co-curricular activities at university. Wright et al. (2017) developed a framework to understand the ecosystem required to enable students to launch successful startups. This framework comprises university mechanisms that encourage student entrepreneurship, "along with a continuum of involvement from pre-accelerators through to accelerators; the involvement of a variety of entrepreneurs, support actors and investors; the particular nature of the university environment and the external context; and their evolution over time" (Wright et al., 2017, p. 909).

Matt and Schaeffer (2018) explored the challenges that universities experience during the development of an entrepreneurial ecosystem. They believe that the emergence of student entrepreneurship does not fit the traditional model of the entrepreneurial university. Moreover, academic entrepreneurship is not only the "creation of high-tech firms by faculty, but includes various types of entrepreneurial activity, leading or not to the creation of new firms" (p. 28). This expanded entrepreneurial ecosystem requires new coordination mechanisms within universities. Overall, the concept of academic entrepreneurship contributes to understanding the ways universities, through their faculty and students, are responding to the demands of the knowledge economy.

2.5 The Entrepreneurial University

Academic entrepreneurship is embodied in the concept of an entrepreneurial university. The concept was introduced by Etzkowitz (1983) and has gained considerable attention by researchers. Modern understanding of entrepreneurship has changed in two ways: firstly, entrepreneurship is now perceived as social and organized; and secondly, it can be taught as a skill. Etzkowitz et al. (2000) explained that entrepreneurial universities emerged "as a response to the increasing importance of knowledge in national and regional innovation systems and the

recognition that the university is a cost-effective and creative inventor and transfer agent of both knowledge and technology" (Etzkowitz et al., 2000, p. 314).

Clark (1998) described an entrepreneurial university as an institution that introduces innovation in its operations and activities, transforms its organizational behavior and becomes an important actor in the innovation system. An entrepreneurial university is also described as a university that has various infrastructural mechanisms to provide entrepreneurship training and support entrepreneurship within the university (Jacob et al., 2003). Moreover, two tasks are performed by an entrepreneurial university: firstly, students are educated to become future entrepreneurs, and secondly, the university operates as an entrepreneur by engaging students in such organizations as technology parks and business incubators, that help students and graduates to start-up their own companies (Schulte, 2004).

Entrepreneurial universities contribute to local and regional economies not only by developing qualified researchers and generating knowledge for commercialization but also by producing "other mechanisms of knowledge transfer, such as generating and attracting talent to the local economy and collaborating with local industry by providing formal and informal technical support" (Bramwell & Wolfe, 2008, p. 1175). Besides generating knowledge-based startups and technology transfer, the entrepreneurial university performs the role of the accelerator of entrepreneurship capital and facilitator of an entrepreneurial society. The evolution of universities from the pure Humboldtian University to the entrepreneurial university is explained by their institutional adaptability and resilience in society (Audretsch, 2014).

Several theoretical models represent the phenomenon of entrepreneurial universities (Clark, 1998, 2004; Etzkowitz & Leydesdorff, 2000; Etzkowitz et al., 2008; Kirby, 2006). Empirical studies have been conducted to examine these theoretical models and to explore factors that impact the creation and development of entrepreneurial universities (Jacob et al., 2003; Jones & Patton, 2018; Martinelli et al., 2008; Philpott et al., 2011; Pugh, 2018; Wong et al, 2007). The analysis of the literature shows that entrepreneurial universities have a unique path of transformation and development. Clark (1998) suggested a model of an entrepreneurial university, based on five European case studies of universities that successfully transformed into entrepreneurial universities. Clark's model (1998) conceptualized five 'pathways of transformation': a strengthened steering core; an enhanced developmental periphery; a diversified funding base; a stimulated academic heartland; and an integrated entrepreneurial culture (Figure 3).

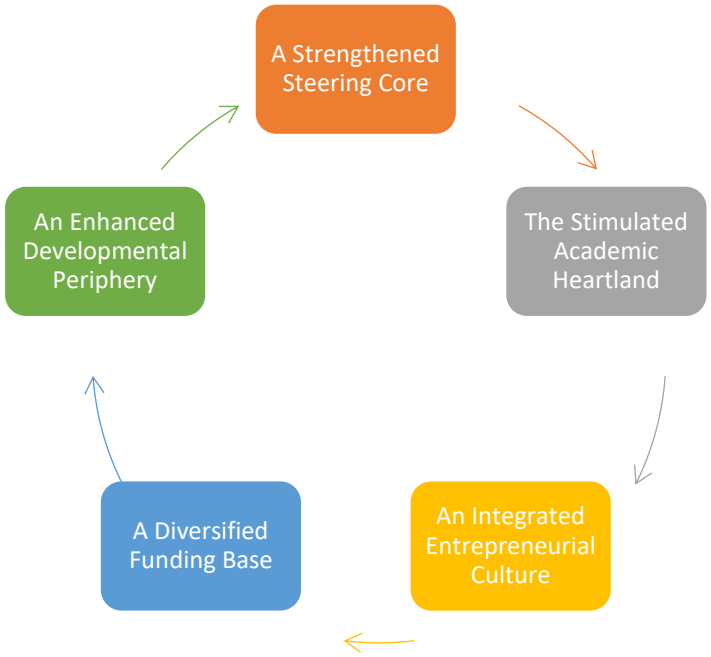

Figure 3. Transformation Pathways of an Entrepreneurial University.
(Source: Adapted from Clark, 1998)

A strengthened steering core is necessary as it finds sources of funding, diversifies income, creates discretionary money pools, establishes links with the industry, and cross-subsidizes among units within the university. Enhanced developmental peripheries are centers that supplement traditional departments and serve as links between the university and the outside world. A diversified funding base increases resources and discretionary funds, and "allows a university to build reserves (and to borrow monies) and then to take innovative steps" (pp. 140-141). A stimulated academic heartland is critical because any change or transformation will not be successful if the heartland does not accept it. An integrated entrepreneurial culture is also crucial to embrace the transformation of the university and to develop strong practices (Clark, 1998).

Furthermore, Clark (2004) studied 14 universities to revisit his model, suggesting dynamics that lead to a new steady state of change. The study focused on key characteristics of university organizations that promote change and "highlights the growing centrality of university-led action based on flexible and adaptive self-reliance" (Clark, 2004, p. 355). Key characteristics were grouped into two parts: "transforming elements, newly clarified; and sustaining dynamics" (p. 357). A steady state of change is achieved through the interaction of elements of the transformation pathway (Clark, 2004). This revisited model further developed and enriched the initial model that suggested five transformation pathways of an entrepreneurial university.

Kirby (2006) argues that universities encounter barriers when they shift their policy towards entrepreneurial activity, as they are not traditionally created to undertake such functions. The barriers include “the impersonal nature of relationships”, “the hierarchical structure and many levels of approval”, “the need for control and the resultant adherence to rules and procedures”, “the conservatism of the corporate culture”, “the time dimension and the need for immediate results”, “the lack of entrepreneurial talent” and “inappropriate compensation methods” (Kirby, 2006, p. 599). To overcome these barriers, the author constructed a model of strategic actions and activities that promote the development of entrepreneurial universities by applying entrepreneurship and intrapreneurship development theories (Kirby, 2006).

Etzkowitz and Leydesdorff (2000) suggested the triple helix of university-industry-government relations model to understand the emergence of entrepreneurial universities (Figure 4). The university has a key role in an economy driven by knowledge and innovation. It has taken the functions of the industry and government by initiating new firms, developing new products and advancing technological innovation. The university is operating in close collaboration with industry and government where innovation policy is a result of interaction (Etzkowitz, 2008).

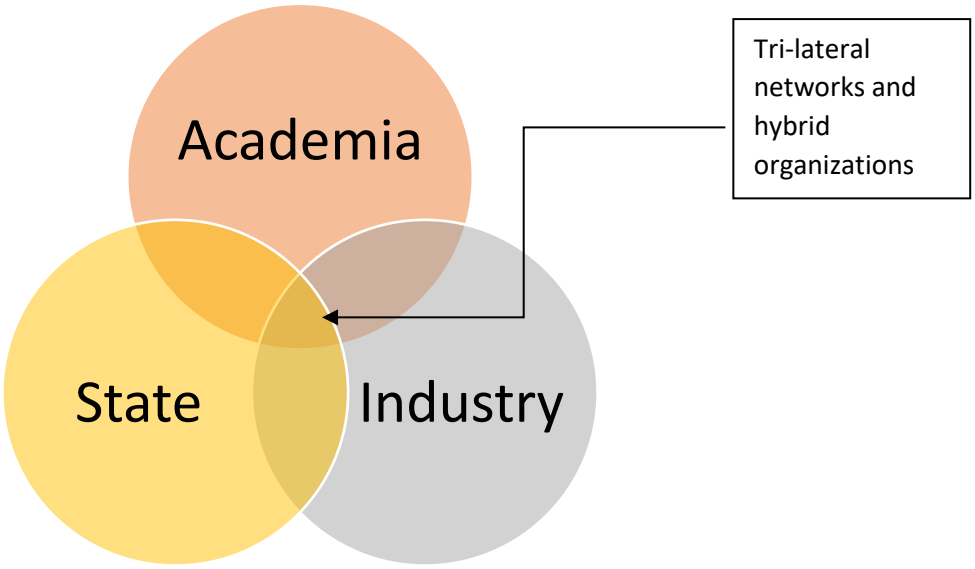

Figure 4. The Triple Helix Model of University-Industry-Government Relations.
(Source: Etzkowitz & Leydesdorff (2000), p. 111)

Etzkowitz et al. (2008) believe that the entrepreneurial university concept is still evolving in many countries as an outcome of the interaction between exogenous and endogenous factors. The exogenous factors are national innovation crises requiring universities’ engagement in innovation and dramatic decreases in core funding that led to searches for other sources of funding. The endogenous factors include internal changes within universities to economically exploit research results as a reaction to the exogenous factors.

2.6 Knowledge Management in Higher Education

With the shift to the knowledge economy, entrepreneurial universities are increasingly playing a key role in academic capitalism. The new missions and functions of higher education, including knowledge production, dissemination, and transmission, require universities to effectively manage their most significant resource - knowledge (Veer-Ramjeawon & Rowley, 2019). Knowledge management (KM) is defined as the "combination of people, processes, and technology that come together to promote a robust system of information sharing while guiding organizations toward ongoing reflexivity and learning" (Petrides & Nguyen, 2006, p. 25). KM enables higher education institutions to enhance their processes including strategic planning, administration, research, teaching, learning, and curriculum development (Ahmad et al., 2015).

KM consists of knowledge creation, knowledge transmission and knowledge transfer. While the OECD (1996) makes a distinction between knowledge transmission and knowledge transfer, the term transfer is used more generally in the literature to cover both. Knowledge is categorized in two ways: explicit/codified knowledge and tacit/implicit knowledge. Explicit/codified knowledge is defined as knowledge that can be represented as data or rules (Moss et al., 2007). Tacit knowledge refers to "the skills to use and adapt codified knowledge" (OECD, 1996, p. 7). In the knowledge-based economy, both codified/explicit and tacit/implicit knowledge are crucial. As codified knowledge becomes more accessible, there is more need for tacit knowledge to use the codified knowledge. Education and continuous learning are an integral part of the knowledge-based economy as human resources with the skills to acquire both codified and tacit knowledge are highly valued (OECD, 1996).

KM is a crucial process in higher education institutions for effective and efficient management of intellectual capital (IC), to facilitate an innovative environment and improve organizational performance (Iqbal et al., 2019). Despite its importance for higher education institutions, there are very few studies of KM in higher education. One study is a systematic literature review conducted by Quarchioni et al. (2022) that analyzed 121 articles on the topic. The study revealed six key research concepts in KM in higher education: adopting KM; managing and reporting IC to create value; enhancing KM technologies; producing and sharing academic knowledge; fostering learning and education; and transferring high-impact knowledge. These are represented in Figure 5.

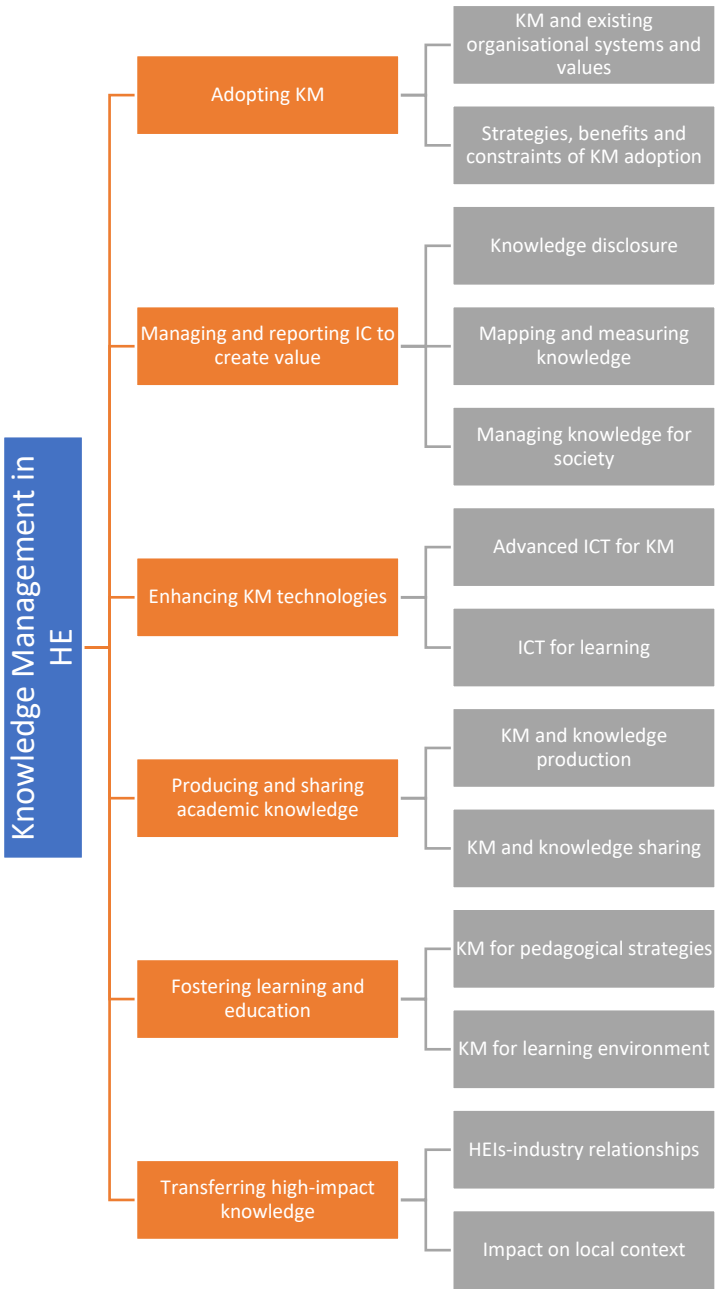

Figure 5. Key Concepts in KM in Higher Education.
(Source: Quarchioni et al. (2022), pp. 310-311)

Based on these key concepts and sub-concepts in KM in HE, a comprehensive framework was developed that represents the process of KM in universities with inputs, outputs, and outcomes. According to the framework, adopting KM, managing and reporting IC to create value, and enhancing KM technologies are grouped as inputs. Producing and sharing academic knowledge and KM and education are outputs. Transferring high-impact knowledge is viewed as an outcome. KM influences the processes of knowledge creation, sharing, and learning by facilitating collaboration between researchers and interaction among teachers and learners and enabling innovative learning environments and effective knowledge exchange. These outputs of KM lead to "the transfer of knowledge outside the organizational borders, impacting directly on

the social and economic system in which HEIs are embedded" (Quarchionni et al., 2022, p. 314). This framework shows that knowledge generation, transmission, and transfer are key components of the KM process. This framework is also consistent with three major functions of HE identified by OECD (1996) as knowledge production, transmission and transfer.

2.7 Knowledge and Technology Transfer (KTT)

Knowledge and technology transfer (KTT) is part of the knowledge management process. Pagani et al. (2020) provide a comprehensive definition of the concept of KTT:

> a process through which products, processes, materials, artefacts, and people imbued with technological knowledge that serves to implement products or processes, are moved to contribute with scientific and technological progress, strengthening the sustainable development in the social, economic and environmental dimension of an organisation, city, region or country. (p. 407-408)

There are different types of KTT, based on the level and category of actors involved in the process. KTT can be at the international/cross-national and local levels. The transfer can be from university to university, from university to industry or from industry to industry (Pagani et al., 2016).

2.7.1 International/Cross-National Knowledge and Technology Transfer

The importance of international KTT in economic growth and innovative development has been much discussed in the literature (Aggarwal & Kapoor, 2018; De Moortel & Crispeels, 2018; Yu et al., 2022). Developing countries can increase the pace of their development through international KTT as the cost of transferring foreign knowledge and technology is much less than the cost of domestic research and development (R&D) and innovation (Yu et al., 2022). Yu et al. (2022) argue that "Only by accumulating a certain level of innovative knowledge can less-developed countries imitate, absorb, and re-innovate the technologies of developed countries more efficiently" (p. 628). The WIPO GII 2022 report acknowledges that knowledge and technology transfer between countries has contributed to the convergence and catch-up in terms of technology for developing countries:

> This was thanks to increased globalization and what came with it in terms of knowledge diffusion and technology and innovation transfer, including managerial and other organizational and process innovations. All those countries that have climbed the GII innovation rankings over time, for example, China, India, Türkiye, the Philippines and Viet Nam, have for various reasons (e.g., industrial policies) been able to develop homegrown technological capabilities; an achievement reflected in measured innovation performance and the ability to participate in global value chains. (WIPO, 2022, p. 78)

In other words, developing countries adopt foreign knowledge and adapt it to their local conditions by adding their own knowledge.

International KTT can involve by using the triple helix actors: governments, universities and industry (reference). Depending on the number of actors involved, the process of international KTT can be direct or indirect. Direct transfer can be between a foreign university and a local industry or a foreign industry and a local university. Indirect transfer takes place between a foreign company or university and a local university where the local branch of a foreign company acts as an intermediary (Govind & Kuttim, 2017). In any case, international transfer implies that universities, whether foreign or local, are important actors in the process, as they are knowledge-intensive organizations open to collaboration and networking.

Govind and Kuttim (2017) argue that cross-national KTT is related to the internationalization of innovation systems, firm R&D and higher education. They developed a framework (Table 5) that represents the objectives, key actors, nature of activities, a theoretical framework of cross-national KTT studies, and policy implications (Govind & Kuttim, 2017). They conclude that international KTT "consists partly of the elements of Internationalization of innovation systems (IIS), Internationalization of R&D (IR&D) and Internationalization of Higher Education (IHE) as the central actors in the studies are either universities, enterprises or government that interact for KT purposes" (Govind & Kuttim, 2017, p. 17).

Table 5. Linkages between the Internationalization of Knowledge Transfer, R&D, Innovation Systems and Higher Education

Parameters	Internationalization of knowledge transfer (IKT)	Internationalization of R&D (IR&D)	Internationalization of innovation systems (IIS)	Internationalization of Higher Education (IHE)
Objectives	To strengthen national research system, contribute to innovation in firms, address the global problems related to environment, health and economy	To achieve global competitiveness, access new markets	To ensure the competitiveness of a country	To enhance the quality of education, mobilize resources, advance in global rankings
Nature of activities	Cooperation and competition	Competition	Cooperation and competition	Cooperation and competition
Dominant actors	Integrated perspectives of universities, enterprises, governments and intermediary organizations	Multinational corporations/enterprises	Government	Universities
Theoretical framework	Movement from 'mode 1'of knowledge production to 'mode 2'; social network theory; triple helix; dimensions of proximity; institutional theory; human capital theory	Resource-based view, principal–agent theory, octopus model, international business theory, innovation theories	Social network theory, triple helix	Triple helix, human capital theory
Policy implications	Inclusive at the international level: academics, enterprises, government	Inclusive at managerial level	Inclusive at government /International level	Inclusive at university as well as government level

Source: Govind & Kuttim, 2017, p. 17

This framework helps to understand the importance and interconnectedness of innovation systems, R&D and higher education in international KTT.

Besides the traditional university-industry KTT, international university-university technology transfer (IUUTT) has become an increasingly widespread form of transfer. In a globalized knowledge economy, it is not reasonable for universities to be isolated in research and innovation. On the contrary, partnerships and cooperation with foreign universities provide access to new knowledge and technology. The importance of IUUTT is evident from the rising trend in international joint research, joint graduate and PhD programs, co-patenting, and staff or student exchange (De Moortel & Crispeels, 2018). Moreover, universities in emerging economies "search technological domains by translating 'hi-tech' global innovations for the local industry" (Chatterjee et al., 2018, p. 369).

2.7.2 University-Industry Knowledge and Technology Transfer

Literature on university-industry KTT focuses on the models, ecosystems, channels, enablers, and inhibitors of the process. The literature presents several models of university-industry KTT, including a traditional, linear model and alternative views of transfer (Bradley, Hayter & Link, 2013). According to the traditional model (Figure 6), the process starts with a discovery by a university scientist.

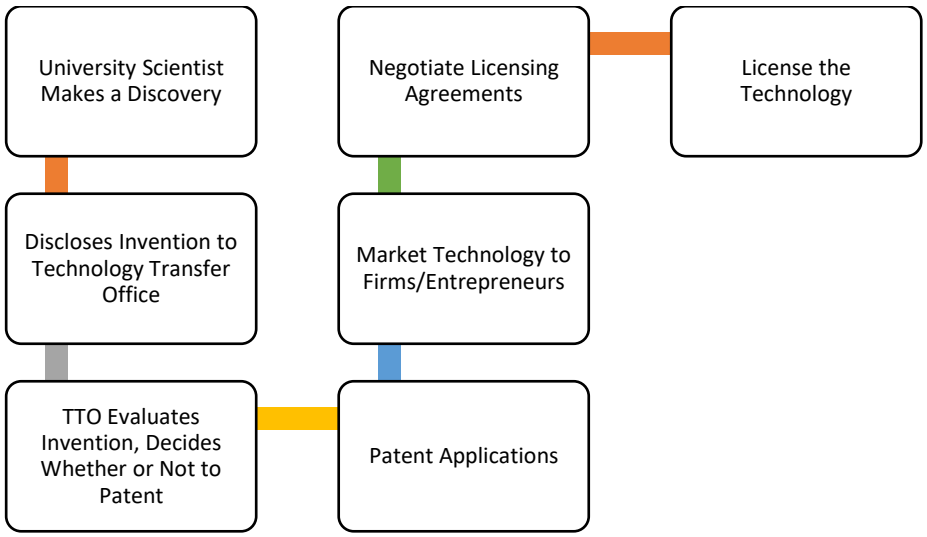

Figure 6. Traditional Model of University Technology Transfer
(Source: Bradley, S., Hayter, C. & Link, A. (2013). 571–650)

Then, the invention is disclosed to the university's Technology Transfer Office (TTO). After the disclosure, the invention is evaluated on whether or not to pursue acquiring a patent. If the TTO decides that the invention is worth investing, then they start the patent application process. After the award of the patent, the technology is marketed to entrepreneurs and organizations, so that it

is matched with an entrepreneur or organization for the best utility and opportunity to gain revenue. Bradley, Hayter and Link (2013) further explain:

> When a suitable partner is found, the university works with the organization or entrepreneur to negotiate a licensing agreement. The licensing agreement typically includes a royalty to the university, an equity stake in the startup, or other such compensation. When an agreement is reached, the technology is officially licensed. In the final stage of the process, the organization or entrepreneur adapts and uses the technology. The original invention typically undergoes extensive adaptation during the process to commercialization. The university, and sometimes the inventing scientist, might continue to be involved with the organization or entrepreneur to help develop the technology or to maintain the licensing agreement. (p. 575)

However, Bradley, Hayter and Link (2013) argue that the traditional model is inaccurate and inadequate as the process of technology transfer is becoming increasingly complex and includes mechanisms that are more informal. They present alternative, dynamic models of technology transfer that incorporate academic entrepreneurship and open innovation. They believe that these alternative models more accurately represent the process of universities becoming dynamic and entrepreneurial (Bradley, Hayter & Link, 2013). According to the dynamic model of technology transfer, mechanisms of technology transfer include joint laboratories between academia and business, spinoffs, licensing of IP, research contracts, mobility of researchers, joint publications, conferences, expositions and special media, informal contact within professional networks, a flow of graduates to the industry, sponsored research, hiring of students, and serendipity (Bradley, Hayter & Link, 2013).

Recently researchers have studied university technology transfer as an ecosystem (Good et al., 2019; Good et al., 2020). A technology transfer ecosystem is a "set of university affiliated intermediary organizations that are connected by directly supporting technology transfer activities" (Good et al., 2019, p. 1). They include technology transfer offices, science parks, incubators, and university venture funds. Good et al. (2019) revealed that there is a lack of research studying the technology transfer ecosystem as a whole. Good et al. (2020) studied the organizational structure of technology transfer (TT) ecosystems in academia and based on their analysis, they developed a typology consisting of three types of ecosystems: the introverted, externalized and allied TT ecosystems. They concluded that within-ecosystem interactions are largely different across the three types (Good et al., 2020).

Research on technology transfer offices (TTOs) focuses on the governance typology of TTOs (Schoen et al., 2012), organizational structure (Brescia et al., 2014), mission statements (Fitzgerald & Cunningham, 2015), the role of the size, age and structure in the performance of

knowledge transfer (Gerbin & Drnovsek, 2015), and why academic patentees choose to bypass TTOs (Goel & Goktepe-Hulten, 2018). Brescia et al. (2014) examined the TTO structures of the top 200 ranked universities in the world and highlighted the presence of three knowledge transfer organizational models (internal, external, and mix) and six configurations of these models. The external model is defined as a structure of the knowledge transfer office independent of the university. The internal model is a structure where all activities and processes of the TTOs are supervised by an office inherent to the university. The 'mix' model combines both the internal and external model features: an internal office and an external company.

Fitzgerald and Cunningham (2015) explored the mission statements of university TTOs. They revealed that the mission statements of university TTOs mainly have two mission elements— principal services and target customers and markets. They found moderate positive correlations between the number of mission statement components and grants and patents granted. Gerbin and Drnovsek (2015) found no straightforward evidence regarding the role of the size, age and structure of technology transfer offices in the knowledge transfer performance of academic institutions. Goel and Goktepe-Hulten (2018) found that patentees in physical and life sciences, those with doctoral degrees, and those with greater job experience are more likely to bypass TTOs. They also revealed that "different forms of industry interactions, including working in industry, industry cooperation and industry consulting, all make TTO-bypassing more likely, with some interesting differences across gender" (p. 240).

Research on other components of the technology transfer ecosystems, including business incubators and science parks focuses on the performance of a technology business incubator (TBI) program (M'Chirgui et al., 2018), the business models of TBIs (Tang et al., 2021), how science and technology parks create value for tenants (Albahari et al., 2018), and the contribution of science parks (Lecluyse et al., 2019). M'Chirgui et al. (2018) found that "the presence of skilled and resourceful staff positively affects incubator activity" (p. 1157). In addition, the presence of other support structures (e.g., universities, research laboratories), and the size and nature of financial resources held by or allocated to incubators favorably influence the formation of new science and technology-based firms. Tang et al. (2021) explored the strategies implemented in the next-generation TBIs in China, the business models of these incubators and the fit between each incubator's business model and their respective strategy.

Science and Technology Parks (STPs) are certain agglomeration subsets that support the start-up and incubation of innovative firms (Albahari et al., 2018; Lecluyse et al., 2019). STPs provide business support which consists of two components: a configuration-oriented component, and a process-oriented component. Albahari et al. (2018) argue that both components must be planned thoroughly so that the tenants of STPs could benefit. Lecluyse et

al. (2019) conducted a literature review on the contribution of science parks (SPs) to economic development. They noticed that studies of the outcomes of SP contribution are mainly at the regional and firm levels. They conclude that "the contributions different SPs provide to their local, regional or national economy are highly divergent and very hard to capture" (p. 575). Similarly, studies of the contribution of SPs at the firm level are also controversial.

The literature emphasizes that there are formal and informal channels of university KTT (Bradley, Hayter & Link, 2013; Grimpe & Fier, 2010; Hayter, Rasmussen, & Rooksby, 2020; Link et al., 2007; Nilsson et al., 2010; OECD, 2019b). Formal technology transfer channels include legal instruments such as patents, licenses, and royalty agreements (Link et al., 2007) established to ensure that the university both manages the commercialization process and reaps the financial returns (Table 6). While formal channels entail a formal contract agreement and include legal instruments, informal mechanisms and channels are non-contractual and facilitate knowledge flow through informal communication processes (Link et al., 2007). However, there is no clear consensus on what formal and informal channels comprise. According to the OECD (2019b) classification, formal channels include intellectual property (IP) transactions, academic spin-offs, contract research, academic consultancy, research mobility, and labor mobility. Informal channels are publications, conferencing and networking, networking facilitated by geographic proximity, facility sharing, and training (OECD, 2019b). Unlike the OECD (2019b), some sources classify collaborative research, consultancy and technical assistance as informal channels (Link et al., 2007; Nilsson et al., 2010).

Table 6. Formal and Informal Channels of University-Industry KTT

Formal channels	Informal channels
Intellectual property (IP) transactions	Publications
Academic spin-offs	Conferencing and networking
Collaborative and contract research	Networking facilitated by geographic
Academic consultancy	proximity
Research mobility	Facility sharing
Labour mobility	Training

Source: *OECD, 2019b*

Formal channels are more about transferring property rights and obligations, while informal channels are focused on communication processes (Link et al., 2007; Schaeffer et al., 2018). According to Dang et al. (2019), "research centres, incubators, and contract-based research and commercialization" (p. 389) are the formal knowledge transfer channels that are used at Australian Universities. The study revealed that research centers and incubators have been recently established and have become the most common channels for knowledge transfer.

Research centers are used as formal channels for one-way or two-way transfer of knowledge, by disseminating research results to the industry or conducting collaborative research with the industry. As for incubators, their goal is to provide "funding, skills, knowledge and professional support for idea developments and start-ups" (Dang et al., 2019, p. 389).

Most research has focused on formal KTT channels, such as patenting, licensing, and university spinoffs or startups. The literature on patents includes an analysis of the drivers and determinants of university patenting (Fisch et al., 2014; Grimm & Jaenicke, 2012), the effects of academic patenting activity on publication and research collaboration (Lee, 2019), and the influence of human capital and perceived university support on patent applications (Munshaw et al., 2018). Fisch et al. (2014) found that university patenting is influenced by "the quantity of the universities' publications and a technological focus in areas such as chemistry and mechanical engineering" (p.318). Lee (2019) revealed that "academic patenting complements publishing up to a certain level of patenting activity, but then replaces publishing. Academic patenting also is shown to have positive effects on research collaboration with industry" (p.1993). Grimm and Jaenicke (2012) found that senior age and experience outside the university contribute significantly to the entrepreneurial attitude of university patentees. Similarly, Munshaw et al. (2018) found that academics with previous entrepreneurial experience were more likely to apply for patenting.

Literature on university spinoffs focuses on spinoff networks and their relationship to entrepreneurial development (Hayter, 2016); how spinoffs differ in composition and interaction (Kolb & Wagner, 2018), the drivers, barriers, and determinant factors that affect the growth of university spin-off firms (Ferretti et al., 2020; Francois & Philippart, 2019; Hossinger et al., 2019; Jung & Kim, 2018), and a systematic review of the development, growth, and performance of university spin-offs (Mathisen & Rasmussen, 2019; Miranda et al., 2018). Hayter (2016) found that "social networks among early-stage academic entrepreneurs are important for spurring and supporting spinoff establishment, but if they do not evolve from their initial configuration, these networks can largely constrain subsequent stages of spinoff development" (p. 475). Kolb and Wagner (2018) found that "the individual entrepreneur has a more important role in the establishment of the projects, whilst contextual factors matter more in the subsequent development of the spin-offs" (p. 750). Hossinger et al. (2019) found that individual factors carried significantly higher explanatory power than organizational and system-level factors in relation to the entrepreneurial behavior of academics. Ferretti et al. (2020) found that the success of academic spin-offs is determined by "the joint efforts of academic individuals and representatives of non-academic organizations on the board and in the shareholder base" (p.137).

The literature on startups focuses on the importance of university startups as a commercialization alternative (Swamidass, 2013), the founders' human capital and university start-up survival (Criaco et al., 2013), the role of universities in the location of innovative start-ups (Calcagnini et al., 2016), and the impact of university entrepreneurial support on start-ups (Breznitz et al., 2018). Criaco et al. (2013) found that knowledge gained from previous work in the industry negatively influences university startup survival, while knowledge gained from previous experience in research, teaching and entrepreneurship enhances the survival likelihood of university startups. Swamidass (2013) presented four successful policies and practices to increase university startups. They include: assessing all university inventions for their startup potential; hiring technology transfer specialists with entrepreneurial experience and ties with business; recruiting faculty who have experience in startups; and allocating funds to support proof-of-concept (POC) programs. Calcagnini et al. (2016) found that innovative start-ups are positively affected by university spillovers. Moreover, "the presence of human capital (graduates) exerts a significant influence on the location decisions of start-ups, being a source for competitiveness for firms close to universities" (p. 670). Breznitz et al. (2018) revealed that "geographical proximity, ad-hoc service support including shared space, and a larger community of member and graduate firms to which network ties may be formed increases the chance of connecting with other past or current member firms" (p.343).

As for the informal channels, a study conducted in HEIs of Hong Kong revealed that "training programmes, workshops, consultations, work-based studies and presentation seminars were found to be effective KT practices to support the recipients in acquiring, contextualizing, internalizing and externalizing knowledge" (Cheng, 2020, p. 288). This implies that informal channels are important in transferring knowledge that can further be adapted and shared. Grimpe and Fier (2010) studied the effects that institutional differences have on the choice of scientists to transfer technology informally. Focusing in more detail on the research productivity of faculty in terms of publications and patents, they found that particularly university scientists with a track record of patent applications are an attractive partner for firm scientists in joint informal technology transfer activities. They conclude that "faculty, like all economic agents, respond to incentives and until universities change their incentives (e.g., patenting as one criterion for promotion and tenure) knowledge will continue to flow out the backdoor" (p. 647).

The literature identifies enabling factors of university KTT such as research novelty, laboratory size, network capital, and resources (Landry et al., 2006; Jung & Kim, 2018), university location, publications, patents, (Jung & Kim, 2018), entrepreneurial attitude (Scuotto et al., 2019), high-quality academic research (Wang & Li, 2019), new doctoral graduates and international scientific co-publications (Calcagnini et al., 2016), curricular valorization

(prestige/visibility/reputation), and/or university incentives, potential of commercialization, and collaboration with industry (Daniel & Alves, 2020). Huyghe and Knockaert (2015) revealed that "the extent to which universities articulate entrepreneurship as a fundamental element of their mission fosters research scientists' intentions to engage in spin-off creation and intellectual property rights" (p. 138). Moreover, university role models and rewards for academic entrepreneurship enable university researchers to engage in patenting, licensing or spinoff creation. Kirchberger and Pohl (2014) conducted a literature review of success factors of technology commercialization. They revealed such success factors as industry closeness, innovation culture, intermediaries' support, management techniques, networking activities, property rights, researchers' characteristics, resource availability, team structure, technology application value, technology suitability for commercialization, technology transfer strategy, and university policy and structure.

University-industry collaboration is mentioned in previous research on factors influencing the process of knowledge and technology transfer (Dahlborg et al., 2017; Daniel & Alves, 2020; Ho et al., 2014; Teixeira et al., 2019; Thomas & Paul, 2019; Ye et al., 2019). A study of technology transfer cases in Korea revealed that university-company partnership is important for successful technology transfer (Min et al., 2019). Daniel and Alves (2020) identified the importance of university-industry collaboration in the process of patenting, by interviewing university faculty who owned several patents at public universities in Portugal. Its importance is explained by the results of a longitudinal study by Dahlborg et al. (2017) that examined technology transfer through academic patenting. They revealed that "small and medium-sized companies are the largest absorbers of academic patents" (Dahlborg et al., 2017, p. 538). Ho et al. (2014) also found that collaboration with industry plays a significant role in efficient technology transfer. They explain:

> When universities own technology property rights, how a university disseminates its owned technologies to realize the economic value becomes another core activity. This is the second stage, or the ''value creation'' stage, within the technology transfer process. The required capabilities in Stage 2 are related to how universities make linkages with external industrial actors and whether they are capable of commercializing their owned technology with the right value. To obtain more external connections, universities must understand the possible applications of their specific technologies and patents and accumulate social capital through different informal scientific events or other types of previous cooperative experiences. (Ho et al., 2014, p. 263)

Thus, collaboration with industry provides an opportunity for assessing the economic value of their knowledge and technologies, exploring innovative ways of transferring knowledge and technology, for building social capital such as trust and network ties between the university and the company (Teixeira et al., 2019; Thomas & Paul, 2019). This suggests that networking and cooperation with industry are important for universities to successfully transfer their knowledge and technologies.

The main inhibiting factors of university KTT are the lack of adequately trained staff and inventions processing capacity in TTOs (Swamidass & Vulasa, 2009), insufficiency of funds, deterioration of the market condition, and insufficiency of marketing capability (Jung et al., 2015), inflexibility in university procedures and in negotiating with industry; lack of R&D funding to further develop the technology suitable for marketing; and low market potential of the patent (Daniel & Alves, 2020). Swamidass and Vulasa (2009) argue that with a lack of staff and budget TTOs will have to devote their resources to filing and issuance of patent applications rather than to marketing inventions. A study of factors that influence KTT in Kazakhstan revealed that the inhibiting factors include "lack of resources to build university university-industry links, lack of time due to high teaching load, poor qualification of technology transfer managers and lack of networking with industry" (Alibekova et al., 2019, p. 76).

Daniel and Alves (2020) analyzed the process of obtaining and commercializing academic patents by university faculty in Portugal. They found that the most common inhibiting factor is a "lack of R&D funding to further develop the technology suitable for marketing" (p. 276). Similarly, Jung et al. (2015) revealed that "insufficiency of funds and lack of facility and equipment are the two main obstacles to commercialization during the technology acquisition stages. Likewise, deterioration of the market condition and insufficiency of funds were the top-ranking barriers at the prototype testing stage" (Jung et al., 2015, p. 896). The results of the study in Latvia suggest that universities need more independence in terms of funding opportunities to be successful in research commercialization (Muizniece, 2020). Ho et al. (2014) explain that "In the early stage, financial funding determines the size of the budget base a university has for research activities… Because funding is a critical input to invent new technologies, how a university enlarges the financial base from external sources becomes the first task" (Ho et al., 2013). These studies show that funding is crucial in all stages, from knowledge generation and technology invention to commercialization and transfer to the industry.

2.8 Conceptual Framework

From the streams of literature reviewed, a conceptual framework of university-industry KTT has been developed for this study (see Figure 7). In particular, the framework adopts the dynamic view of technology transfer by Bradley, Hayter & Link (2013), the complementarities

between formal and informal channels of university–industry knowledge transfer by Schaeffer, Öcalan-Özel, and Pénin (2018), the multi-level model of university research commercialization by Belitski, Aginskaja, and Marozau (2019), and a typology of technology transfer ecosystems by Good, Knockaert and Soppe (2020). To avoid confusion in terms of the channels, this framework applies the OECD (2019b) classification of formal and informal channels of KTT. The integration of these concepts is explained below.

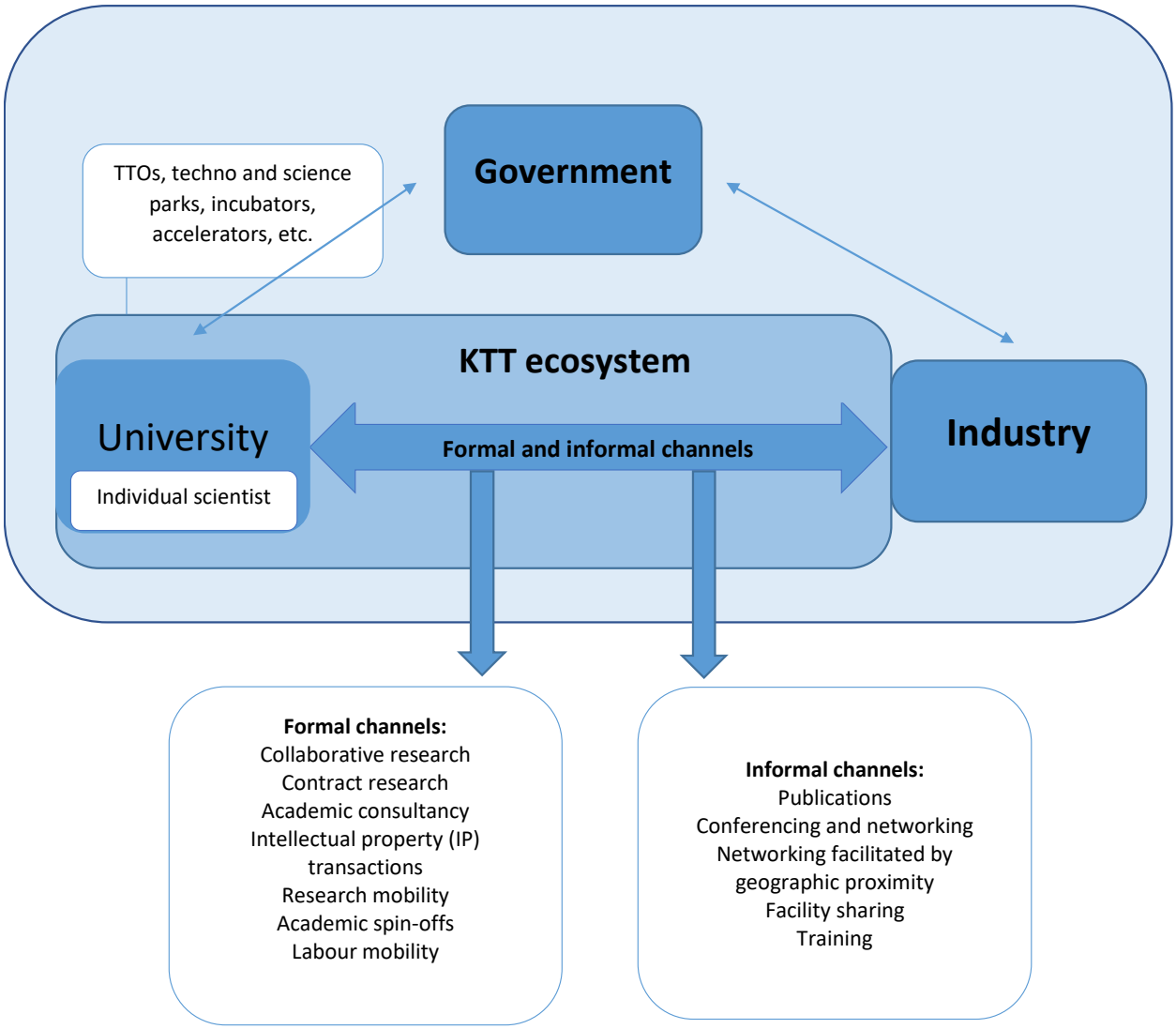

Figure 7. Conceptual Framework of the Dynamic, Multi-level Model of University-Industry Knowledge and Technology Transfer

The process of university-industry KTT is becoming increasingly complex and includes mechanisms and channels that are more informal compared to the traditional, linear model of KTT (Bradley, Hayter & Link, 2013). The dynamic model of KTT provides a more accurate and adequate representation of the process, focusing on both formal and informal mechanisms and channels of KTT. Formal mechanisms and channels are more about transferring property rights and obligations, while informal mechanisms and channels are focused on informal

communication processes. Formal mechanisms and channels entail a formal contract agreement and include legal instruments, whereas informal mechanisms and channels are non-contractual and facilitate knowledge flow through informal communication processes (Link et al., 2007; Schaeffer et al., 2018). The dynamic complementarities between the formal and informal mechanisms and channels of KTT facilitate the successful transfer of knowledge and technology from universities to industry (Schaeffer et al., 2018).

The process of university KTT is multi-level, involving mutual interactions of stakeholders at the individual (researcher, scientists, etc.), the organization (university, industry, etc.) and the system levels. There are enabling and inhibiting factors at each level that influence the interaction of stakeholders and the process of KTT. The system level is the largest square that comprises the entrepreneurial environment and stakeholders involved in the KTT process, including the government, universities, industry, entrepreneurs, and risk capital providers. The conducive, entrepreneurial environment at the system level facilitates university KTT as individual researchers and universities use available resources and opportunities, and interact with each other and with other stakeholders to transfer new knowledge and technology to industry (Belitski et al., 2018).

At the university level, the university environment, administrative structures and policies have a significant influence on the process of KTT (Belitski et al., 2019; Kirchberger & Pohl, 2014). University incentives are important for scientists to engage in the KTT processes (Daniel & Alves, 2020; Grimpe & Fier, 2010; Huyghe & Knockaert, 2014). Inflexibility in university procedures and in negotiating with industry inhibits the KTT (Daniel & Alves, 2020). Other determinant factors at the university level are curricular valorization (prestige/visibility/reputation), the potential of commercialization, and collaboration with industry (Daniel & Alves, 2020), laboratory size and resources (Landry et al., 2006), university location, publications, research funding, patents, (Jung & Kim, 2018), new doctoral graduates and international scientific co-publications (Calcagnini et al., 2016), entrepreneurial attitude (Scuotto et al., 2019), industry closeness, innovation culture, management techniques, networking activities (Kirchberger & Pohl, 2014).

Universities develop KTT ecosystems on campus and/or off campus that include organizational entities, such as technology transfer offices, techno and science parks, incubators, accelerators, and so on. These entities acting as intermediaries are critical for bridging science and industry, and for successful transfer of knowledge and technology (Good et al., 2019; Good et al., 2020). In contrast, the lack of adequately trained staff and inventions processing capacity in technology transfer offices inhibits the process of KTT (Swamidass & Vulasa, 2009).

At the individual level, the characteristics of the scientist (e.g., the field of science, position, the proportion of time dedicated to research, number of research publications), as well as his/her awareness and perception of the technology transfer ecosystem influence the decision of the scientist to disclose the invention. If the scientist perceives the KTT ecosystem as efficient, he or she usually chooses formal mechanisms of KTT and discloses the invention to the technology transfer office for commercialization. However, if the scientist does not perceive the KTT ecosystem as efficient, he or she might bypass the technology transfer office and choose informal mechanisms of technology transfer (Belitski et al., 2019). Other factors at the individual level include research novelty (Landry et al., 2006), quality of academic research (Wang & Li, 2019), technology suitability for commercialization and technology transfer strategy (Kirchberger & Pohl, 2014).

Most studies have focused on university KTT in industrialized countries. There is a gap of knowledge on university KTT in other parts of the world, particularly in countries with developing and transitional economies. Very few studies have been conducted on university KTT in post-socialist countries such as Kazakhstan where the public sector still dominates and government controls every sector of the economy (Belitski et al., 2019). Hardly any research has focused on university KTT in the agricultural industry in Kazakhstan. Therefore, it is an opportunity to study whether the same models, channels, and determinants of university KTT presented in this conceptual framework apply to the context of Kazakhstan. The conceptual framework was used as a compass that provided the methodological orientation. It guided the development of data collection instruments, particularly interview questions. Furthermore, the framework guided the data analysis approaches in this research study. Finally, the framework was developed further to generate theory from the findings.

2.9 Summary

In this chapter, six interrelated streams of literature were reviewed, including knowledge management in HE and university knowledge and technology transfer. The literature on globalization, knowledge economy and higher education; academic capitalism; academic entrepreneurship and the entrepreneurial university provide a description and explanation of the global shift to the knowledge economy and transformation of higher education. Academic capitalism is a broader concept compared to the entrepreneurial university and academic entrepreneurship because academic capitalism is a conceptual framework that explains the linkages between the government, higher education, and industry. Academic capitalism enables us to understand the changing nature and role of higher education in the globalized knowledge economy. The concepts of the entrepreneurial university and academic entrepreneurship are interrelated as the entrepreneurial university integrates entrepreneurship into its culture, and

stimulates entrepreneurial activities through various policies, strategies and incentives. Thus, academic entrepreneurship is a key component of the entrepreneurial university.

Furthermore, the conceptual literature provides a description and explanation of the concepts of knowledge management in HE and university knowledge and technology transfer that are also interrelated. University KTT is a part of the process of knowledge management in HE. The transfer of knowledge and technology is the ultimate outcome of successful knowledge management. The conceptual framework that will guide this research study is the dynamic, multi-level model of university knowledge and technology transfer. The process of university KTT is becoming increasingly complex and includes mechanisms and pathways that are more informal. The process of university KTT is also multi-level, involving mutual interactions at the individual, the university, and the system levels. There are enabling and inhibiting factors at each level that influence the interaction of stakeholders and the process of KTT.

CHAPTER 3. METHODOLOGY

3.1 Introduction

In this chapter, I describe the theoretical positioning of the research and explain its alignment with the research design and methods. The site selection criteria, data collection methods and instruments, participants, approach to data analysis, and ethical and research quality considerations will be explained.

3.2 Research Design and Methods

The research paradigm that is close to my worldview is social constructivism as "individuals seek understanding of the world in which they live and work" (Creswell, 2014, p. 8). My ontological belief is that there are multiple, relative realities constructed by individuals experiencing a certain phenomenon (Creswell, 2014; Krauss, 2005). My epistemological stance is also constructivist, as I believe that "knowledge is established through the meanings attached to the phenomena studied; researchers interact with the subjects of study to obtain data; inquiry changes both researcher and subject; and knowledge is context and time dependent" (Krauss, 2005, p. 759). In other words, to understand a certain phenomenon, the researcher consults the views and meanings developed and negotiated by multiple participants, while focusing on their specific contexts (Creswell, 2014).

This study is conducted using a qualitative research method, which aligns with my social constructivist ontology and epistemology. The main objective of a qualitative researcher is to understand the reality constructed by individuals, since reality is interpreted in many ways (Merriam, 1998). With a qualitative study, it is possible to explore the role of universities in knowledge and technology transfer in Kazakhstan from the subjective meanings that participants attach to the phenomenon. The rationale for using a qualitative method is that the qualitative data and its analysis give an opportunity to explore the role of universities in the process of knowledge and technology transfer in Kazakhstan from institutional and faculty perspectives. The qualitative method helps to study the social world in various dimensions, "including the texture and weave of everyday life, the understandings, experiences and imaginings of our research participants, the ways that social processes, institutions, discourses or relationships work and the significance of the meanings that they generate" (Mason, 2002, p. 1). With a qualitative study, it is possible to explore the specific mechanisms of and understand the inhibiting and facilitating factors for university knowledge and technology transfer in more depth from the first-hand experiences and understandings of participants. Moreover, through the qualitative method, contextual conditions, including institutional, social, and environmental conditions of universities are covered as they may have a great influence on the process of knowledge and technology transfer (Yin, 2011).

This qualitative research study uses a case study design. A case study is an approach "in which the investigator explores a real-life, contemporary, bounded system (a case) or multiple bounded systems (cases) over time, through detailed, in-depth data collection involving multiple sources of data and reports a case description and case themes" (Creswell, 2013, p. 97). In a qualitative case study, the researcher investigates the practice or the process holistically to understand the case (Njie & Asimiran, 2014). The literature on technology transfer research, reviewed in chapter two, highlights that the processes and effectiveness of technology transfer are context-dependent (Autio et al., 2014; Baxter & Jack, 2008). However, qualitative case methods "are still in an emergent state within the field of technology transfer research" (Cunningham et al., 2017, p. 17). Therefore, using qualitative case studies in university technology transfer is an appropriate research design for building theory and developing recommendations for practice.

A multiple-case design is used in this study, where two universities are each considered as an individual case multiple-case design is used when each case is investigated separately and then compared with other cases (Starman, 2013) to explore similarities and differences among them (Baxter & Jack, 2008). The aim of studying multiple cases at a deeper level is "to see the processes and outcomes across many cases, to understand how they are qualified by local conditions, and thus to develop more sophisticated descriptions and more powerful explanations" (Miles & Huberman, 1994, p. 172), to "enhance generalizability", and "deepen understanding and explanation" (Miles & Huberman, 1994, p. 173). The multiple case study design is particularly helpful in this study as perceptions of university-industry knowledge and technology transfer in Kazakhstan will be explored in two specific case contexts. Using more than one research site increases the possibility for the transferability of findings to other agrarian universities in other Central Asian countries.

3.3 Research Questions

To address the research problem identified in Chapter One, the following central research questions and sub-questions were used to guide the study.

Central Question: What is the role of universities in the process of agricultural knowledge development and technology transfer in Kazakhstan?

Guiding Question 1: How do universities understand the purpose of knowledge and technology transfer in Kazakhstan?

Guiding Question 2: What are the specific mechanisms, channels and pathways of university-industry knowledge and technology transfer in Kazakhstan?

Guiding Question 3: What are the inhibiting and facilitating factors for university-industry knowledge and technology transfer in Kazakhstan?

3.4 Site Selection

There were four criteria for selecting a university as a research site in this study. They included: focusing on a specific industry sector; a university of national and regional strategic importance; research publications and outputs, and the presence of commercialization offices.

Based on these criteria, the research sites for this qualitative case study were Northern University and Southern University. The rationale for choosing these two universities is their national and regional strategic importance. Each university is the only agrarian university located in the northern and southern parts of the country. They are also key agrarian universities on the national level, as they are both included in the list of 11 main universities for industrial and innovative development of the country (Ministry of Education and Science of the Republic of Kazakhstan, 2017). Among those 11 universities, Northern University and Southern University are the only agricultural universities. Since 2015, both universities are taking part in training specialists for implementing the projects of *SPIID for 2015-2019* (Government of Kazakhstan, 2018). They are also undergoing step-by-step transformation into research universities (Government of Kazakhstan, 2018). Their mission is to become research universities and to transfer knowledge and technology to agriculture. They were among the top 15 Kazakhstani universities by their research publications in 2016-2018 (NASRK, 2019). They also have offices for research commercialization and provide educational and consulting services to farmers (KazNAU, 2020; KazATU, 2020).

Northern University is the oldest higher education institution in the region. It was established in 1957 by the Ministers' Council of the Soviet Union to train specialists for agricultural production in northern and central regions of Kazakhstan. In more than half a century about 60 000 highly qualified specialists were trained for various agro-industrial sectors, who have been contributing to the economic development of the country. The biggest achievement of the university was being awarded the gold medal of Blinnikov for its huge contribution to inventions and patents (KazATU, 2020). The university aims to become an international research university in agriculture, with competitive research capacity, and unique programs, integrated into the world research community, actively introducing research results, and disseminating knowledge and technology. There are seven research centers and an Extension Office at the University. Research centers are engaged with the active introduction of research results through educational processes, dissemination of knowledge and commercialization of technologies, and university integration with research organizations of the Ministry of Agriculture and the Ministry of Science and Education. The Extension Office is involved in introducing advanced innovation in agriculture, dissemination, and transfer of knowledge to the agricultural industry (KazATU, 2020).

Southern University was founded in 1929 as the first agrarian higher education institute in Soviet Kazakhstan. The university managed to focus its resources to become an educational, research and innovation center of agricultural development, and have a significant impact on the national competitiveness of this sector. From 2010 to 2016, the university transformed into a national research university applying international standards of project management with experts from leading research centers and universities around the world. Today the university has been successfully integrated into the world research community, collaborating with leading universities and research centers (KazNAU, 2020). Since 2015, the University has been operating the Agrotechnological Hub, which includes all innovative research laboratories and centers. Today, a new concept for the development of an AgroHub has been developed, which will catalyze all areas of the university in one place: science, education, commercialization, technology transfer and interaction with the ecosystem. In December 2017, the University became the winner of the competition for Technology Transfer/ Commercialization Offices at the universities of the Republic of Kazakhstan (KazNAU, 2019).

Overall, the main similarities between the two agrarian universities include their historical background, national strategic importance for industrial and innovative development, and gradual transformation into research universities. Both were established during the Soviet period and have become key agrarian universities with regional strategic importance, training specialists for the agricultural sector. The differences between the two universities are their location and focus on the subsectors of the agricultural industry. One of them is located in the northern part of Kazakhstan, while the other is located in the southern part of the country. Therefore, the focus of the universities differs, as the northern part of Kazakhstan consists of mainly grain-producing regions, while the southern part produces livestock, fruits, and vegetables (World Bank, 2016). The two sites provide relevant and interesting comparative sites for the purpose of this study.

3.5 Procedures

After receiving approval to conduct the study from the Nazarbayev University Graduate School of Education Research Ethics Committee, I sent letters to the Rectors of Northern and Southern Universities (Appendix A), explaining the details of the study to gain permission to use the universities as research sites. As soon as I received permission, I gained contact details of potential participants through university websites. I contacted potential participants by e-mail and by phone, introducing myself and providing them with a brief overview of the research study and the data collection process (Appendix B). I asked them if they were willing to take part in the study. They were informed about confidentiality and that they could ask questions about the study by e-mail or by phone. After they expressed their willingness to participate in the study, I

set up an appointment with them for an individual interview at a time that was convenient for them. As the data collection occurred during the Covid-19 pandemic, interviews were conducted using technology, such as Zoom or WhatsApp Video Calls.

The day before the interview, the participants were contacted to remind them about the interview and to confirm the time. I also emailed them the informed consent form to sign and return to the researcher (Appendix C). Before starting the interview, I confirmed the verbal consent from each participant to voluntarily participate in the study and their permission to audio-record the interview. The interviews were conducted using an interview protocol (Appendix D). After addressing any questions or concerns of the participants, I concluded the interview and thanked them for their participation.

3.6 Data Collection Methods

Data was collected in the form of documents and individual semi-structured interviews, as multiple sources of evidence help to triangulate data, corroborate findings and minimize potential biases. The data collection process consisted of two stages. In Stage, I, relevant documents (strategic plans, annual reports and webpages) from both university websites were selected and analyzed, whereas individual interviews with university faculty were conducted in Stage II. The rationale for choosing document analysis as the first stage of data collection is that it helped to understand the policy context of university-industry knowledge and technology transfer, to gain insights into each case and to develop additional questions for the interview protocols.

3.6.1 Documents

Documents were chosen as a data collection method because their analysis provides "a systematic procedure for reviewing or evaluating printed and electronic (computer-based and Internet-transmitted) material" (Bowen, 2009, p. 27). The advantages of using documents include efficiency, availability, cost-effectiveness, lack of obtrusiveness and reactivity, stability, exactness, and coverage; however, they also have such limitations as insufficient detail, low retrievability, and biased selectivity (Bowen, 2009). To minimize these potential limitations, criteria for selecting documents were identified to avoid biased selectivity.

The following criteria were applied to select documents: relevance to the research questions, the year of publication, the source of documents, authenticity, accuracy, credibility, representativeness, completeness, the original purpose of the document and its target audience. The university websites were browsed and reviewed to find the documents of the two universities related to policies, strategies and initiatives taken to transfer knowledge and technology to the agricultural industry. The types of documents analyzed were publicly available policy documents, strategies, reports, articles, and press releases, as well as other electronic

material on the university websites related to the university technology transfer published from 2015. Before selecting documents to analyze, I determined the relevance of the documents to the research questions by reading and understanding the content. The choice of documents was guided by the conceptual framework of the study. As Bowen (2009) recommends, I determined the authenticity, accuracy, credibility, representativeness, and completeness of the selected documents by carefully reading the documents. I considered the original purpose of the document and the target audience. The language of the documents was Russian, which is the official language of Kazakhstan. The document selection process is represented in a matrix as part of the audit trail for the study.

3.6.2 Interviews

The next stage of data collection involved individual, semi-structured interviews with the university faculty, which were conducted in Kazakh and Russian languages, depending on the language preferences of the interviewees. As there was a pandemic during my data collection period and face-to-face interviews were not possible, I used technology to conduct interviews such as WhatsApp Video Call or Zoom. Initially, I planned to conduct focus group interviews with university faculty. However, due to the pandemic, it was unsafe to bring people together. Therefore, I conducted individual interviews with university faculty. The length of each interview was approximately one hour. I was unable to secure interviews with managers – and therefore, the documents increased in importance, becoming a proxy for the institutional perspective.

The rationale for conducting individual interviews with the university faculty was to ensure that they were comfortable expressing their subjective views on university-industry knowledge and technology transfer. According to Cohen et al. (2007), interviewing is "a valuable method for exploring the construction and negotiation of meanings in a natural setting" (p. 29). It is possible to cover a wide range of issues in more depth through interviews. Interviews also allow the researcher to interact with the participant, and to explain the meaning of terms and questions that might be unclear for the participant (Hobson & Townsend, 2010). Individual semi-structured interviews were employed for this study to cover the research agenda while giving opportunity to the participants to express their subjective views (Hobson & Townsend, 2010). The limitations of individual semi-structured interviews are that the researcher's presence might bias the participants' responses and not every participant is articulate (Creswell, 2013). To address these limitations, I prepared in advance follow-up and probe questions to pursue detail, depth, richness, and vividness of responses.

The interview questions were developed based on the literature review and conceptual framework on university technology transfer. The conceptual framework of university

technology transfer is based on the multi-level, dynamic model of technology transfer that technology is transferred to industry through formal and informal channels and mechanisms as well, involving mutual interactions of stakeholders at the individual (researcher, scientists, etc.), the organization (university, industry, etc.) and the system levels (Belitski et al., 2019; Bradley, Hayter, & Link, 2013; Schaeffer et al., 2018). The interview protocol (Appendix D) consisted of three types of questions: main questions, follow-up questions, and probes. The main questions were aligned with my research questions, while the follow-up and probe questions helped me to pursue detail, depth, richness, and vividness.

3.7 Participants

Purposeful sampling was used to recruit interview participants from the university faculty, to "intentionally sample a group of people that can best inform the researcher about the research problem under examination" (Creswell, 2013, p. 146). For individual interviews with the university faculty, nine participants were recruited from Northern University, whereas seven participants were recruited from Southern University (Table 7). Faculty members were selected based on their active involvement in knowledge and technology transfer. Information about university faculty and their contact details were obtained from their university websites. All of the participants have been assigned a reference number to reduce the identifiability of participants.

Table 7. Participants

#	Northern University	Southern University
1	Associate Professor, School of Technology and Technical Sciences	Professor, School of Agrobiology
2	Associate Professor, School of Veterinary	Professor, School of Agrobiology
3	Assistant Professor, School of Veterinary	Associate Professor, School of Agrobiology
4	Assistant Professor, School of Technology and Technical Sciences	Professor, School of Agrobiology
5	Associate Professor, School of Technology and Technical Sciences	Head of the Department, School of Agrobiology
6	Associate Professor, School of Forest Resources Management	Associate Professor, School of Forest Resources Management
7	Assistant Professor, School of Veterinary	Head of the Department, School of Veterinary
8	Associate Professor, School of Veterinary	
9	Associate Professor, School of Veterinary	

There were in total 16 participants from both universities: nine from the Northern University and seven from the Southern University. Table 8 provides a comparative summary of the demographic details of all participants. Ten of the 16 participants were female and six were male. There were almost an equal number of male and female participants from Northern

University, whereas female participants prevailed from Southern University. The participants from Southern University had higher academic qualifications and positions than the participants from Northern University. In terms of their academic qualifications, there were three Doctors of Sciences from Southern University, whereas there was no Doctor of Sciences from Northern University. In terms of their positions, there were two heads of departments and three full professors from Southern University, whereas there were no heads of department and full professors from Northern University. The participants from Northern University tended to be younger and less senior in their professional ranking and role. In terms of the schools that participants represented, there were no participants from the School of Agrobiology and five participants from the School of Veterinary at Northern University, whereas there were four participants from the School of Agrobiology and one from the School of Veterinary at Southern University. Most of the participants (12 out of 16) have more than 10 years of experience in higher education and research.

Table 8. Comparison of Participants' Characteristics

	Category	Northern University	Southern University
1	Gender	5 male, 4 female	6 female, 1 male
2	School	5 School of Veterinary, 3 School of Technology and Technical Sciences, and 1 School of Forest Resources Management	4 School of Agrobiology, 1 School of Veterinary, 1 School of Technology and Technical Sciences, and 1 School of Forest Resources Management.
3	Academic qualification	4 PhDs, 3 candidates of sciences, and 2 Masters'	3 Doctors of Sciences, 2 candidates of sciences, and 2 PhDs
4	Position	6 Associate Professors and 3 Assistant Professors	2 heads of departments, 3 Full Professors, 2 Associate Professors
5	Work experience	3 have less than 10 years of experience, 3 have between 10-20 years of experience, and 3 have more than 20 years of work experience	1 has less than 10 years of experience, 2 have between 10-20 years of experience, and 4 have more than 20 years of work experience.

The rationale for recruiting participants from the university faculty is that this study aims to explore university-industry knowledge and technology transfer from the perspectives of individuals that play different and distinct roles in the process. This aligns with Clark's (1998)

conceptualization of an entrepreneurial university, where "a stimulated academic heartland" is crucial for successful university transformation (p. 5-7). In a stimulated academic heartland, in the context of this study, faculty members are critical because any change or transformation will not be successful if the heartland does not accept it (Clark, 1998). Therefore it is important to explore the perspectives of faculty members to understand how they conceptualize knowledge and technology transfer and what channels they prefer to use to transfer knowledge and technology. It is also important to explore how policies are translated into incentives and opportunities for university faculty, and what factors determine their involvement in the process of knowledge and technology transfer.

3.8 Data Analysis

According to Wood et al. (2020), there are four steps in qualitative document analysis: establishing the initial corpus of documents, based on relevance to the research purposes; "open coding" which identifies broad topic areas in the data; "theoretical coding," that clusters open codes into themes and concepts; and creating a coherent story, that connects themes emergent from the data and the literature in a meaningful way (pp. 463-464). These data analysis methods were applied to both the document and interview data.

Early data analysis helps "cycle back and forth between thinking about the existing data and generating strategies for collecting new, often better, data" (Miles & Huberman, 1994, p. 50). The main methods of early data analysis that were used in this study were coding and memoing. Codes are "tags or labels for assigning units of meaning to the descriptive or inferential information compiled during a study" (Miles & Huberman, 1994, p. 56). They are used to organize the pieces of data, for the researcher to "quickly find, pull out and cluster the segments relating to a particular research question, hypothesis, construct or theme" (Miles & Huberman, 1994, p. 57). Memos are "the theorizing write-up of ideas about codes and their relationships as they strike the analyst while coding…it exhausts the analyst's momentary ideation based on data with perhaps a little conceptual elaboration" (Glaser, 1978, pp. 83-94, as cited in Miles & Huberman, 1994). Memos are helpful to make sense of data, to step back and connect pieces of data so that they make a coherent, recognizable picture.

3.8.1 Document Analysis

As a first step, the corpus of documents was constructed by reviewing the relevant databases. The websites and strategic documents (strategic plans and annual reports) of the two universities were analyzed to identify their understanding of and involvement in knowledge and technology transfer. The documents were also analyzed to identify formal and informal channels of knowledge and technology transfer that the universities use. The review was conducted as a series of keyword searches using universities' websites and their strategic documents. Search

terms were identified from the review of the literature and included Russian words such as “коммерциализация” (commercialization), “трансферт знаний” (knowledge transfer) and “трансферт технологий” (technology transfer) (Table 9). The keywords were typed into the search engine on the main page of the university website. The keyword search on the website of Northern University for “коммерциализация” (commercialization) yielded 44 results, for “трансферт знаний” (knowledge transfer) yielded five results and “трансферт технологий” (technology transfer) yielded 10 results. The first result for all three keyword searches was the link to the webpage of the university’s vision, mission and strategy. The results 2-8 of the keyword search of “коммерциализация” (commercialization) included links to the webpages of the Science section, particularly innovative activities of the university, research institutes and centers, the commercialization office, science news, announcements and research publications. The remaining keyword search results were links to announcements about seminars, training, conferences, and contests related to research commercialization.

Table 9. Summary of Website Search Results

	Keyword	Northern University	Southern University
1	“трансферт знаний” (knowledge transfer)	5	72
2	“трансферт технологий” (technology transfer)	10	157
3	“коммерциализация” (commercialization)	44	212

Furthermore, the web pages were visited individually to find information related to knowledge and technology transfer. The first webpage visited was the vision, mission and strategy of Northern University. There was a link to the program of the university development for 2020-2024. The link to webpages of the department of Science and Innovation and the Commercialization Office of Northern University were also visited and browsed. On the webpage of the Commercialization Office, there was a list of links to announcements about seminars, trainings, conferences, and contests related to research commercialization. A summary of the documents used in this study is presented in Table 10 and Table 11.

Table 10. Summary of Documents of Northern University Used in this Study

	Document Title	Publication Date	Type
1	University vision, mission, and strategy		Webpage
2	Science Department		Webpage
3	Commercialization Office		Webpage
4	Development Program 2020-2024	2020	Strategic Plan
5	Report 2017-2018	2018	Annual Report
6	Report 2018-2019	2019	Annual Report
7	Report 2019-2020	2020	Annual Report
8	Interview of the Rector to the mass media	2022	Interview

Table 11. Summary of Documents of Southern University Used in this Study

	Document Title	Publication Date	Type
1	Mission		Webpage
2	Science Department		Webpage
3	Development Program 2020-2024	2020	Strategic Plan
4	Report 2017-2018	2018	Annual Report
5	Report 2018-2019	2019	Annual Report
6	Report 2019-2020	2020	Annual Report
7	Interview of the Rector to the mass media	2021	Interview

3.8.2 Interview Data Analysis

After completing the interview data collection, I compiled the data by transcribing the interviews myself. Although it took time to transcribe, it allowed me to be close to the data and have a deeper understanding. All identifying information was removed, pseudonyms were assigned, and the transcripts were translated into English.

3.8.3 Within and Cross-Case Analysis

Both within-case and cross-case analyses were used to analyze the data. Typically, for a multiple-case study, within-case analysis is conducted before cross-case analysis (Creswell, 2013) to understand "the dynamics of each particular case before proceeding cross-case explanations" (Miles & Huberman, 1994, p. 207). Within-case analysis was used to answer the research questions and cross-case analysis was used to answer the overarching research question.

I applied Miles and Huberman's (1994) approach to data analysis for within-case analysis, which consists of data reduction, data display, and conclusion drawing and verification. Data reduction refers to "the process of selecting, focusing, simplifying, abstracting, and transforming the data that appear in written-up field notes or transcriptions" (Miles & Huberman, 1994, p. 10). It is employed throughout the research study, starting from choosing a conceptual framework up until the final draft of the thesis is ready. In other words, I disassembled the data

by using codes for "taking the data apart and creating meaningful groupings" (Castleberry & Nolen, 2018, p. 808). I coded the documents and interview transcripts to identify ideas that are related to each other and organized the codes into patterns and hierarchies of ideas. A sample of a coded interview transcript is presented in Table 12.

Table 12. Sample of Interview Transcript from Participant 1

	Interview transcript	Codes
R	Could you tell me about your activities at the university? Are you involved in research projects?	
P1	Yes, I work at the Agrarian University…, I am engaged in research, I am more of a scientist. I worked in the Agrarian University, then worked at a research institute, was the head of laboratories, then came back to the university by invitation. I continue my research activity at the Agrarian University. The problem of research institutes is that they are very dependent on budget funding and every 3 years scientists experience tremendous stress. Our funding does not start on time, despite the fact that we have grant funding or a targeted financing program. I worked at the Research Institute of the Ministry of Agriculture and the targeted financing program comes from the Ministry of Agriculture, and grants and the commercialization of the project comes through the Ministry of Education and Science. When we win a grant, the Ministry of Education and Science tries to start funding on time, but there are always delays. And from the Ministry of Agriculture, almost never financing is on time. Firstly, the announcement of the competition is already underway. For 2021-2023, the competition was announced only at the end of December, only on February 25, they collected applications. While it is already the middle of the year and funding, accordingly, will begin very late. And the workers of the research institute which belong to the agriculture will be without salaries. Even if you won the targeted financing program grant does not mean that you will receive your salaries on time every January. They can postpone until March… And in the end, since I was invited, I went to the university, because in the university, in addition to research work, you also teach. Due to teaching, wages are paid on time. In the university, all this is more streamlined and before the first day of a month you will definitely receive a salary. Therefore, it is easier for me in the university in this regard. Of course, teaching activity is very burdensome, a lot of hours, up to 800 hours. But at the Agrarian University, the hours are reduced to 500 hours, before it was generally 50 percent. They often write that the hours should be for someone who is the project manager, hours should be reduced, in addition, there should be more graduate students, not such direct teaching hours ...	Site Role Academic career Comparison b/w uni & RI Funding problems/ Issues at the Ministry level Comparison b/w uni & RI Funding
	How do you feel about the role of science and universities in innovation and transfer of knowledge and technology?	
	To be honest, I will not say that universities that exist today even Nazarbayev University does have. We can immediately say that the applied science is underdeveloped everywhere. So, I don't know a single university which would, even Satpayev University	Underdeveloped applied science

	or others develop technology and implement some kind of technology there, and all that is there, know some small ones. Well, at the university, first of all, I say again that the teaching load is heavy. This should be generally reduced and give the opportunity to do more research and to demand research directly. It seems to me that at the beginning it is necessary to shorten the hours, then, you know, universities will produce the best works. In fact, many teachers, I noticed, do not even want to do science. For example, this year I collected applications for the program on targeted funding, I wanted to attract, well, I came to the faculty of the technical faculty. In general, the teachers are many, at least I noticed at the university, I myself came from the research institute, it turns out, I kind of worked for a long time, so I immediately noticed that the teachers had a reluctance to do science. If there is no desire to do research, then he might be a good teacher, maybe. I don't say anything, maybe his pedagogical part is excellent there, but if the teacher does not improve, is not familiar with new technologies, it turns out that he himself does not work out these issues, lectures are done according to old books, for example, what kind of innovations and novelty he can introduce? It seems to me that these are moments like this in order to improve work at the university, so that our universities are quoted, so that graduates are competitive even abroad, it seems to me that first we need to start with the teaching staff ...	Teaching load as an inhibitor Lack of interest? Motivation to do research? Nexus between teaching and research All Higher ed teachers to have a role in knowledge production Knowledge production and prestige of uni, prestige of students, internationally competitive

I used NVivo Qualitative Data Analysis Software as a supplementary tool to organize and manage my data, including interview transcripts, documents and journal articles (Figure 8). It helped me to have rapid access to my codes, data, notes, and references, to recall them, and to focus on coding and thinking. I coded documents and interview transcripts in NVivo.

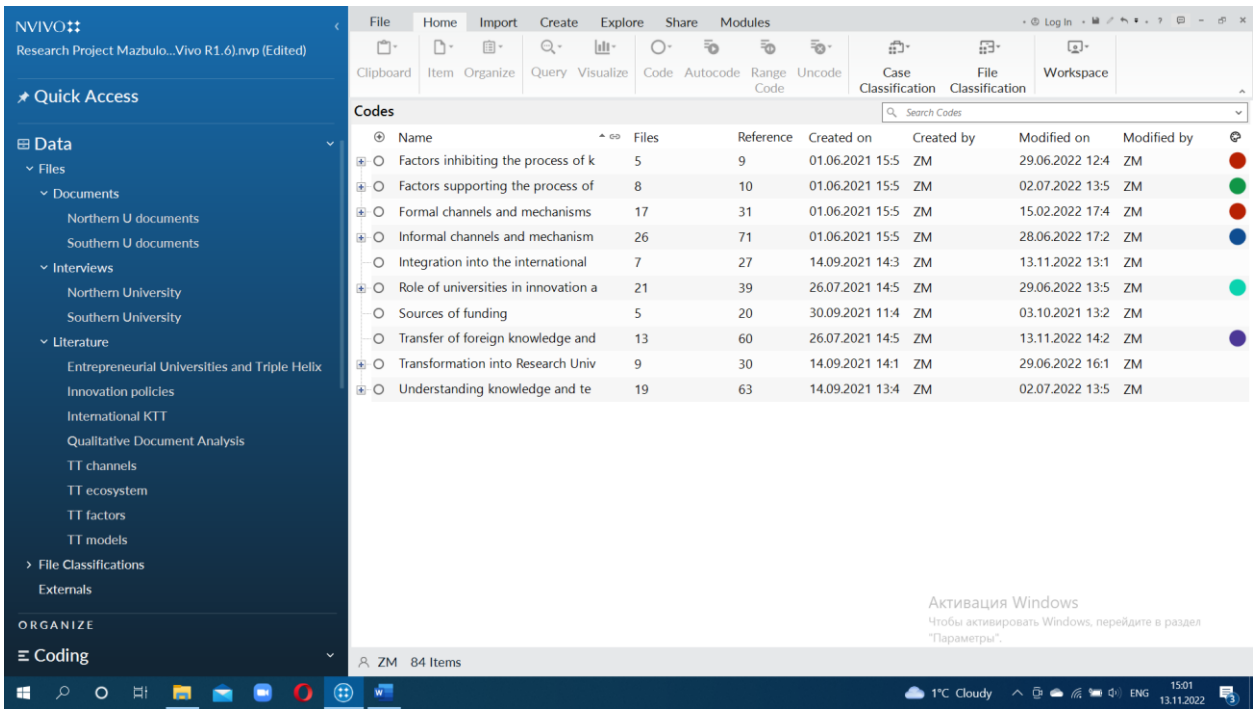

Figure 8. Data Management and Coding in NVivo Qualitative Data Analysis Software

The next stage of data analysis was data display, which is “an organized, compressed assembly of information that permits conclusion drawing and action” (Miles & Huberman, 1994, p. 11). It can be in the form of graphs, matrices, and charts so that the researcher can decide regarding the data whether to further analyze it or draw conclusions. The software helped me in data reduction and display. For example, I used the function “World Cloud” which extracted the most frequent words in the interview transcripts and strategic documents of both universities. I excluded the words that do not have a meaning when used separately such as “and” and combined the words that have the same meaning but different endings in Russian (Figures 9, 10 and 11).

Figure 9. Word Cloud of the Development Program for 2020-2024 of Northern University

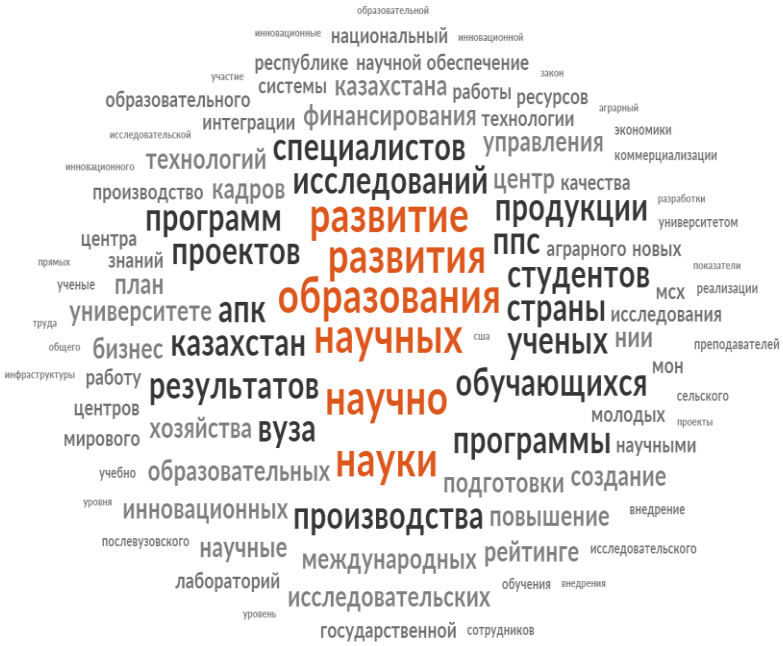

Figure 10. Word Cloud of the Development Program for 2020-2024 of Southern University

Figure 11. Word Cloud of Interview Transcripts from Northern and Southern Universities

The most frequent words in the interview transcripts were “university”, “work”, “knowledge”, “research”, “projects”, “transfer”, “technology”, “Kazakhstan”, “foreign”, “commercialization” and so on.

Then, I selected the top 20 most frequent words from the strategic documents of both universities. In both documents, the most frequent words were “science”, “research”, “educational”, “programs”, “Kazakhstan”, “development”, “projects”, “faculty”, “agricultural industry”, “results”, “international/foreign”, “teaching/training” and “financing” (Tables 13).

Table 13. Top 20 Most Frequent Words in the Development Programs for 2020-2024 of the Northern University and Southern University

#	Northern University	Count	Southern University	Count
1	science	352	science	407
2	programs	242	educational	338
3	research	241	research	204
4	educational	207	development	198
5	farms	187	Kazakhstan	177
6	teaching	180	programs	133
7	Kazakhstan	142	students	111
8	development	123	innovative	107
9	faculty	115	centers	103
10	results	97	production	90
11	systems	92	results	87
12	financing	89	projects	84
13	academic	88	international	82
14	knowledge	85	agricultural industry	79
15	technology	84	training	70
16	world	82	researchers	70
17	projects	77	technology	61
18	foreign	76	farms	58
19	training	73	financing	44
20	agricultural industry	65	faculty	43

Using NVivo software tools, I could find out the percentage of coding coverage in the document starting from the most frequent code to the least frequent one (Figure 12).

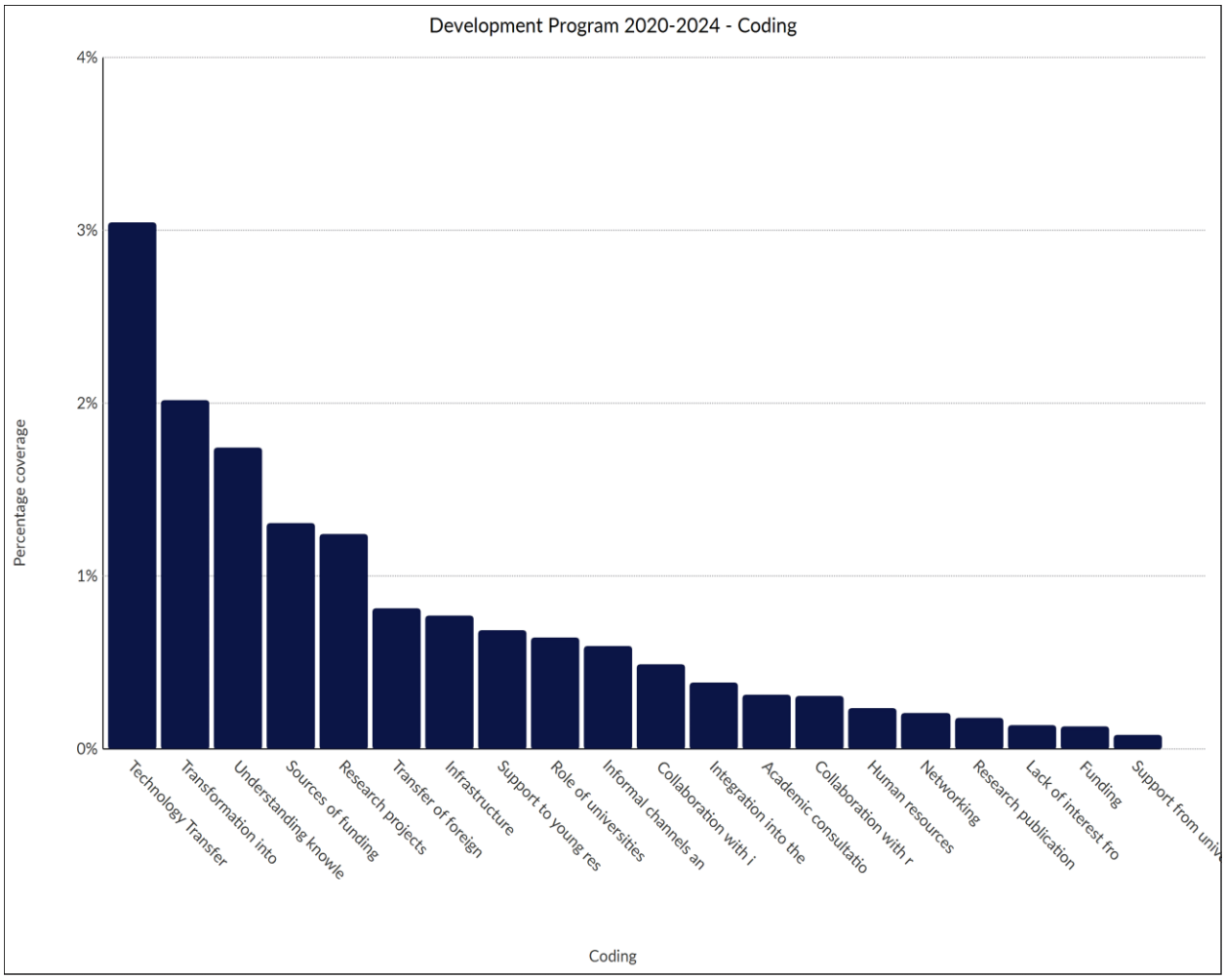

Figure 12. Percentage of Coding in the Document Development Program for 2020-2024

With the help of NVivo software tools, I could decide what codes and themes were more represented. For example, the hierarchy chart of code presented the codes and themes starting from the most frequent to the least frequent (Figure 13).

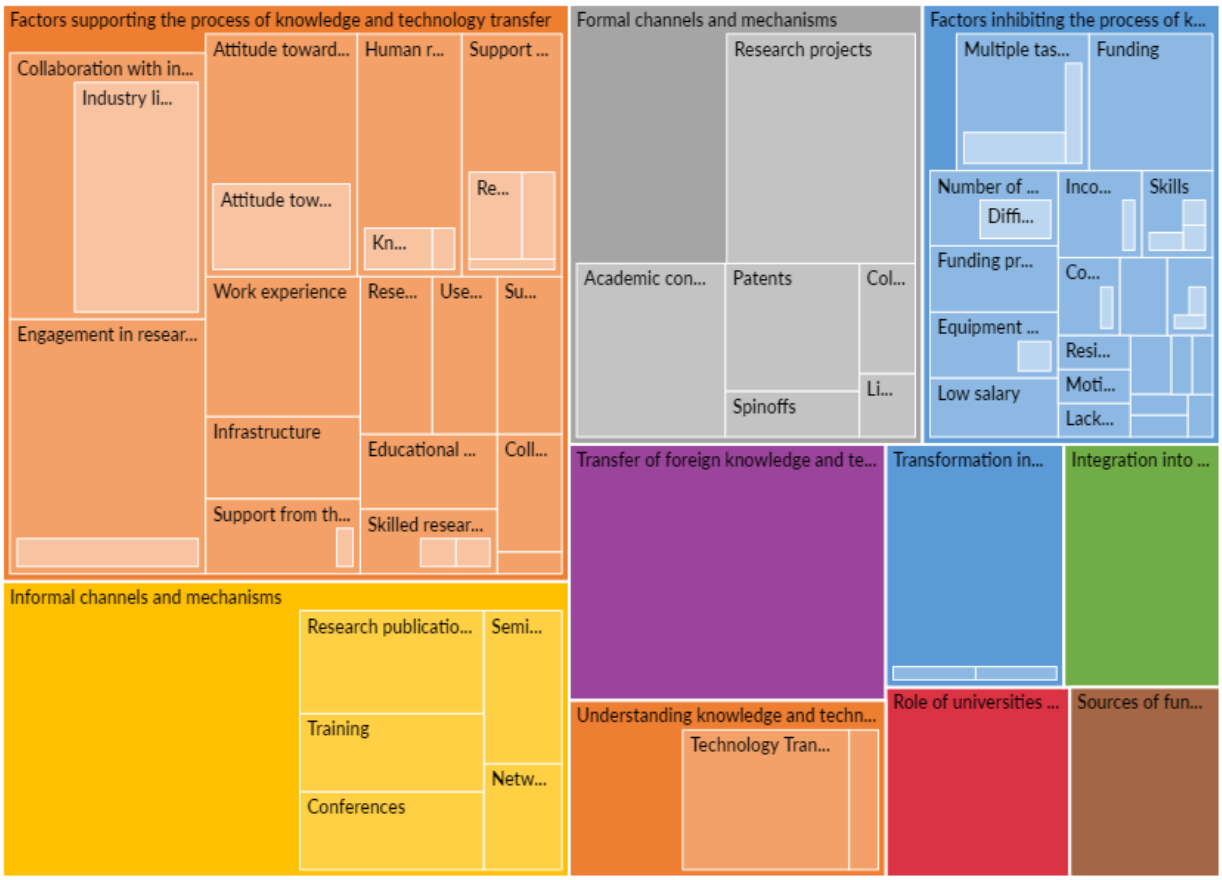

Figure 13. Hierarchy Chart of Codes

I reassembled the data or created themes by identifying patterns in the codes. After reassembling, I interpreted "what is going on within and across varied experiences, beliefs, and histories and thus begin to identify thematic patterns across the data" (Castleberry & Nolen, 2018, p. 812). Table 14 represents the horizontal analysis of the themes linked to RQ 3.

Table 14. Sample of Horizontal Analysis of Interview Transcripts from Southern University

RQ3: What are the inhibiting and facilitating factors for university-industry knowledge and technology transfer in Kazakhstan?							
Themes linked to the RQ3	Participant 1	Participant 2	Participant 3	Participant 4	Participant 5	Participant 6	Participant 7
Facilitating factors		Support from the government, cooperation with the industry	Support from the government, cooperation with the industry, support from university administration, the	Support from the government, cooperation with the industry,	cooperation with the industry	cooperation with the industry	cooperation with the industry, support from university administration
Inhibiting factors	Lack of funding, limited number of grants, incompetent administration of grants, lack of interest and investment from industry, heavy workload, multiple tasks, low salary	Lack of English proficiency, bureaucracy, funding delays, inadequate support from the government		Corruption, funding problems, incompetent allocation and administration of research grants, inadequate support from the government	Corruption, resistance to change and development of university administration, incompetent personnel at the university administration,		

For within-case data analysis, conceptually ordered displays were employed. With conceptually ordered displays, data is organized by variables or concepts. For example, Table 15 represents the analysis of findings on formal and informal channels of KTT organized by documents and interviews.

Table 15. Within-case Data Analysis of Findings from Documents and Interviews

	Documents	Interviews
1	*Formal channels*	
	3 innovative companies were launched in 2018, the university is the largest patent owner in the Republic of Kazakhstan and is significantly ahead of all agricultural universities in Kazakhstan (6 out of 41 patents issued to the subjects of the Republic of Kazakhstan)	More than half have patents (7 out of 9) and provide consultations (8 out 9).
2	*Informal channels*	
	In 2018, 144 publications were published in the publications of the scientometric databases Web of Science and Scopus, the university among the 10 most productive scientific organizations of Kazakhstan in terms of the quality of publications	All participants are engaged in teaching, seminars, conferences, publications, networking

For cross-case data analysis, case-oriented approaches and strategies were applied, as they help to find "specific, concrete, historically-grounded patterns common to small sets of cases" (Miles & Huberman, 1994, p. 174). Table 16 presents the number of times inhibiting factors were mentioned in the process of KTT.

Table 16. Cross-case Analysis of Factors Inhibiting the Process of KTT

	Codes	Northern University (9)	Southern University (7)	Total (16)
1	Equipment to do research	3	0	3
2	Formal requirements	1	0	1
3	Funding	7	4	11
4	Incompetent administration of grants	2	2	4
5	Lack of interest from industry	1	0	1
6	Low salary	2	1	3
7	Motivation	1	1	2
8	Heavy workload	4	1	5
9	Number of grants	2	0	2
10	Plagiarism	1	0	1
11	Resistance to change and development	0	1	1
12	Skills	1	0	1

The last stage of data analysis was conclusion drawing and verification. It includes "regularities, patterns, explanations, possible configurations, causal flows, and propositions" (Miles & Huberman, 1994, p. 11). Finally, I drew conclusions by determining how my interpretations of codes and themes were related to the research questions. These conclusions will be presented as the findings of the study in the next chapter.

3.9 Ethical Considerations

The study was conducted in accordance with the parameters established by the NUGSE Research Committee to ensure the ethical protection of research participants. An information sheet (Appendix B) and an informed consent form (Appendix C) were provided to participants before data collection. The information sheet and consent form outlined the participants' protections and the ethical guidelines I would follow during the research project. Specific areas outlined in the consent form included the voluntary nature of the study and that participants could withdraw at any time. In addition, the consent form outlined risks (social or psychological) that the participants might experience. They were informed that they were not obligated to complete any part of the study if they were uncomfortable. In this case, the research was considered to be of minimal risk because it did not involve individuals who were in vulnerable categories, such as minors, subordinate employers, etc.

The study was categorized as involving no more than minimal risk by the NUGSE Research Ethics Committee. The potential risks identified in the information letters and consent form included loss of personal or work time. There were also risks that participants may express views that are contrary to their managers or the organization and if they were to be identified then this could have potential career or reputational damage for them. Interviewing might also unleash psychological stress– participants might be worried about some innovation that they are working on or attempting to commercialize. These risks were minimized by addressing issues around confidentiality.

The issue of confidentiality was problematic because of the visibility of the specific institutions, and the need to provide relevant details because of the case study design of the research. Participants were made aware of the limitations of confidentiality that were possible. However, I endeavored to conceal the specific roles of university faculty.

There were no direct benefits of the study to the participants. However, the findings will be beneficial to universities to understand the mechanisms, pathways, channels, and determinants of university-industry knowledge and technology transfer in Kazakhstan. Better understanding will contribute to the development and implementation of effective innovation policies and strategies, which may provide additional enabling factors to the participants in the conduct of their work, research and commercialization roles in the future.

Due to the pandemic, I used technology to conduct interviews such as WhatsApp or Zoom. After the data were collected, all identifiable data were eliminated. Interviews were numbered or coded to match the participant; thus, protecting participants' identities. The video component was disposed and only the audio track was retained to reduce risks of breaches of confidentiality. Participants were informed that all data will be kept in a password-protected

laptop at my residence for the period required by Nazarbayev University. I would be the only one with access to the data stored on my private laptop. I would only share data information with my dissertation advisor. I would also back up the data after every interview in password-protected cloud storage in case the laptop was broken or stolen.

3.10 Research Quality Considerations

In the constructivist paradigm, the quality of the research and its findings is based on trustworthiness (Lincoln & Guba, 1985). Trustworthiness consists of the following criteria: credibility, dependability, confirmability, and transferability (Guba & Lincoln, 1989). Credibility refers to "the methodological procedures and sources used to establish a high level of harmony between the participants' expressions and the researcher's interpretations of them" (Given, 2008, p. 138). Credibility can be increased through the following procedures such as prolonged engagement at a site, persistent observation, peer debriefing, triangulation, and member checks (Guba & Lincoln, 1982). To ensure credibility, I followed the principle of triangulation by using different sources of data and multiple methods of data collection. By analyzing data collected through different methods, I was able to "corroborate findings across data sets and thus reduce the impact of potential biases that can exist in a single study" (Bowen, 2009, p. 28). l also used multiple participants to increase the credibility of the findings. In this study, 16 participants from two different universities were interviewed. These participants represented university faculty perspectives. Although it was not possible to interview participants from the higher management of both universities, their interviews in the mass media, annual reports and strategic policy documents were considered as proxies for the collective university senior management perspective.

In a qualitative study, dependability "requires that the researcher supply adequate and relevant methodological information to enable others to replicate the study" (Given, 2008, p. 208). Any changes in the research design should be tracked by the researcher as "the transparency and relevancy of this process will increase the dependability of the study" (Given, 2008, p. 209). Dependability can be ensured using a dependability audit (Guba & Lincoln, 1982). I ensured the dependability of the data by providing detailed audit trails of the research process for readers. In this methodology chapter, I stated my position as a researcher at the start of the research study. I provided a detailed description of the process of data collection and analysis. I provided excerpts from the analysis of documents and interview transcripts. I applied both vertical and horizontal analysis of transcripts, within cross-case analysis of data to see individual and group patterns.

Confirmability is "an accurate means through which to verify the two basic goals of qualitative research: (1) to understand a phenomenon from the perspective of the research

participants and (2) to understand the meanings people give to their experiences" (Given, 2008, p. 112). Confirmability requires that any biases of the researcher should be taken into account through a transparent and clear description of the process of data collection and analysis. Confirmability can be ensured by triangulation, practicing reflexivity and confirmability audit (Guba & Lincoln, 1982). I ensured confirmability by triangulation, providing an audit trail, examples of the coding process and citing pieces of data, using direct quotations frequently and appropriately from participants to support my arguments. Confirmability was also ensured by sending the interpreted data for inter-rater reliability to the participants (Cohen et al., 2009).

Transferability means that "the results of the research can be transferred to other contexts and situations beyond the scope of the study context" (Given, 2008, p. 886). Although transferability is of limited importance in a case study because the case is considered to have uniqueness, findings could be transferable if other contexts were seen to have similar attributes. Transferability can be increased through purposive sampling and thick description (Guba & Lincoln, 1982). I used multiple case studies and rich, thick descriptions to increase the transferability of the findings of my research study.

3.11 Summary

This section presented the theoretical underpinnings of the qualitative multiple-case study methodology that guided the study including the rationales for choosing the particular research design, data collection methods and research sites. Data analysis procedures and ethical and research quality considerations were described. A multiple case study design was implemented, with each university considered as an individual case. The research sites for this qualitative case study were Northern University and Southern University. The rationale for choosing these two universities is their national and regional strategic importance. Document analysis and individual interviews were conducted to collect data for this study. As it was not possible to secure interviews with the university management, the documents and interviews on mass media were considered as a proxy for their views. Individual interviews were conducted to explore the perspectives of university faculty on knowledge and technology transfer. Purposeful sampling was employed in this study as a sampling strategy. Participants included sixteen participants from the university faculty members at the two sites. Within-case and cross-case thematic analysis was used to answer the research questions. The findings developing from this qualitative case study will be presented in the next chapter.

CHAPTER 4. FINDINGS

4.1 Introduction

This chapter presents findings from a qualitative case study, using within-case and cross-case analysis of documents and interview data on university-industry knowledge and technology transfer from two agrarian universities in Kazakhstan. The universities have been given the pseudonyms Northern and Southern University. Firstly, the institutional context of Northern University is described and findings from the within-case analysis of Northern University are presented. Secondly, a description of the institutional context of Southern University and the findings from the within-case analysis of Southern University are presented. Thirdly, the findings of the cross-case analysis of both universities are presented according to the following four themes: The role of universities in innovation and technological development; Cross-national versus local knowledge and technology transfer; Formal and informal channels of university-industry knowledge and technology transfer; and Facilitating and inhibiting factors for university-industry knowledge and technology transfer. Data from documents and interviews are presented as evidence in each theme. Interview participants are identified by a pseudonym, job position and the school of the participants.

4.2. The Case of Northern University

The case of Northern University has been developed from the analysis of four documents, the University website and interviews conducted with nine participants. Table 17 summarizes the documents used, categorized according to type. The documents provide strategic and promotional material about the university and represent the vision of the university management. As it was not possible to secure interviews with the management, the documents become a proxy for their views. *The University Development Program for 2020-2024* is a strategic plan that describes the steps and process for transforming the university into a research university. The Program also provides information about the current state of the university, including its achievements, problems, weaknesses, and strengths. The annual reports provide information about the completed work for the academic year.

Table 17. Northern University Documents

	Document Title	**Publication Date**	**Type**
1	The University Development Program for 2020-2024	2020	Strategic Plan
2	Report for 2017-2018	2018	Annual Report
3	Report for 2018-2019	2019	Annual Report
4	Report on implementation of goals of the Development Program for 2020-2024	2020	Annual Report

4.2.1 Institutional Background

Northern University was established in the 1950s to train high-quality specialists for exploiting the soils of Northern Kazakhstan. In 2018, the university entered the top 200 in Quacquarelli Symonds (QS) University Rankings in Eastern Europe and Central Asia. In 2018, the university ranked the second in the agricultural specialization of the rankings of the Republican Rating Agency (RRA) (KATU, 2022). In 2019, the university successfully passed institutional accreditation for seven years with the Independent Agency of Accreditation and Rating, which has been a member of the European Association for Quality Assurance in Higher Education since 2016. The university also passed international specialized accreditation for nine undergraduate programs, nine master programs and six doctoral programs (KATU, 2020b). The university has 42 departments in eight schools: agronomy; veterinary and technology of animal farming; computer systems and professional education; technical sciences; management of land resources, architecture and design; economy; energy; and humanities. There are 18 undergraduate, 16 Masters and 12 PhD programs. The number of students as of October 1, 2018 was 11,543, of which 1,159 students (10.0%) were in master's programs, and 71 people (0.6%) were in doctoral programs. In comparison with the 2010-2011 academic year, which was the beginning of a strong push for educational reform, the number of students increased by 23.8%. More than half of the students are supported by state educational grants. In 2019, the number of full-time faculty was 884, of which 367 were candidates of science, 83 held the qualification of doctors of science, and 60 PhDs. The share of faculty with an academic degree increased from 53.8% in 2011 to 60.4% in 2019. The number of faculty members with international experience has increased more than 10 times between 2011-2019 (KATU, 2020b).

In 2013, the university started reforming into a Western-style agrarian research university to meet international standards (KATU, 2020b). In 2014, a cooperation agreement with UC Davis was concluded. According to the agreement, UC Davis provides consultancy to reform management systems, training processes and research. In 2019, a cooperation agreement with AgroParisTech was concluded, to support the university in improving the quality of the educational process and academic environment. It is planned to gradually develop and introduce double-degree master’s programs on plant protection, soil science and animal husbandry (KATU, 2020b).

The total income of the university in 2018 increased by 2.1 times compared to 2011. The main share of the income is tuition fees (75.7%), including state educational grants. Investments, mainly from public sources, increased by 2.5 times in comparison with 2015. In contrast, “investments from own funds are relatively stable (36.2% of total investments in 2018, 37.0% in 2017), but are aimed at maintaining the existing buildings, machinery and equipment”

(KATU, 2020b, p. 18). Due to systematic work to attract external funding for research, in 2018, research funding increased 12 times compared to 2011. In 2018, the amount of funding for research was 1036.6 million tenge. The share of income from research in the total income of the university was 17.2%. At the same time, the demand for services and products of a research and technical nature from non-state sources increased by 13.7 times (KATU, 2020b).

At the university, four technological platforms were created as part of the state program for industrial and innovative development: "Agroengineering", "Processing of agricultural products", "Production of crop products", and "Production of livestock products." Technological platforms are interdisciplinary-shared infrastructures for training and research. They were created by combining laboratories, workshops and auxiliary infrastructure, connected by a common technological process and/or scope. They can be used for research and development work, testing and implementing research results, and teaching undergraduate and graduate students. They provide instrumental support at all stages from the formulation of an idea to the implementation of its results in practice (KATU, 2020b).

In summary, Northern University is the largest agrarian university in the northern part of Kazakhstan established during the Soviet period. The university is expanding as the income and investments to the university are increasing with the growing number of students enrolled in the programs. The university transforming into a research university, adopting best practices from Western universities to meet international standards, through partnerships with international institutions.

4.2.2. Characteristics of Interview Participants

There were nine participants from the Northern University. The characteristics of the participants are summarized in Table 18.

Table 18. Demographic Characteristics of the Participants from Northern University

Pseudonym	Gender	School	Academic qualification	Position	Work experience	Publications
Aknur	Female	Veterinary	PhD	Associate Professor	10-15 years	more than 40
Aldiyar	Male	Technology and Technical Sciences	PhD	Associate Professor	10-15 years	less than 10
Ansar	Male	Veterinary	Candidate of sciences	Associate Professor	more than 20 years	more than 40
Askar	Male	Veterinary	Candidate of sciences	Associate Professor	more than 20 years	more than 40
Assel	Female	Veterinary	Master's	Assistant Professor	5-10 years	less than 10
Aydin	Male	Technology and Technical Sciences	Master's	Assistant Professor	less than 5 years	less than 10
Aygul	Female	Technology and Technical Sciences	Candidate of sciences	Associate Professor	more than 20 years	more than 40
Azamat	Male	Veterinary	PhD	Assistant Professor	5-10 years	30-40
Azhar	Female	Forest management, wildlife and environment	PhD	Associate Professor	15-20 years	20-30

Five of the nine participants were male and four were female. In terms of their positions, six of the participants were Associate Professors and three were Assistant Professors. In terms of their academic qualifications, four had obtained PhDs, three were candidates of sciences, and two participants had a Masters' qualification. Five participants were from the School of Veterinary, three from the School of Technology and Technical Sciences, and one from the School of Forest Resources Management. Most of the participants (6 out of 9) have more than 10 years of experience in higher education and research. Three participants have less than 10 years of experience, three have between 10-20 years of experience, and three have more than 20 years of work experience. Five participants have more than 30 publications, whereas three participants have less than 10 and one participant has between 20 and 30 publications.

The findings from these participants will be presented under four themes: The role of universities in innovation and technological development; Cross-national versus local knowledge and technology transfer; formal and informal channels of university-industry knowledge and technology transfer; and, facilitating and inhibiting factors for university-industry knowledge and technology transfer.

4.2.3 The Role of Universities in Innovative and Technological Development

The strategic documents and reports of the Northern University position the university as a key actor in the innovative and technological development of agriculture in the region and the country. In the *Development Program for 2020-2024*, Northern University refers to the "Triple

Helix", which is the model of innovative development based on the potential of universities (KATU, 2020b). According to this model, agrarian universities become "centers of concentration of resources (knowledge, human resources, infrastructure and finance), providing technological modernization of the economy and supporting its competitiveness at the regional, national and international levels" (KATU, 2020b, p. 8). In the *Annual Report for 2017-2018*, the university describes itself as a center of technological competence in the field of digitalization of the agro-industrial complex within the framework of the *State Program of Industrial and Innovative Development for 2015-2019* (KATU, 2018). These strategic documents demonstrate the university's focus on increasing its role in the innovation and technological advancement of the agriculture of the country.

To perform its role in innovative and technological development, the university has set a mission to develop human capital, and disseminate and transfer new knowledge and technology. The university describes itself as developing human capital for the agricultural industry through the delivery of undergraduate and graduate programs to train specialists for the agricultural sector. Knowledge and technology transfer is implemented through research and development, adopting and adapting foreign knowledge and technologies. Knowledge dissemination is implemented through conferences, publications, through seminars, short-term training of agricultural specialists and professional development of college teachers, and providing consultations to the industry (KATU, 2020b).

Interview participants supported the view that agrarian universities can be facilitators of the innovative and technological development of the country. More than half (5 out of 9) of interview participants shared their views on the university's role in knowledge and technology transfer. Participants believed that universities are a source of human resources, centers for conducting research, implementing their results, and training specialists. For example, Aygul, an Associate Professor of the School of Technology and Technical Sciences stated, "You do research so that the economy develops, and the economy will develop when you introduce something new" (p. 9).

Some participants believe that the purpose of the collaboration of the university with foreign universities and companies is to transfer foreign knowledge and technologies to the agrarian industry. For example, Ansar, an Associate Professor from the School of Veterinary, believes that agrarian universities play a leading role in innovative development as they operate as intermediaries between innovators and users. Agricultural researchers have contacts with manufacturers of new technologies and "know the problems, know the current state of the world and can themselves develop and act as intermediaries in the transfer of technologies" (p. 2).

Aknur, an Associate Professor from the School of Veterinary, acknowledged that the university is implementing research projects and introducing the results to the industry. She commented:

> Now there are such serious projects that require huge efforts, of course there are projects that are really being implemented. For example, we have a workshop for food production technologies, where we develop various yoghurts, sausages, dairy products. They are slowly trying to enter the Kazakhstani market. Of course, this is not easy, you need to have your own channels, you need to have a huge volume of production. In veterinary medicine, there was also a draft 2GIZ program, where a fresh focus of infections was determined, then these data were statistical processed using this technology. (pp. 2-3)

Participants discussed the importance of universities in human capital development. For example, Assel, an Assistant Professor of the Veterinary School, commented, “After secondary education, the student goes to the university, he cannot immediately go to work in the industry, he receives the first knowledge at the university” (p. 2). Similarly, Azamat, an Assistant Professor of the Veterinary School, believes that universities are places where human resources are constantly being updated. He continues, “As the younger generation learns quickly, and adapts technologies, research work should be carried out mainly at the university” (p. 2). Most (4 out of 5) of the faculty who shared their views on university KTT were from the School of Veterinary. This implies that the faculty of the School of Veterinary is more engaged in the transfer of knowledge and technology from university to the agriculture. In terms of gender and position, more than half (3 out of 5) were female and Associate Professors, which suggests that there are no significant gender and position differences in the engagement of the faculty in KTT.

To implement its role in innovation and technological development, Northern University is transforming into a research university. Particularly, the university is learning best practices from foreign research universities. The process of university reforming is described in the University Development Program for 2020-2024 as the following:

> The reforming of universities should be carried out in partnership with the world's leading agricultural research universities, inviting foreign professors to modernize educational programs and teaching. In addition, the integration of education, research and production has been ensured to synchronize the processes of development and implementation of domestic research and developments, transfer of successful foreign technologies, training and retraining of human resources with innovative competencies. (KATU, 2020b, p. 2)

The university has been reforming since 2013, envisioning itself as one of the leading agricultural research universities in the post-Soviet space (KATU, 2020b). It strives to become "a research university through high academic and financial standards, institutional autonomy, significant research results and a recognized impact on the agricultural industry of the Republic of Kazakhstan" (KATU, 2020b, p. 14). In his interview in the mass media, the President of the Northern University stated that transformation into a research university has opened a new path for the university to integrate science, education and industry (Aytuganov, 2022). Initially, the university was created to train specialists for the agricultural industry, while research was not widely conducted at the university. Therefore, "with the beginning of the transformation into a research university, the emphasis was placed on expanding the range and volume of research as the basis for innovative potential" (KATU, 2020b, p. 28).

One of the senior management team believes that innovation is an integral part of the development of a research university, and it "involves the implementation of a set of organizational, scientific, technological, financial and other measures" (Tokbergenov, 2021, p. 4). According to the *Development Program for 2020-2024*, research conducted at the university should address key problems in agriculture and correspond to the priorities of the world agricultural science. With high-quality research, the university would support the transfer of knowledge and technologies, and integrate into the world research and educational space (KATU, 2020b). The results of research activities are transferred to the industry through the educational process, as one of the senior management team stated, "All knowledge and skills obtained in the framework of ongoing research are reflected in educational activities, KATU research is increasingly integrated into the educational process" (Tokbergenov, 2021, p. 3).

The findings from interviews with the university faculty suggest that the beliefs and attitudes of some faculty regarding the transformation into a research university are aligned with the institutional perspective. Some (3 out of 9) interview participants shared their views on the purpose of transforming into a research university. All of the three participants who shared their views were from the School of Veterinary. For example, Askar, an Associate Professor of the Veterinary School, believes that there must necessarily be commercialization in the research university. He shared his understanding of a research university:

> At a research university, first of all, it should be not only within the framework of funding but also in the worldview of all teachers that education should primarily be based on knowledge of new technologies. And in order to have knowledge of new technologies, you need to conduct research yourself. Thanks to research and development, you will be one step ahead of the learners because no one knows this

> research except you. And the second position of a research university is that there must necessarily be commercialization. (p. 2)

Assel, an Assistant Professor of the Veterinary School, also believes that the university should strive to change and develop to meet the status of a research university. She believes, "We are making changes to our future in small steps, trying to make it interesting for students, for the development of the university, so that our university reaches a new level, we received the status of a national research university" (p. 1). She continues that to transform into a research university, the university should learn best practices from Western universities, saying: "To do this, our work must be relevant, we also try to focus on Western universities" (Assel, p. 1). Azamat, an Assistant Professor of the Veterinary School, also believes that the mission of the university is knowledge production and transfer to the industry, as he states, "Our mission is to do this, because, that is, training and practice should be close, there should be no obstacles between them, for example, students should do research, conduct experiments" (Azamat, p. 2). The findings from the interviews suggest that the beliefs of some university faculty are aligned with the management as they expressed positive attitude towards transformation into a research university. University faculty believe that by becoming a research university, it would be possible to adopt and adapt foreign knowledge and technologies, as well as generate and transfer new knowledge and adapted technology to the industry. However, the other six participants did not express their views on the transformation of the university in the research university.

4.2.4 Cross-National versus Local KTT

Analysis of relevant documents and interview transcripts revealed two different interpretations of the process of KTT by the university and faculty. On the one hand, there is an interpretation in university documents and from faculty that KTT is transfer of "own" knowledge and technology that is developed and invented by the university researchers. This interpretation is presented in the mission of the university, which is "generating, implementing, disseminating and applying advanced knowledge to improve the quality of life, increase labor productivity and competitiveness of the agricultural and other sectors of the economy of Kazakhstan" (KATU, 2020b, p. 43). Only two participants explicitly shared the view that KTT represent transfer of knowledge and technology developed by themselves. These participants have more than 20 years of experience in research and have more than 40 publications. For example, Aygul, an Associate Professor of the School of Technology and Technical Sciences, shared commented:

> First, fundamental research is conducted, based on some new discoveries of something you find, then you can use all this in the applied part, conduct applied research. Next, you have some kind of ready-made sample. Further, there is experimental-industrial approbation and commercialization. (p. 9)

Askar, an Associate Professor of the Veterinary School, also shared his experience of knowledge and technology based KTT. He recalled:

> We did research work in animal husbandry, which today is already commercialized and brings profit. We also developed the chemical composition of the nutritional value of forage crops in Kazakhstan, but only for the northern and central regions. (Askar, p. 1)

This implies that university faculty with more experience in research and developments believe in their ability to produce local knowledge.

University documents and faculty also interpret KTT as transfer of "foreign" knowledge and technologies to the agricultural industry. This interpretation is demonstrated in the *Development Program for 2020-2024*. The document states that the university is developing a comprehensive system of transfer of foreign technologies to modernize the agricultural industry and reduce the technological gap between Kazakhstan and leading countries. The process of foreign technology transfer is described as the following:

> Purposeful work will be carried out on a regular basis to find suitable technologies, test them in the conditions of Kazakhstan (if necessary, with adaptation to local conditions) and then implement positive experience into practice. The form of technology transfer implementation will be the integrated research and technical programs, with the involvement of relevant structural subdivisions of KATU (faculties, technology platforms, centers) and stakeholders of the business sector. Considering applicability, a component on testing and adapting successful foreign technologies will be developed within each integrated research and technical program. (KATU, 2020b, p. 83)

According to the *Development Program for 2020-2024*, international centers of competence will be created on university campuses and technological platforms to learn knowledge and innovations that come with foreign technologies.

Unlike the documents, university faculty differentiate knowledge transfer from technology transfer as technology transfer involves explicit/codified knowledge whereas knowledge transfer involves implicit/tacit knowledge. The faculty believe that there is transfer of foreign knowledge for curriculum innovation, direct adoption of foreign technology for industry innovation, transfer of foreign knowledge and technology for adaptation, and transfer of new knowledge and technology to the industry. Some participants, mostly from the Veterinary School, believed that there is mainly international transfer of knowledge and technology from foreign universities to the local universities for further transfer to the industry. In other words, local universities act as intermediaries between foreign universities and local industries. For example, Ansar, an

Associate Professor from the School of Veterinary, shared his understanding of knowledge transfer. He interprets the transfer of knowledge as related to the harmonization of curriculum according to international standards. He commented:

> As for the transfer of knowledge, we wanted to harmonize our curriculum with the OIE [World Organization for Animal Health] curriculum for training veterinary specialists, they developed for bachelors, everything is spelled out there, competencies from the first day of a graduate of veterinary specialties. They allocated funds for this training project, our parent university, Toulouse Veterinary School, sent two experts, they came to us and studied our curricula, gave recommendations. This is one of the transfer mechanisms - training projects, when a leading Western university helps the beneficiary university to change the working curriculum in accordance with international standards. (Ansar, p. 5)

Azamat, an Assistant Professor of the Veterinary School, also acknowledged that there is mainly international transfer of knowledge and technology from foreign universities to local universities. However, he added that the technology should be adapted to the local conditions:

> There are, of course, new developments that are suitable only for us. Well, animal husbandry mainly depends on environmental and climatic conditions, and, accordingly, we cannot adopt an exact copy of this technology here, that is, we are studying it in our conditions, introducing some new aspects. (Azamat, p. 2)

Assel, an Assistant Professor of the Veterinary School, holds a similar view to Azamat, as she stated, “Most likely we borrow and improve some details, because no one makes such innovative discoveries, even those foreign ones, there is always an improvement, adaptation to our regions” (p. 4). Askar, an Associate Professor of the Veterinary School, expressed his concern that knowledge about how to use the foreign technology is not transferred with the technology. He stated:

> The transfer of technology comes with the transfer of knowledge, but it turns out that they [the local university] brought the technology, but did not bring the knowledge. And it takes ten to fifteen years to learn, and if scientists were competent at universities, then they would study here and continue working without hurting animals and the economy. (Askar, p. 3)

That is, Askar believes that there is mainly a transfer of codified/explicit knowledge and technology, whereas implicit/tacit knowledge is not transferred. This issue is causing difficulties as it takes time and resources to learn the technology without the transfer of tacit knowledge. Aygul, an Associate Professor of the School of Technology and Technical Sciences, believes that transfer of foreign technologies is impossible in her field of research, as the technologies are

very expensive. She states, “They say make a transfer, but the transfer cannot be done. Not a single country, for example, developed countries sell practically such technologies, if a factory sells, it sells for such fabulous money and technologies are mostly inaccessible”. Her understanding of the transfer of foreign technologies might be influenced by her field of research, which is deep food processing.

The findings from documents and interview transcripts suggest that there are variations in the form of KTT, involving explicit/codified and implicit/tacit knowledge. This knowledge and technology can be adopted directly or adapted to the local conditions. Moreover, university faculty do not have a singular understanding and interpretation of the process of KTT. The difference in understanding and interpretations may be explained by their difference in fields of research. All participants from the School of Veterinary believe that there is the transfer of foreign knowledge and technology, whereas the participant from the School of Technology and Technical Sciences believes that the transfer of foreign technology is not possible. The difference in the understanding of participants might be related to difference in the level of technological advancement of their research fields and the cost of adopting foreign technologies.

4.2.5 Formal and Informal Channels of University-Industry KTT

Related to the form of knowledge transfer are channels of transfer of codified/explicit and tacit/implicit knowledge. The literature on KTT differentiates between formal and informal channels of transfer. Most studies have focused on formal channels as they are quantifiable, whereas informal channels are not easily measured and represent an emerging topic for research.

The most common formal channels of university-industry KTT at Northern University are patents and consultations, whereas contract research, academic spinoffs and startups are not so common (Table 19).

Table 19. Frequency of Mentioning Formal Channels

	Formal channel	Response frequency
1	Consultations	8 out of 9
2	Patents	7 out of 9
3	Contract research	3 out of 9
4	Spinoffs/startups	0 out of 9

According to the documents, the university actively uses patenting. In fact, Northern University is the leading university among agrarian universities in the number of patents developed in Kazakhstan. *The Development Program for 2020-2024* states:

> In terms of the number of patents issued by the Eurasian Patent Organization in 2018, KATU is the largest patent owner in Kazakhstan and is significantly ahead of all agricultural universities in the country (6 out of 41 patents issued to the subjects

> of Kazakhstan). In terms of patents of Kazakhstan for an invention and a utility model, the university is also ahead of all agricultural universities. (KATU, 2020b, p. 45)

According to the *Annual Report for 2017-2018*, the university obtained 26 intellectual property rights, including four Eurasian patents, seven invention patents and 15 utility model patents of the Republic of Kazakhstan in 2018 (KATU, 2018). The following varieties of plants were submitted for state variety testing: spring barley "Arka yrysy" and spring soft wheat "Saryarka sapasy" (KATU, 2019). However, the patents are not commercialized further as licensing agreements have not been concluded. *The Development Program* further stated that starting from 2021 a new patent policy would be introduced to effectively protect and commercialize intellectual property objects. This policy would include its own system for assessing the commercialization potential of each object and developing an individual implementation strategy. One of the activities would be the organizing replication of breeding achievements and promotion to the market (KATU, 2020b). These documents suggest that the university faculty would be actively involved in transferring new knowledge and technologies through patenting.

These findings are supported by the fact that more than two-thirds (7 out of 9) of the interview participants have patents. For example, Assel, an Assistant Professor of the Veterinary School, shared her experience in patenting as she stated, "We have developed a new way to determine the quality of meat. I think we have made a great contribution. We have two patents on this topic; our developments are used in the educational process" (Assel, p. 2). Those participants who hold patents are from the School of Veterinary and the School of Technology and Technical Sciences, and have more than 5 years of experience. One of the participants who does not hold patents is an Assistant Professor who has less than 5 years of experience. The other participant is an Associate Professor from the School of Forest Management, Wildlife and Environment. This implies that patent ownership depends on work experience and the field of research of university faculty.

According to the findings from interviews, almost all (8 out of 9) of the participants provide consultations to the industry. For example, Azamat, an Assistant Professor of the Veterinary School, acknowledged that farmers approach university faculty for consultations. He commented, "If they are interested in this or that issue, like feeding animals, in terms of maintenance then they approach us. Someone, for example, wants to open a new farm, and beginners, for example, also come to us. We conduct consultations, seminars" (Azamat, p. 5). Aldiyar, an Associate Professor of the School of Technology and Technical Sciences, also shared that he provides consultation to the private sector. He acknowledged, "It's easier for me to work

with private sector, if you trust them, you can work without a contract" (Aldiyar, p. 2). Askar, an Associate Professor of the Veterinary School, also provides consultations.

> When I worked full time at the university, yes. I consulted, I had 3-4 farms, where I went, consulted, established the production. Until now, we continue this within the framework of research projects, that is, we advise farms, show how to properly conduct animal husbandry, the technology of maintenance and reproduction. I do all this, for today I have opened my own business. If the phone call is short, then it's free. If you need me to come, I say that you have to pay. (Askar, p. 6)

There is evidence that most faculty participants are engaged in academic consultancy to the industry. The interview participant who is not involved in academic consultancy is an Assistant Professor with less than 5 years of experience.

Contract research is also a channel of KTT that is used by the university. *The Development Program* states that from 2022 the functions of the Technology Commercialization Office will be expanded in "the organization of contract research commissioned by business entities" (KATU, 2020b, p. 81). Some (3 out of 9) interview participants mentioned they were involved in contract research. For example, Ansar recalled that they conducted contract research that was ordered and funded by the local government. He commented,

> Yes, for example, in winter, the Akimat of the Kurgaldzhin district contacted us, there was a big problem with the gnat, bloodsucking insects, and they asked for scientific support so that we could find out the main characteristics of the bloodsucking population. And we completed the work on the state order, identified the types, dynamics, structures in the reservoir. (Ansar, p. 4)

Ansar also recalled that they developed recommendations for the prevention of a disease, and issued two patents. He thinks that the patents can be further used and implemented in the farms. Azhar, an Associate Professor of the School of Forest Resources Management, shared that she was involved in a research project that was contracted by the local government. She commented,

> For example, in terms of the last project related to the capital city. In fact, the capital city is located in the Saryarka steppe, where the wind blows all year round. For protection from wind and snowstorm in winter, 85 thousand hectares of trees have been planted near Astana, in 2-3 years it is planned to increase them to 100 thousand hectares. When there are plants, they develop various diseases, various bacteria and fungi that hinder growth. We develop measures to combat them, we predict their growth, and there are departments in the Green Zone Department that will need our results. They do not have a laboratory, they do not conduct deep experiments, that is, they use our results. We then look at the results from 50 years ago. (Azhar, p. 1)

Azamat, an Assistant Professor of the Veterinary School, confirmed that farmers approach university faculty for contract research. He commented, “Yes, on a paid basis. There are farms to whom we carry out analytical work. We conclude agreements, accordingly” (Azamat, p. 5). Out of 3 contract research, two contracts were from the local government. This implies that there is very little contract research ordered from the agricultural industry.

In 2017 and 2018, with the support of the Technology Commercialization Office, three innovative companies were launched. Financing was attracted from the funds of the Science Foundation, the World Bank project “Promoting Productive Innovations” and the entrepreneurs of the agricultural industry (KATU, 2020a; KATU, 2020b). However, academic spinoffs and startups were not mentioned by the interview participants as a formal channel of KTT that university faculty use. The findings from documents and interview transcripts suggest that Northern University is actively employing patenting and consultation as formal channels of KTT, whereas contract research, licensing, academic spinoffs and startups are not so common.

Informal channels of KTT are actively used in Northern University, such as training, seminars, conferences, and publications. As an informal channel of KTT, the Office for Knowledge Dissemination was formed in 2017. The Office organizes short-term training seminars and consultations for farms and enterprises. According to the *Development Program for 2020-2024*, the Office for Knowledge Dissemination will promote research results, which are difficult to commercialize. It is stated in the document, “To demonstrate advanced technologies in practice, campus development will be planned with the organization of demonstration sites for knowledge dissemination activities. Part of the university faculty will be involved in knowledge dissemination activities besides teaching and/or research” (KATU, 2020b, p. 79). For example, in 2017-2018, together with the National Chamber of Entrepreneurs, the university implemented a project to introduce and disseminate knowledge in the digitalization of the agricultural industry on the basis of nine pilot farms and four areas, where 27 university faculty members were involved (KATU, 2018). According to the Annual Report for 2018-2019, seminars were organized by the Office for Knowledge Dissemination where 2,436 people took part, including 108 rural mayors and heads of agricultural departments. In 2018-2019, a program of short-term advanced training courses for 900 governors of various levels was implemented for the first time for Akmola, Karaganda, Kostanay and North Kazakhstan regions (KATU, 2019).

In 2018, a program for advanced training of agricultural workers in precision farming was developed, a special section was launched on the university website and remote consulting based on the WhatsApp application (KATU, 2020b). According to the Annual Report for 2019-2020, 503 specialists were trained under the extension programs, 13 seminars and one field day

was held with the participation of 486 agricultural entrepreneurs, and remote consultations were held for 17 agricultural entrepreneurs in 2020 (KATU, 2020a).

The findings from documents are supported by the findings from interview transcripts. Findings from interviews suggest that all university faculty are actively engaged in informal channels of KTT, particularly training, seminars, conferences, networking and publications. For example, Askar, an Associate Professor of the Veterinary School, provides training for farmers,

> And also as part of the dissemination of knowledge, at the university and Atameken, we lectured for farmers. It was financed by the government. It was nice when, after the lecture, 2-3 years later, we went to the farms, they said that they are using the technologies we mentioned. (Askar, p. 6)

Ansar, an Associate Professor of the Veterinary School, shared his networking experience with the private sector. He commented, "We also have informal contacts with farmers, with producers, and if there is an opportunity to somehow use these opportunities, we use them in the educational process and to promote research" (Ansar, p. 4). Ansar shared that university faculty conduct seminars for farmers, "we conduct every year, we give our topics and they invite representatives of ministries, farms, farmers, based on the results of scientific work" (p. 4).

The Northern University regularly holds conferences and encourages its faculty to participate in conferences. To gain an international reputation, the university holds international conferences as well. The Development Program states that "in order to improve the reputation of KATU in the system of world agricultural science, together with partner organizations, at least one international conference per year on the most relevant areas of science and technology development will be held" (KATU, 2020b, p. 84-85). Askar acknowledged that conferences are channels of knowledge transfer as he stated, "I really love conferences, because I get a lot of knowledge, a lot of new things, what the transfer of knowledge looks like for myself and for my future projects in Kazakhstan" (p. 5). He also added,

> We go to conferences, seminars, within the framework of research projects. The government allocates money to us; we can go there to learn. There is also when the government itself attracts a speaker to the conference held in the country and so I participated in a seminar on commercialization from Malaysia and specially went to these courses two weeks to understand how they present it. (Askar, p. 5)

The university has improved its quality of publications, as more university faculty are published in international journals with high impact factors. According to the website "Nature-Index" in 2017, the university was ranked ninth among the academic organizations in the country by the number of articles in the most prestigious international journals (KATU, 2018). *The Development Program for 2020-2024* states:

> 144 publications were published in the publications of the Web of Science and Scopus scientometric databases in 2018, while in 2011 there were no such publications. For 2015 – 2018, 14 articles were published in publications with the Q1 quartile of the WebofScience database, 35 publications – in publications with the 50-100 percentile of the Scopus database, which corresponds to the most prestigious and authoritative publications in the relevant fields of knowledge. This dynamics allowed KATU to enter the top 10 scientific organizations in Kazakhstan in terms of the quality of publications, ahead of most research institutes. (KATU, 2020b, p. 30-31)

Azhar, an Associate Professor of the School of Forest Resources Management, shared her experience of publications. She commented, "In addition, we published our results in the form of articles in domestic and foreign journals with an impact factor. Then these results are very important for the country's forestry, because there are very few such studies" (Azhar, p. 1). Azhar explained that the active involvement of university faculty in informal channels of KTT is due to the high requirements that the university set for the faculty. She noted, "The university has high requirements, … to publish in journals with a high impact factor, write a project, teach from morning to evening, and there is also educational work" (p. 2). The findings from documents and interview transcripts suggest that all university faculty are actively engaged in informal channels of KTT, particularly training, conferences, networking, and publications.

4.2.6 Facilitating and Inhibiting Factors for University-Industry KTT

The findings revealed that the most important facilitating factors are personal connections, networking and cooperation with industry, and support from university administration (Table 20).

Table 20. Frequency of Responses for KTT Facilitating Factors

	Facilitating factor	***Frequency of mentioning***
1	Personal connections, networking, collaboration with industry	8 out of 9
2	Support from university administration	5 out of 9

Personal connections, networking/collaboration with industry

One of the most important facilitating factors is personal connections, networking, and cooperation with industry.

Most (8 out of 9) interview participants think that personal connections and cooperation with industry is crucial for KTT. Aldiyar, an Associate Professor of the School of Technology and Technical Sciences, noted that personal ties, networking and cooperation with industry helped him to apply for research grants and commercialize research results. He commented:

> Well, until today all the work has been done by me is related to industry. This is not due to any efforts of the university; it is due to the fact that I work with industry. When I applied for a grant, I took the group out, we conducted field experiments. We carried out instrumental measurements along those lines, the objects for which we were allowed to do throughout the city. Personal connections help in the implementation of projects. I did this to write articles on my topic. (p. 3)

Aygul, an Associate Professor of the School of Technology and Technical Sciences, also has close personal connections with the companies. She believes it is important for the researcher to cooperate with the industry to be up to date about the problems and demands of the industry. She explained:

> I am in contact with industry, large enterprises and directors of enterprises, technologists directly as a researcher. That is, it is not the university that contacts them, but me. It turns out that I develop for this specific field, I find an enterprise. I'm looking for their problems, in fact, this is the way it should be. Since this is my direction, I need to know my direction inside and out, so I must communicate, find out that. For example, I travel to enterprises, I go there weekly, for several weeks. I talk with technologists, I find out what problems they have there. I talk to the management about development prospects, what they want to produce at their enterprise, what technology they want us to develop. This is how it works, so we can do it. For example, I work with the Zharkent starch and syrup plant, it is an exporter, and such an innovative enterprise is considered a high-tech enterprise. There, the management is more progressive, a lot depends from the management, and whether they will make contact, and then the researcher should also succeed in inspiring confidence, right? (p. 11)

Aygul is making huge efforts to collaborate with industry and establish personal contacts with the management of the companies. Similarly, Aknur, an Associate Professor from the School of Veterinary, shared that they have to look for industry partners to implement their research projects. She commented:

> For example, in order to promote my project, I have to find a businessman in my field who works in the agricultural sector, who will take on this project and say let's do this project together, if you win a grant, I will help you by allowing you to access my farm to conduct research at any time, receive data, and then I will help to promote your product or method. A businessman is more involved in this, he has channels, he has more opportunities, a lot of connections, unlike a researcher. Of course, there must be a relationship between a researcher and an entrepreneur,

> without this, you cannot promote your product or technology. I could not have done my own project without an entrepreneur. (p. 4)

Ansar, an Associate Professor from the School of Veterinary, also shared that it is possible to transfer technologies through personal connections and cooperation with a foreign company:

> Yes, I have contacts; they contacted me, representatives of [company] in Kazakhstan. We discussed how it is possible to promote these technologies through seminars with students, they would see new technologies, they will go into production, and then they can offer them to their employers. (p. 2)

All interview participants from the School of Veterinary and the School of Technology and Technical Sciences agreed that personal connections, networking and collaboration with entrepreneurs/companies are important for the successful implementation of research projects, KTT from university to industry. The only participant who did not mention cooperation with industry as an important factor is from the School of Forest Resources Management, where forest management is under public management, not private industry. These findings demonstrate the importance of personal connections and personal efforts to make these connections and suggest that the university needs to look at developing more of a brokerage approach to help university faculty find these connections.

However, at the system level, university-industry collaboration is underdeveloped. *The Development Program for 2020-2024* admits that weak university-industry cooperation inhibits KTT. The document states:

> A systemic problem hindering the improvement of the quality of research results and the competence of specialists is the underdevelopment of the relationship between research, training and the introduction of new technologies in the agro-industrial complex. As a result, research is not focused on the actual needs of the economy and society, the results are not reflected in the educational process of universities and are not passed on to the next generation of specialists, and graduates who do not have advanced competencies and non-competitive developments do not provide the expected effect from the introduction of domestic developments into practice. In search of innovations, the subjects of the agro-industrial complex are forced to turn to foreign organizations, their interest in cooperation with domestic scientists is declining, which does not stimulate the orientation of research to the needs of business and the improvement of the quality of research developments. (KATU, 2020b, p. 3-4)

The document explains that weak cooperation with industry leads to lower quality research and specialists as they do not correspond to the needs of the agricultural industry. This indicates that more support could take the form of university-led brokerage.

Support from university administration

An important factor at the university level is support from the university administration. More than half (5 out of 9) of interview participants acknowledged that the university administration supports faculty in engaging in KTT. Ansar, an Associate Professor from the School of Veterinary, noted the university administration for commercialization projects. He commented, “This is the policy of all universities, for example, in our department, one employee won a grant for the commercialization from the Science Fund. This kind of initiative is supported by the university” (p. 3). Assel, an Assistant Professor of the Veterinary School, also gave an example of support for university faculty in applying for grants. She explained:

> We have just started working with the Science Department, with the Commercialization Office, they support us in everything, help in the economic calculations of projects, because the interest is for both parties. We have good relations, we are constantly in touch with them, and they consult us on any questions. They send us the provisions on which we need to write an application for grant funding, send us to financiers, economists. In this regard, they are helping us. (Assel, p. 4)

Azamat, an Assistant Professor of the Veterinary School, valued the support from the university administration, “Of course, the university fully supports this. There is a separate department that deals with this here, highly qualified specialists in commercialization. They help in everything” (p. 2). Askar, an Associate Professor of the Veterinary School, noted that the university administration provided incentives for the faculty to publish in journals with a high impact factor. He recalled:

> At the university there was such a system, when publications came out with a large impact factor, then the authors were given prizes for this publication. There was a regulation developed, that is, researchers were reimbursed for their publication costs. This really prompted the fact that today the number of publications in agricultural science in our country has increased. (p. 7)

Most interview participants who mentioned that the university supports them in engaging in KTT were from the School of Veterinary. This suggests that the School of Veterinary is more supported by the university in the process of KTT.

Key inhibiting factors for university-industry KTT are shown in Table 21. The most frequently identified factors are lack of funding or inadequate funding, heavy workload of university faculty, and lack of infrastructure/equipment to do research. The least frequently mentioned inhibiting factors are low salary and issues in grant administration.

Table 21. Frequency of Responses for KTT Inhibiting Factors

	Inhibiting factor	***Frequency of mentioning***
1	Funding issues	7 out of 9
2	Heavy workload	4 out of 9
3	Lack of infrastructure/equipment to do research	3 out of 9
4	Low salary	2 out of 9
5	Issues in grant administration	2 out of 9

Funding issues

One of the most important inhibiting factors at the system level is the lack of funding. The strategic document acknowledges that the lack of resources is the main issue hindering the implementation of most strategic initiatives related to the transformation of the university into a research agricultural university (KATU, 2020b, p. 93). *The Development Program for 2020-2024* clearly states, "The implementation of long-term, large-scale infrastructure modernization projects from own funds is not possible due to their shortage" (KATU, 2020b, p. 18). The document further states that the university has the potential to expand knowledge dissemination tools to the agricultural industry. However, "lack of targeted, stable funding does not allow full involvement of faculty in this work" (KATU, 2020b, p. 32). The document emphasizes:

> In particular, KATU's own resources are not enough for large-scale modernization and expansion of infrastructure, expansion and deepening of scientific research, a fundamental reform of the organization and content of the educational process, academic mobility, internships for teaching staff, stable work of knowledge dissemination offices and technology commercialization. (KATU, 2020b, p. 40)

The document analysis demonstrates the awareness of the university management that funding is one of the most crucial issues for the university. Similarly, most participants (7 out of 9) mentioned lack of or inadequate funding as a key factor inhibiting KTT, including research commercialization. Askar, an Associate Professor of the Veterinary School, commented:

> Why our science lags behind the business today? Because our science is not properly funded. And not a single teacher will go to work with farmers for commercialization, because travel allowances do not allow. The university knows that this is a utopia,

> money will not come back, and you need to understand that commercialization is a long process. No one wants to invest in it. (p. 3)

Aknur, an Associate Professor from the School of Veterinary concurred:

> We are mainly financed by the Ministry of Education and Science, but the Ministry cannot finance all projects, all universities of the country participate there, and the Ministry of Agriculture is weak in this regard. If we would receive more funding from the Ministry of Agriculture, our situation would not be so bad, we would pay more attention to research. (p. 3)

Ansar, an Associate Professor from the School of Veterinary, advocated for increased research. He explained:

> When a competition for financing research projects in Kazakhstan is held, research institutes and universities take part there, of course, then research institutes have more chances to win these projects than universities. There is some kind of inconsistency, here it is necessary either to increase the number of grants because everyone is submitting good projects, quite high scores, but these grants do not reach many universities. And they also need to train doctoral students. I think this is a very big problem. (pp. 6-7)

Assel, an Assistant Professor of the Veterinary School, explained that inadequate funding for local research to develop new technologies, results in reliance on the adaptation of foreign technologies. She elaborated on this:

> In order to develop scientific research, funding is needed, because we have nothing left to do except adaptations, because in order to develop something new, we need not 1 or 10 million tenge. For example, in a new project we need large sums to buy a machine. We want to conduct ultrasound on ewes, we need several ultrasound machines. And they gave us 6-7 million tenge, where are they going? One ultrasound machine costs that much, and you still need to keep animals for a whole year. (p. 5)

Some (2 out of 9) interview participants mentioned funding delays as an inhibiting factor for research. Aygul, an Associate Professor at the School of Technology and Technical Sciences, shared that there are always delays in grant funding from the government. She commented:

> After we win a grant, the Ministry of Education and Science tries to start funding on time, but there are always delays. And from the Ministry of Agriculture, almost never financing is on time. Firstly, the announcement of the competition is already underway. For 2021-2023, the competition was announced only at the end of December, only on February 25, they collected applications. While it is already the middle of the year and funding, accordingly, will begin very late. (p. 1)

According to Azhar, an Associate Professor of the School of Forest Resources Management, these funding delays cause inconveniences:

> Actually, the project says 3 years, but there are many problems. For example, funding will only be available in April. They ask to submit a report in January. You cannot move anywhere until the money is allocated, and then by the end of the year, at the end of October, they will ask for another report. This is very uncomfortable. (p. 2)

The findings suggest that funding issues are relevant for all.

Heavy workload of university faculty

Almost half (4 out of 9) of interview participants mentioned heavy workload as an inhibiting factor to engage in KTT. Participants identified teaching, pastoral care and administrative responsibilities as occupying excessive time which detracts from time available for research:

> As a young researcher, I also want to do research, even though it is not easy for teachers to additionally engage in research because we have a very large teaching load of 730 hours per person… The teachers have a huge load, they need to leave time to make presentations, handouts, to make some kind of game, for example, brainstorming, in addition to academic hours, must additionally fill out Platonus[2] in the evenings. A bunch of all sorts of additional activities that the teacher should not be engaged in. …. It turns out that there is very little time left for research. (Aknur, p. 1)

> Moreover, we have educational work going on, there is supervising, accommodating students in a dormitory. There are students who do not study well; you need to constantly write letters, call parents. It is not like a university, but a large kindergarten… Teachers do not have time to do research. They are busy with paperwork, calling students' parents, writing reports. (Aldiyar, p. 4)

Moreover, there is a negative impact of heavy workload on faculty well-being. Azhar, an Associate Professor at the School of Forest Resources Management, complained that she had health issues because of too much workload that the university faculty is assigned. She believes that different people should be involved in different tasks. She elaborated:

> In addition, the university has high requirements, that is, you have to publish in journals with a high impact factor, write a project, and teach from morning to evening, there is also upbringing work. That is, you have to be like a robot, there is

[2] An automated information system used by universities and colleges in Kazakhstan for educational purposes, such as registering to courses, assessment of students, etc.

> no time to rest. During these 6 years that I worked at the university, my health deteriorated. There are no conditions for teachers. Young teachers like us are overwhelmed. In my opinion, a person should be engaged in teaching or research, that is, the two should be separate from each other. In addition, the university must have a separate person who is engaged in "upbringing work" [pastoral care]. Then there would be quality. (p. 2)

Participants from all schools mentioned heavy workload as an inhibiting factor for the faculty to be involved in research projects, indicating it is a university wide problem. However, all of the participants who mentioned heavy workloads are Associate Professors, suggesting that participants at this career rank may bear the brunt of workload expectations.

Lack of Infrastructure/Equipment to do research

Another factor that inhibits KTT is a lack of infrastructure/equipment to do research. *The Development Program* points to a lack of infrastructure as a factor that limits the implementation of research results. The document states:

> For example, the Dudarai campus lacks conditions for the educational process, accommodation of teaching staff and students, which limits its use. The scientific and experimental fieldwork campus is located in an area with atypical soils, which limits the applicability of the results obtained in practice. Due to the lack of space at the Shchuchinsk campus, there is no opportunity for training specialists on an interdisciplinary basis, linking forestry issues with environmental sciences, natural resource management, and other related areas. Thus, for the effective transformation of KATU into a research agricultural university, there is an objective need to further expand the campus network. (KATU, 2020b, p. 17)

Some (3 out of 9) interview participants mentioned lack of infrastructure and lack of equipment as inhibiting factors for university faculty to conduct research. Aknur, an Associate Professor from the School of Veterinary, shared that there is a shortage of laboratories and equipment in her department. She emphasized that this causes challenges as university faculty lose time waiting for the delivery of equipment. She commented:

> Secondly, there is no material and technical base, when there is no opportunity to do research in your department. There are not enough equipment, chemical reagents, you ask other research institutes, sign contracts with them. This creates a lot of discomfort, you have to go to the research institute to negotiate, take your samples. It seems to me that this is wrong, it is necessary that all these equipment are available when you apply for a grant, and not so that later you order from somewhere when

> you win a grant, and wait six months for this equipment to be delivered. It's a waste of time. (p. 5)

Aygul, an Associate Professor of the School of Technology and Technical Sciences, needed to rely on foreign sample analysis because of a lack of equipment. This causes significant delays in the research process. She explained:

> I have a constant problem, constantly having problems with the equipment. I have no equipment and have to go to China [to do experiments]… That is, when there is no equipment at hand, this is also bad. (p. 6)

Askar, an Associate Professor of the Veterinary School, also admitted that the lack of infrastructure is inhibiting KTT. He stated:

> Accordingly, there is no infrastructure. I always note that for anyone, for example, for crop production, we have our own fields in research institutes, at universities, where research is carried out independently of farmers, but this is not the case in animal husbandry. And we suffer from this, to get a normal result, these half results remain unfinished, so we must have our own base. And it should go with the technologies that industries use today. It has to be two steps ahead for them to learn…Today there are many different technologies, but unfortunately we do not know about them, because this is not within our competence due to the fact that we do not have our own base and we don't have a lot of money to acquire, develop and implement all this. (p. 3)

However, some (2 out of 9) participants believed that the university infrastructure is adequate to do research. Aldiyar, an Associate Professor of the School of Technology and Technical Sciences, stated, "the university has opportunities, you can't even imagine how much technology we have at the university, so much equipment that no one even touched, because the teachers do not have time to do research" (Aldiyar, p. 4). The difference in the views of interview participants might be related to the field of research as each field of research needs specific equipment to conduct research experiments.

Low salary

The Development Program recognizes that the salaries of university faculty are very low. The document states:

> To attract and retain the most qualified teachers and scientists, KATU strives to regularly increase the salaries of the faculty. However, in comparison with 2011, wages increased by 64.1%, the shortage of KATU resources does not allow for significant progress in this matter. So, in 2018, the average monthly salary of teaching staff was 167.2 thousand tenge, which is less than the average salary in the

> Republic of Kazakhstan (176.1 thousand tenge per month), and 2 times less than wages by type of activity "Professional, research and technical activities" (332.5 thousand tenge per month).

Some (2 out of 9) interview participants also mentioned low salary in a research project and at the university in general that does not make a university an attractive place to work. Assel, an Assistant Professor of the Veterinary School, noted that “when we are involved in a project, we have a salary, but not a very large amount, somewhere 80,000 tenge, and only for a few months” (p. 3). Azhar, an Associate Professor of the School of Forest Resources Management, admitted that she is thinking of leaving the university, “because the salary is very low, even the shop assistants get more” (p. 2). Although very few participants mentioned about the salary, it does not mean that salary is not an important factor. Salary is related to the funding issues, which most participants believe is crucial for successful KTT.

Issues in grant administration

Some (2 out of 9) interview participants noted that there are issues in grant administration at the government level. Aknur, an Associate Professor from the School of Veterinary, shared her experience in applying for research grants as a young researcher. She commented:

> I applied there 2 times, last year and this year, I did not pass on formal grounds. They considered that I had incorrectly written the expected results, not according to the requirements. I was one of those young researchers who wrote a collective complaint to the Committee, why we were turned down on formal grounds, maybe I want to conduct research that is significant for Kazakhstan. There were many complaints from all over Kazakhstan, young researchers wrote complaints, but the decision remained the same. The Committee did not admit their mistake, if they admit it will be incompetent work on their part. (p. 2)

Aygul, an Associate Professor of the School of Technology and Technical Sciences, believes that research grants should be fairly awarded. She commented:

> First, there should be fair competition... In general, the state, in principle, allocates huge funds for us to commercialize. But these funds turn out to be going in the wrong direction. Therefore, some kind of commission is needed. Maybe there should be some kind of body from above to oversee if the distribution is correct… (p. 12).

These findings suggest that there are issues in grant administration. Particularly, young researchers have difficulties in getting research grants, as their applications are not successful. This implies that there is lack of transparency in the process of grant administration.

4.2.7 Summary

This section presented a description of the institutional context of Northern University and the within-case analysis of findings from Northern University. The analysis of findings revealed that university faculty understand KTT as transfer of foreign knowledge and technology that is adapted to the local conditions and transferred further to the industry. University faculty are more involved in informal channels of KTT than formal channels. Main channels of formal KTT are patenting and providing consultation to agricultural industry, farmers and entrepreneurs. The most important enabling factors affecting the process of KTT are personal connection, networking and cooperation with industry. Key inhibiting factors are lack of funding and efficient funding mechanisms, heavy workload of university faculty, low salary and lack of infrastructure/equipment to do research.

4.3 The Case of Southern University

The case of Southern University has been developed from analysis of four documents, the University website and interviews conducted with seven participants. Table 22 summarizes the documents used, categorized according to type. The documents provide strategic information about the university and represent the vision of the university management. As it was not possible to secure interviews with the management, the documents become a proxy for their views. *The University Development Program for 2020-2024* is a strategic plan that describes the steps and process of transforming the university into a research university. The Program also provides information about the current state of the university, including its achievements, problems, weaknesses, and strengths of the university. The annual reports provide information about the completed work for the academic year.

Table 22. Southern University Documents

	Document Title	Publication Date	Type
1	The University Development Program for 2020-2024	2020	Strategic Plan
2	Report for 2017-2018	2018	Annual Report
3	Report for 2018-2019	2019	Annual Report
4	Report for 2019-2020	2020	Annual Report

4.3.1 Institutional Background

Southern University was formed in 1996 by merging the two oldest universities in Kazakhstan - the Alma-Ata Veterinary Institute and the Kazakh Agricultural Institute, established in the 1930s. In 2001, the university was given the status of a national university (KNAU, 2022). In 2018, the university ranked 651 in the QS World University Rankings, and 96th out of 200 universities in the QS Emerging Europe and Central Asia (KNAU, 2020b). In 2021, the university participated in the ranking of the Republican Rating Agency (RRA) and

took 1st place in the agricultural direction. In 2019, the university passed institutional accreditation with the Kazakhstan Association for Engineering Education (KNAU, 2022).

The university offers 41 undergraduate, 39 masters and 16 doctoral (PhD) programs. It has six schools, combining 31 departments: agrobiology; technology and bio-resources; veterinary; water, land and forest resources; IT technologies, automation and mechanization of agricultural industry; business and law. The number of students (as of October 1, 2018) was 7988 people, out of which 717 were graduate students (9%), and 236 were doctoral students (3%). Two-thirds of the total number of students are supported by state education grants. Compared with the 2010 - 2011 academic year, the total number of students increased by 10%, including master's students by 70%, and doctoral students by 84%. The duration of internships for students has been extended to eight months. The level of employment of graduates reached 84% (KNAU, 2020b).

There are 766 faculty members, including 19 academicians of the National Academy of Sciences of the Republic of Kazakhstan, 138 doctors of sciences, 314 candidates of sciences, and 62 PhDs. The share of the faculty with an academic degree in 2018 compared to 2010 increased from 52% to 67%. More than half (57%) of department heads are young scientists under the age of 40 who are fluent in English and have experience in international programs and projects. Every year, 30-35% of the teaching staff undergo advanced training and research internships. For example, 150 university employees were trained in English under the government project "Stimulation of Productive Innovations" (KNAU, 2020b).

In its innovative development, the university focuses on the experience of Wageningen University (Netherlands), which is the number one university in the QS ranking and has a very developed ecosystem. Since 2010, the university began the process of transformation into a national research university, using international project management standards. The year 2015 was a turning point when the university was transformed into a new organizational and legal form. The university was transferred from the jurisdiction of the Ministry of Education and Science to the Ministry of Agriculture of the Republic of Kazakhstan. This allowed the university to gain academic freedom, move to autonomy, implement the principles of self-financing, using the mechanisms of public-private partnership (KNAU, 2020b).

An analysis of income and expenses shows that, in general, the university operates efficiently. The profitability level increased from 1.4% in 2011 to 3.5% in 2019. The amount of funding for research projects over the past eight years has increased 3.3 times. In 2018, the total amount of funding of research was 719.4 million tenge. The amount of funding from non-state sources amounted to 415.0 million tenge, which is 57.7% of the total amount of funding. In 2019, the university carried out 51 research projects (KNAU, 2020b).

Since 2015, an agrotechnological hub has been operating at the university, which includes all innovative research laboratories and centers. Its goals are to search, attract and transfer new knowledge and innovative technologies to the agricultural industry. It includes six research institutes, 31 research laboratories, seven innovation centers: Kazakh-Japanese innovation center, water, agro-engineering problems and energy conservation, Kazakh-Korean innovation center, innovation center for sustainable agriculture, technology and food quality, Kazakh-Belarusian agro-engineering innovation center, and the digital center. The university has an agrotechnopark based on the educational and experimental farm “Agrouniversitet" (KNAU, 2020b). Established in 2011, the agricultural research and production consortium "AgroDamu" coordinates more than 90 organizations of science and business. More than 22,000 agricultural producers use the services of university faculty. In all five southern and southeastern regions of Kazakhstan, the university has created from three to five educational, research and production centers, where rural entrepreneurs can improve their skills, and students in these farms undergo all types of practices (KNAU, 2020b).

In summary, Southern University is the largest agrarian university with the status of a national research university established during the Soviet period in the southern part of Kazakhstan. The university is one of the first universities in the country that began reforming into a research university, adopting best practices from top agrarian universities in the world. The university operates as a hub for innovative agricultural research and technology in the country as it includes research institutes, laboratories, and innovation centers.

4.3.2 Characteristics of Interview Participants

There were 7 participants from the Southern University. The characteristics of the participants are summarized in Table 23.

Table 23. Demographic Characteristics of the Participants from Southern University

Name	**Gender**	**School**	**Position**	**Academic title**	**Work experience**	**Publications**
Balzhan	Female	Agrobiology	Head of department	Candidate of sciences	15-20 years	10-20
Banu	Female	Agrobiology	Associate Professor	PhD	5-10 years	10-20
Bayan	Female	Agrobiology	Full Professor	Doctor of sciences	more than 20 years	More than 40
Bekarys	Male	Technology and Technical Sciences	Full Professor	Doctor of sciences	more than 20 years	More than 40
Bibigul	Female	Agrobiology	Full Professor	Candidate of sciences	more than 20 years	More than 40
Botakoz	Female	Veterinary	Head of department	Doctor of sciences	more than 20 years	More than 40
Bulbul	Female	Water, land and forest resources	Associate Professor	PhD	10-15 years	Less than 10

Six of the seven participants were female and one was male. In terms of their positions, two of the participants were heads of departments and five of the participants were university faculty, including three Full Professors, and two Associate Professors. In terms of their academic titles, there were three doctors of sciences, two candidates of sciences, and two PhDs. Four participants were from the School of Agrobiology, one from the School of Veterinary, one from the School of Technology and Technical Sciences, and one from the School of Forest Resources Management. Most of the participants (6 out of 7) have more than 10 years of experience in higher education and research. One participant has less than 10 years of experience, two participants have between 10-20 years of experience, and four participants have more than 20 years of work experience. In terms of the number of publications, more than half of the participants (4 out of 7) have more than 40 publications, whereas one participant has less than 10 publications, and 2 participants have between 10 and 20 publications.

4.3.3 The Role of Universities in Innovative and Technological Development

The university set an ambitious objective to develop a national innovation system in the agricultural industry of the country (KNAU, 2019). The strategic documents stated that the research activities of the university were aimed at promoting the innovative development of the agricultural industry in a competitive environment (KNAU, 2018; KNAU, 2020b). They refer to the "Triple Helix" model, where "universities are seen as generators of knowledge and research and technological development are considered as the main driving force of innovative development" (KNAU, 2020b, p. 16). In the *Development Program for 2020-2024*, it is highlighted:

> Improvement of innovative activity at the university will be aimed at 1) positioning the university as a driver of the agrarian economy, based on new knowledge and technologies; 2) organizing the transfer of the results of intellectual activity to the economy of the agriculture of the Republic of Kazakhstan; 3) implementation of a marketing strategy to bring the university's scientific, educational, and consulting services to international markets. (KNAU, 2020b, p. 53)

The university management values the role of the university in innovation and economy, as the center of new knowledge and technology. According to an interview in the mass media, the Rector of Southern University noted that the agricultural sector of the country is not competitive in the world markets for high-tech products. He stated that the only way to solve this issue is through knowledge-based innovative development. He elaborated:

> Improving the training of highly qualified specialists is impossible without the modernization of the domestic education system, in particular, the formation of a

> new model of a university that actively carries out innovative activities based on the development of science. At the same time, we consider science not only as a source of innovative ideas, but also as a resource penetrating all parts of the innovation process. (Yespolov, 2021)

The strategic document links transfer of new knowledge and technology from university to agriculture with innovative and technological development. The document states that it is highly important to establish relations with business and to collaborate with industry in the process of knowledge generation and transfer. It states:

> The development of the innovative potential of the university is aimed at developing new mechanisms for interaction between science and business, increasing the effectiveness of research, their focus on practical implementation, ensuring the introduction of high-tech technologies in the agriculture and stimulating the business sector to participate in research projects. (KNAU, 2020b, p. 46)

The findings from the strategic documents and interviews on mass media demonstrate that the university understands the role of the university as contributing to technological and innovative development of the country.

The *Development Program* presents university strategies that emphasize innovation, knowledge generation and transfer (Figure 14).

Figure 14. University Strategies

University strategies include “multifunctionality of the university, or the ability to both generate and ensure the transfer of modern knowledge”; “innovative focus of the university on

research and development, primarily on applied research"; "a high degree of information openness and integration into the international research and educational space"; "formation of specialized scientific, technical and economic zones at the university, such as: agrotechnopark, high-tech sites, business incubators, innovation laboratories, greenhouses and other structures"; "motivation of employees for creative thinking and innovative approach in solving urgent problems facing the university" (KNAU, 2020b, p. 42). These strategies represent beliefs and attitudes of the university management towards KTT and how they will be turned into practice. These findings demonstrate a strong focus of the university on innovation and transfer of new knowledge to the agricultural industry of the country. These strategies are shared by the university as most of them are engaged in research and development, and knowledge dissemination. For example, Bekarys, a Full Professor of the School of Technology and Technical Sciences, believes that innovation is key to sustainability. He shared his view, "If we want to be sustainable, to go further, we must rely on innovation. It is necessary to promote innovation in Kazakhstan more often and we must all help in this" (Bekarys, p. 5).

Southern University started transformation in 2010, striving for the status of a world-class national research university. The university was given a special status of the National Research University defined in the *Law on Education*. According to the Law, to receive a special status, a university must have a five-year development program approved by the government, "independently develop educational curricula of higher and graduate education in three or more groups of specialties, use the results of fundamental and applied research to generate and transfer new knowledge" (KNAU, 2020b, p. 7). To become a research university, the management of the university has taken the "success factors" approach to transformation, where people, processes and technologies are key aspects (KNAU, 2020b). New positions were introduced - a teacher-researcher who carries out research projects, and a teacher-consultant who provides consulting services to agricultural enterprises. The university is implementing the integration of science and industry, and the commercialization of research results. The focus is on the transfer of knowledge to the economy through the agro-technological hub. Moreover, the university is developing IT solutions and a new training format (KNAU, 2020b).

4.3.4 Cross-National versus Local KTT

As for the interpretation of the concept of KTT, there are two different interpretations evident in the university documents and the interviews with faculty. On the one hand, there is an interpretation in the documents that there should be a transfer of knowledge and technology created and developed at the university by the university researchers. It is mentioned in the *Development Program for 2020-2024*, the development strategy of the university is "to create new knowledge in the agrarian science of Kazakhstan" (KNAU, 2020b, p. 41). On the other

hand, documents indicate that foreign agricultural knowledge and technology can be adopted and adapted. In the Annual Report for 2017-2018, it is stated:

> The Agrotechnological hub is successfully functioning, which is engaged in attracting and transferring the best international practices and technologies to the agricultural sector of the Republic of Kazakhstan. The Hub includes all innovation centers and scientific and educational laboratories, where students are engaged in and conduct their research. (KNAU, 2018, p. 6)

However, some faculty do not share the view that foreign knowledge and technology should be transferred. Bibigul, a Full Professor in the School of Agrobiology, holds a view that the university should conduct its own research and produce new knowledge, not just import foreign knowledge and technologies. She commented:

> Our university is more inclined to introduce foreign technology, there is such an admiration for the advantages of Western, foreign research. Although we have a very strong school in Kazakhstan and, most importantly, the West offers us their technologies ... we can use them, but adapting them to our conditions, without worshiping their research results. (p. 2)

Bayan, a Full Professor from the School of Agrobiology, shared her interpretation of the form of KTT. She believes that every researcher must develop new knowledge and technology and transfer it to the industry. She also believes that doctoral students should have a plan on how they will introduce the results of their research into the industry before defending their theses. She stated:

> Of course, the most important task of a researcher when defending research is the benefit for our country, that is, the results of research must be introduced into production, and researchers should not be allowed to defend without implementation. When a researcher defends his research, he must have an implementation act or a patent. (p. 1)

Bekarys, a Full Professor of the School of Technology and Technical Sciences, has rich experience in research and development of agricultural machinery. He is an example of a university faculty that develops new knowledge and technology and introduces to the industry. He stated:

> All my life I have been engaged in innovative developments, for example, my developments … at one time they were criticized that this is only an idea on paper, etc., in the end I proved it was made at the level of industrial enterprises, it has a scientific and methodological basis. (p. 1)

Bekarys further explains the process of development of agricultural machinery. He admitted that it is a hard work that requires huge efforts and resources:

> An idea comes to mind, and it is patented. And when the obtained title of protection has reached the level of implementation, a lot of research work is needed. First, a mock prototype must be made, it must be investigated, then its parameters must be optimized, it must be modeled, this is a whole volume of work. Then it is necessary to test the obtained parameters of the prototype directly in the field. For example, in agricultural engineering, we must test it in the field, correct the technical documentation, we need to make it anew, considering adjustments during testing, that is, a whole contribution of very labor-intensive, capital-intensive work. (p. 3)

The findings from interview transcripts suggest that university faculty differentiate knowledge and technology transfer. According to the university documents, technology can be directly transferred, whereas foreign knowledge can be adapted to the local conditions. Unlike the view represented in documents, some faculty members believe in their capacity to develop new knowledge and technology. Those faculty members tend to have higher academic positions and more experience in research and developments.

4.3.5 Formal and Informal Channels of University-Industry KTT

Formal channels

Southern University employs the following formal channels to transfer knowledge and technology, such as patents, startups, contract research and contractual consultations. The most common formal channels are patents, consultations, and contract research, whereas licensing, academic startups are not so common (Table 24).

Table 24. Frequency of Mentioning Formal Channels

	Formal channel	Frequency mentioned
1	Patenting	6 out of 7
2	Consultations	5 out of 7
3	Contract research	4 out of 7
4	Startups	2 out of 7

Most interview participants have patents (6 out of 7), provide consultations (5 out of 7), contract research (4 out of 7), and some have startups (2 out of 7). For example, in the 2019-2020 academic year, university faculty and researchers obtained 52 intellectual property rights, including 36 utility model patents, 14 invention patents and 2 trademarks (KNAU, 2020a). Although most of interview participants have patents, the level of commercialization is low as there is no further licensing of the patents to the agricultural industry. In 2019, the percentage of commercialized research results were 12% (KNAU, 2020b). The findings from the documents are supported by the findings from interview transcripts as some of the participants were

involved in research commercialization. For example, Botakoz, head of a department, commented about commercialization of her research results,

> My results are already being commercialized, today there are hot springs in an ecologically clean area not far from Almaty, there is a fish farm... And so they contacted me ... They had a problem with feed, there was no specific feed. We started to work together, we won the project, because I have patents of the Republic of Kazakhstan, and we commercialized, installed the feed shop. They use my recipes patented within the framework of this project, now there are 15 patents of the Republic of Kazakhstan. Not only feed, but also new products from this fish. (Botakoz, p. 2)

According to the *Development Program for 2020-2024*, university researchers began to launch startups from 2016. In 2018, the volume of funding for startups reached 300 million tenge, commercialization of research results increased by 3.6 times compared to 2014 (KNAU, 2020b). In 2019-2020, the university faculty provided research support services for 93 projects with business entities (economic contracts) (KNAU, 2020a). For examples, Bayan, a Full Professor from the School of Agrobiology, won grants for research commercialization from the World Bank and the local government, and obtained four patents. She shared her experience of introducing her research results into the industry through start-ups. She recalled:

> We received grant funding in 2012-2014 on applied research. …. I helped to open a mini-workshop for the processing of camel milk… We developed three products: shubat, improved shubat and pasteurized milk. Further, the akimat allocates funding specifically for implementation of research results... Under this program, a mini-workshop was opened in the Kyzylorda region. (Bayan, p. 1)

Bayan further recalled that she won grants from the Science Fund to commercialize research results. She continues,

> In 2016, the Science Fund was organized for the first time, they allocated 300 million tenge and we had to find business partners. We must have fundamental or applied research and we must substantiate our groundwork, patents. And so, we participated in 2016 in a project for the processing of camel meat into canned food. This was the first time in Kazakhstan... After that, in 2017, we won a grant for a project to modernize a dairy plant, it was designed only for cheeses, we developed 8 fermented milk products with stevia. (Bayan, p. 2)

Bayan also mentioned establishing a start-up company with the grant funding from the Ministry of Agriculture. She commented,

> We also have a [Ministry of Agriculture funded] project in 2017. We opened a start-up company, we produce dairy products from cow's milk there, soon we will be producing from camel milk. We have introduced the technology. (Bayan, p. 2)

University faculty regularly travel to the regions, meet with agricultural entrepreneurs to provide them with practical assistance, conduct explanatory work on all problems of the agricultural sector. This is also mentioned in the *Development Program for 2020-2024*:

> The only Higher School of Farmers in Kazakhstan provides consulting services for the application and implementation of innovative technologies in production through the Extension knowledge transfer centers established in all regions and districts. During the year, according to the schedule, university faculty and researchers travel to base farms to study the needs of farmers and solve existing problems. (KNAU, 2020b, p. 27)

In addition to the consulting services provided by the Higher School of Farmers, the university established Information and consulting service centers in all districts to provide consulting services to rural entrepreneurs, disseminate and transfer knowledge. These centers study and analyze current problems of farmers and entrepreneurs in collaboration with the Center for Strategic Studies of the University (KNAU, 2020a). These centers are also mentioned in the *Development Program*:

> In all regions of Kazakhstan, based on the existing large agricultural formations, processing enterprises, centers serving entrepreneurs in each pilot region, from 5 to 10 training and research and production centers have been created in all areas of training specialists for the agricultural sector of the country's economy. Information and consulting service centers have also been created here to provide consulting services to rural entrepreneurs, disseminate and transfer knowledge through Extension. (KNAU, 2020b, p. 39)

Bibigul, a Full Professor in the School of Agrobiology, has published more than 120 publications and obtained four patents, was involved in providing consultations and contract research. She recalled, “We conduct online seminars and consultations, and on the line of Atameken, they hold a competition every year, we submit our topics and we go on business trips” (Bibigul, p. 4). Bibigul further commented on how she conducts contract research and provides consultations to the farms,

> I give recommendations only based on the results of the research ... only reliable ... and in order for the results to be proven, I conduct research in a household. I tell the farms if you are ready to endure, I will conduct research, I offer them the terms, the minimum is 1 year for undergraduate students, then 2 years for master's students, and

> if they want more in-depth research, these are doctoral students, and if they want to commercialize, then these are projects ... I conduct research and consultations in a complex, solve all these issues. When I go to the farms, I give advice on all issues, I fully control how they prepare the soil, etc. (Bibigul, p. 5)

Bulbul, an Associate Professor in the School of Forest Resources Management shared that she provides contract consultations. To be specific, she is invited as an expert in forestry in the framework of international projects of international organizations like the UNDP. She also shared, "Moreover, within the framework of commercialization of AgroDamu, we provide consultations for agricultural producers" (Bulbul, p. 3). These interview quotes suggest that university faculty in Southern University actively use patenting, contract research and consultation as formal channels of KTT. However, licensing and startups are not widely used formal channels of KTT among university faculty.

Informal channels

All informal channels of KTT are actively used in the Northern University, such as training, seminars, conferences, and publications. According to the *Annual Report for 2019-2020*, the Institute for Professional Development conducts professional development for specialists in the agricultural sector and employees of educational organizations. Currently, the Institute implements more than 70 professional development programs (KNAU, 2020a). The Higher School of Farmers is another organization at the university that constantly holds training, seminars, round tables and field days. According to the *Annual Report for 2017-2018*:

> The integration of the education of research and production is realized through the Higher School of Farmers, whose work is aimed at providing practical assistance to rural entrepreneurs in the development of their enterprises, the dissemination and transfer of new knowledge, the introduction of innovative technologies in agricultural production. (KNAU, 2018, p. 9)

These findings demonstrate that training and seminars are widely used as informal channels to transfer knowledge and technology at the university.

Conferences and publications are also widely used informal channels of KTT by the university. According to the *Annual Report for 2019-2020*:

> The University regularly holds international and republican research and practical conferences on priority issues of the development of the agriculture where researchers from leading research and educational centers of the country, as well as near and far abroad, participate. In 2019, 25 international and regional conferences, round tables, research seminars were held… (KNAU, 2020a, p. 65)

The *Annual Report for 2019-2020* further states:

> In December 2019, the IV International Agrotechnological Summit was held. The Agrotechnological Summit was attended by leaders and experts from the UN, G-Global, the Asian Development Bank, researchers and experts from leading foreign universities and research centers from more than 30 countries of the world… The annual Agrotechnological Summit, held by the Kazakh National University, provides an additional incentive to effectively involve the business environment in research and educational activities, commercialize the research results, and automate key business processes. (KNAU, 2020a, p. 66)

In terms of publications, it is stated in the *Development Program*:

> More university scientists began to publish the results of research projects in various periodicals, including journals with a high impact factor. In 2019, the total number of published articles increased by 51.8% compared to 2011. The number of articles published in foreign journals included in the Thomson Reuters and Scopus (Elsevier) database has increased 220 times over this period. (KNAU, 2020b, p. 33)

In fact, according to the document, the university has become a leader in Web of Science publishing activity among agrarian universities of the Commonwealth of Independent States (KNAU, 2020b). These findings from documents demonstrate the importance of conferences and publications for the university to disseminate and transfer new knowledge and technologies.

The findings from interview transcripts support the findings from relevant documents. Bulbul, an Associate Professor in the School of Forest Resources Management, shared her experience of being part of the Council of Young Researchers:

> The university has a Council of Young Researchers and I take part there. As part of the Council of Young Researchers, with the support of the Nazarbayev Foundation, we hold conferences every year where we share knowledge, experience, and offer new ideas. (Bulbul, p. 3)

Banu, an Associate Professor in the School of Agrobiology, also mentioned the Council of Young Researchers, where they share their ideas and discuss issues. She is also actively involved in extracurricular activities with students and online conferences:

> For example, recently there was a winter school for undergraduates, where I was the director of Agro-processing, I worked, I had a lot of experience. Scientists from Portugal and Malaysia lectured and we learned a lot. If the borders open, I am ready to participate in foreign conferences within the framework of the project. Last year, we participated in two foreign online conferences. (p. 2)

The active involvement of university faculty in informal channels of KTT might be related to the fact that there are formal requirements for university faculty to be engaged in those channels. For example, Balzhan, the Head of a Department at the School of Agrobiology, commented:

> The fact that I work at a university I must do all my best for 200-300 percent. We need patents, publications, and conferences, and at the same time, you teach and supervise... If you want to be a supervisor of graduate and doctoral students, then there is a list of requirements. (p. 4)

The findings from documents and interview transcripts suggest that all university faculty participants are actively engaged in informal channels of KTT, particularly training, seminars, conferences, and publications.

4.3.6 Facilitating and Inhibiting Factors for University-Industry KTT

Facilitating factors

The findings revealed that the most important facilitating factor is cooperation with industry, other important factors are support from university administration and developed infrastructure (Table 25).

Table 25. The Most Frequently Mentioned Facilitating Factors

	Facilitating factor	Frequency mentioned
1	Personal connections, networking and cooperation with industry	6 out of 7
2	Support from university administration	2 out of 7
3	Developed infrastructure	2 out of 7

Personal connection, networking and cooperation with industry

The most important facilitating factor is cooperation with industry. Most (6 out of 7) interview participants believe that cooperation with industry is necessary for successful KTT. Banu, an Associate Professor in the School of Agrobiology, shared her experience of cooperating with the private companies. She commented: “In 2011, I worked with many companies that produce pasta. Smaller companies have shown interest in disease prevention and expanding their preventive range. We worked with sugar factories in South Kazakhstan on syrup” (Banu, p. 1). Bibigul, a Full Professor in the School of Agrobiology, also shared that she cooperates with many farms in her research field by providing them consultations. She elaborates:

> In winter and summer, practically ... I have many farms that I consult, we have an agreement with them. Since I cannot be a legal entity because I am an employee of the university department, an agreement is concluded between the research worker and the farm, and on the basis of this agreement, the teachers of the department can consult. I conduct consultations on various issues all year round. (Bibigul, p. 4)

Bibigul also shared that through networking and collaboration with farms, her students conduct research on the farms, which is benefits for both farmers and students. She commented,

> When I go to these farms, I propose to them to conduct research in this farm, 4 diploma theses and 1 master's thesis on pruning and protecting a garden have been completed. When you conduct research, you can really show them, for example, we carry out pruning using such and such technologies, and provide them with the results of research, and then how they will use them, they decide for themselves. Here, an agreement on research collaboration and internships for undergraduate, graduate and doctoral students is immediately concluded. In these farms, they undergo internship and conduct research. (Bibigul, p. 4-5)

Bulbul, an Associate Professor in the School of Forest Resources Management, acknowledged that her department cooperates with the industry in order to develop local forestry. She commented:

> We cooperate with forestry enterprises, and there is also interest from businessmen and investors. That is, investors want to invest their funds, for example, in the creation of nurseries, this is done in order not to import foreign material, but to create their own local nurseries for urban greening. (Bulbul, p. 3)

Almost all interview participants from Southern University agreed that cooperation with industry is important for KTT from university to industry. The participant who did not mention cooperation with industry as an important factor is from the Department of Ecology (Environmental protection), which might be related to the fact that protecting the environment does not belong to the private industry, rather it is under the public management.

Support from university administration

Only some (2 out of 7) interview participants mentioned support from university administration as a facilitating factor for KTT. Bayan, a Full Professor from the School of Agrobiology, acknowledged that the Commercialization Office at the university help university faculty to commercialize the research results. She commented:

> Our commercialization office works very well, when we did not understand anything about commercialization, they invited the staff of the Science Fund, they explained everything thoroughly. The Science Fund has one coordinator for each project who thoroughly checks all the documents, whether we are going according to plan or not, etc., that is, we work very well on both sides. (Bayan, p. 3)

Bulbul, an Associate Professor in the School of Forest Resources Management, also acknowledged that the university administration supports faculty in engaging research projects by reducing their teaching load. She elaborated:

> Our university encourages when a teacher participates in research activities, when a teacher has his own research project, then his teaching load is reduced so that the teacher devotes more time to conducting research, presenting his research, at various kinds of conferences, etc. Yes, the university fully supports the conduct of scientific research, and even here we are introducing a position as a teacher-researcher, since our university received the status of a research university, science and research are in the first place with us (Bulbul, p. 2).

These findings suggest that support from university administration is not the most significant factor for university faculty of Southern University to actively engage in research projects and commercialization.

Developed Infrastructure

Some (2 out of 7) interview participants mentioned developed infrastructure as a facilitating factor for KTT. For example, Banu, an Associate Professor in the School of Agrobiology, admitted that the university has developed infrastructure, including research centers and laboratories, to conduct research. She commented, “Our University has well developed food research laboratories and good results can be achieved. For example, there is a Kazakh-Japanese innovation center, an agrotechnical hub. A person who wants to study has all the conditions” (Banu, p. 1) Bulbul, an Associate Professor in the School of Forest Resources Management, also acknowledged that the university has great potential, with developed infrastructure, innovative research centers and laboratories, where students can learn and do research. She commented:

> I want to mention the experience of our university, an innovation cluster has been established since last year on the territory of our university. There are entrepreneurs, businessmen who have experience and technologies, our university attracted them, on the basis of an agreement, they installed installations for the production of food on the territory of the university, thanks to this, researchers, teachers can conduct research on these installations, undergraduates can carry out their work, students can be shown live technology so that they can practice. (p. 5)

She also added that students share their experience after graduating and coming back to the rural area. She stated, “Of course, the potential of the university is very large. We have an innovative laboratory, educational and research centers, and students come from rural areas. There is a high probability that tomorrow after graduation they will return to the countryside” (Bulbul, p. 5).

These findings suggest that, although the developed infrastructure for research is important, it is not the most significant factor for active engagement of the faculty into KTT at Southern University.

Inhibiting factors

Key inhibiting factor for university-industry KTT are lack of funding or inadequate funding, whereas the least frequently mentioned inhibiting factor was issues in grant administration (Table 26).

Table 26. The Most Frequently Mentioned Inhibiting Factors

	Inhibiting factor	Frequency mentioned
1	Funding problems	4 out of 7
2	Issues in grant administration	2 out of 7

Funding problems

More than half (4 out of 7) of the interview participants mentioned funding problems as a significant inhibiting factor for university-industry KTT. Bekarys, a Full Professor of the School of Technology and Technical Sciences, shared that he could have international patents if the government provided funds to pay patent fees. He elaborates:

> If I had the financial means, I could have patented the idea in all the harvester-building countries of the world. But the trouble is that not only abroad, we cannot even pay the patent fee on the territory of Kazakhstan here. It is not that big, but it has to be paid annually. If the fee is not paid, the patent is canceled. Therefore, those officials who are involved in the allocation of funds for innovation in Kazakhstan, they should consider, first of all, not the number of articles, but innovation, since this is prestige for the state. (Bekarys, p. 5)

Balzhan, the Head of a Department at the School of Agrobiology, shared that they have to fund their projects themselves as they could not win research grants from the Ministry of Agriculture. She further explained that the university cannot attract private funds as it has a status of a national university. Moreover, the university is financed by the Ministry of Agriculture which has tight funds. She stated:

> If it were a private university, they would attract sponsors. But since it is considered as a national university, I don't think there are such resources. Firstly, I am not in the know, and secondly, the university already has enough expenses. There are so many visits per year. In addition, we are financed by the Ministry of Agriculture, they pay little. (Balzhan, p. 2)

Bayan, a Full Professor from the School of Agrobiology, admitted that it is difficult to implement research results due to lack of funding, "Of course, many things are very difficult to implement, many industries cannot allocate money for our research" (p. 1).

Issues in grant administration

Some (2 out of 7) interview participants noted that there are issues in grant administration at the government level. Bekarys, a Full Professor of the School of Technology and Technical Sciences, admitted there are issues in grant administration for innovative research projects. He believes that the allocated budget funds are not effectively used, therefore he thinks that there should be targeted funding. He shared his view on this issue:

> In any case, for budget money to be allocated, it is precisely those officials who distribute these funds for innovation, they should be focused not on the number of articles, impact factors, but specifically on innovation, while the innovation created by families is intertwined. For example, I tried to patent an idea that I had during research work in various aspects. And I began to argue that we needed targeted funding, organizational assistance. There are big drawbacks in this regard, in words everyone says what is needed, and when exactly when an idea needs to be implemented, tested and promoted further to the market, at this stage the innovator is left alone with his invention. It is a pity that the budget money allocated by the state goes into the sand. (Bekarys, p. 3)

Balzhan, the head of a department at the School of Agrobiology, shared that they applied twice for research grants from the Ministry of Agriculture and failed. She commented:

> It is financially difficult for us, after we tried twice and failed, we applied for an initiative project. An initiative project is when you take all the expenses yourself. There are no travel allowances, there is no money for tillage, we will collect money and carry out this on our own, because the university requires each teacher to participate in research. And we have to conduct research at our own expense. (Balzhan, p. 2)

These findings suggest that issues in grant administration is inhibiting some university faculty to implement their innovative ideas and transfer their knowledge to the industry. However, it is not the most significant inhibiting factor for the faculty of Southern University to engage in KTT.

4.3.7 Summary

This section presented a description of the institutional context of Southern University and the within-case analysis of findings from Southern University. The university management has set a strong focus of the university on innovation and transfer of new knowledge to the agricultural industry of the country. These values are shared by the university as most of them are engaged in knowledge dissemination and transfer of research results to the industry. Most interview participants have patents, provide consultations, more than half of them are engaged in contract research, and some have startups. All participants are actively engaged in informal channels of KTT, particularly training, seminars, conferences, and publications. The findings

revealed that the most important facilitating factor is personal connections, networking and cooperation with industry, other important factors are support from university administration and developed infrastructure. Key inhibiting factor for university-industry KTT are lack of funding or inadequate funding, whereas the least frequently mentioned inhibiting factor was issues in grant administration.

4.4. Cross-Case Analysis

This section presents findings from the cross-case analysis of Northern and Southern Universities. Firstly, the institutional backgrounds of each university are compared with each other. Then, comparison of characteristics of interview participants from both universities are presented. The findings of the cross-case analysis of both universities are presented according to the following four themes: The role of universities in innovation and technological development; Cross-national versus local KTT; Formal and informal channels of university-industry KTT; and Facilitating and inhibiting factors for university-industry KTT. The chapter concludes with a summary of the main findings from the cross-case analysis.

4.4.1 Institutional Backgrounds

Both universities are the largest universities in their geographic regions, in the north and the south of the country, and operate as hubs for innovative agricultural research and technology in their regions. Both universities were established during the Soviet period, and both are undergoing a transformation into a research university. Southern University was given the status of a national research university, whereas Northern University is in the process of obtaining a status of a research university.

Table 27 provides a comparative summary of the institutional backgrounds of the two case study universities. Northern University has more students and teaching staff in total, more undergraduate and graduate programs, more schools and departments than Southern University. However, compared to Northern University, Southern University has more doctoral students, and more Doctor of Sciences and academicians of the National Academy of Sciences working as a faculty. Northern University has schools and departments not related to the agriculture such as humanities, economy, architecture and design, computer systems and professional education. In contrast, except for the School of Business and Law, all schools and departments at Southern University are related to agriculture. Although Southern University has less research institutes and laboratories than Northern University, it has seven innovation centers, including international ones. In terms of research projects, faculty at Southern University are doing twice as many projects as Northern University. Southern University has also more funding of research from non-state sources than Northern University.

Table 27. Comparison of Institutional Background

Category	Northern University	Southern University
Number of students (As of October 1, 2018)	11,543 people, of which 1,159 people were in master's programs (10.0%), 71 doctoral students (0.6%).	7988 students, out of which 717 graduate students (9%), 236 doctoral students (3%).
Number of teaching staff	884 units, of which 83 doctors of science, 60 PhDs and 367 candidates of science	766 teachers, including 19 academicians of the National Academy of Sciences of the Republic of Kazakhstan, 138 doctors and 314 candidates of science, 62 PhDs.
Schools and departments	8 schools, combining 42 departments: agronomy; veterinary and technology of animal farming; computer systems and professional education; technical sciences; management of land resources, architecture and design; economy; energy; and humanities	6 schools, combining 31 departments: agrobiology; technology and bio-resources; veterinary; water, land and forest resources; IT technologies, automation and mechanization of agricultural industry; business and law.
Number of programs	47 undergraduate, 53 Master's and 33 PhD programs.	41 undergraduate, 39 Master's and 16 doctoral (PhD) programs.
Research centers and laboratories	A construction bureau, 46 laboratories and research centers	6 research institutes, 31 research laboratories, 7 innovation centers
Number of research projects	In 2018-2020 - 25 research projects	In 2019, the university carried out 51 research projects
Amount of funding of research projects	In 2018, the total amount of funding of research was 1036.6 million tenge. The amount of funding from non-state sources 171.3 million tenge.	In 2018, the total amount of funding of research was 719.4 million tenge. The amount of funding from non-state sources amounted to 415.0 million tenge
International collaboration	472 agreements with foreign universities, research centers and international organizations	137 agreements with foreign universities and research centers

4.4.2 Characteristics of Interview Participants

There were in total 16 participants from both universities: nine from the Northern University and seven from the Southern University. Table 28 provides a comparative summary of the demographic details of all participants. Ten of the 16 participants were female and six were male. There were almost equal number of male and female participants from Northern University, whereas female participants prevailed from Southern University. The participants from Southern University had higher academic qualifications and positions than the participants from Northern University. In terms of their academic qualifications, there were three Doctors of Sciences from Southern University, whereas there were no Doctor of Sciences from Northern University. In terms of their positions, there were two heads of departments and three Full Professors from Southern University, whereas there were no heads of department and full professors from Northern University. In terms of the schools that participants represented, there

were no participants from the School of Agrobiology and five participants from the School of Veterinary at Northern University, whereas there were four participants from the School of Agrobiology and one from the School of Veterinary at Southern University. Most of the participants (12 out of 16) have more than 10 years of experience in higher education and research.

Table 28. Comparison of Participants' Characteristics

	Category	**Northern University**	**Southern University**
1	Gender	5 male, 4 female	6 female, 1 male
2	School	5 School of Veterinary, 3 School of Technology and Technical Sciences, and 1 School of Forest Resources Management	4 School of Agrobiology, 1 School of Veterinary, 1 School of Technology and Technical Sciences, and 1 School of Forest Resources Management.
3	Academic qualification	4 PhDs, 3 candidates of sciences, and 2 Masters'	3 Doctors of Sciences, 2 candidates of sciences, and 2 PhDs
4	Position	6 Associate Professors and 3 Assistant Professors	2 heads of departments, 3 Full Professors, 2 Associate Professors
5	Work experience	3 have less than 10 years of experience, 3 have between 10-20 years of experience, and 3 have more than 20 years of work experience	1 has less than 10 years of experience, 2 have between 10-20 years of experience, and 4 have more than 20 years of work experience.

4.4.3 The Role of Agrarian Universities in Innovation and Technological Development

Analysis of relevant documents revealed that both universities have shared understanding of the purpose of KTT. In their strategic documents, both universities highlight the importance of agrarian universities in the innovation and technological development of the country. For example, in the *Development Programs for 2020-2024* both universities refer to the "Triple Helix", which is a model of innovative development based on the potential of research universities. Etzkowitz and Leydesdorff (2000) are the pioneers who suggested this model to understand university-industry-government relations, where the university has a key role in an economy driven by knowledge and innovation. The University documents represented agrarian universities as facilitators of the innovative and technological development of the country. The documents describe universities as sources of human resource development, centers for conducting research, implementing their results, and training specialists. Universities collaborate with foreign universities and companies to transfer foreign knowledge and technologies.

The documents of both universities describe initiatives to reform their universities as with approved *Development Programs for 2020-2024*. In the programs, they refer to the international experience where research universities are successful in concentrating resources. Research

universities have high quality human resources, networking with employers and business, modern infrastructure for teaching, research and experimental activities. Both universities have simultaneously started transformation into research universities based on foreign experience, by collaborating with foreign agrarian universities. The main objectives of transformation were the following: integration of education, science and industry; creating conditions for the commercialization of intellectual property products and technologies; training highly qualified specialists for the country's agricultural labor market.

Comparison of the vision, mission and strategic goals of both universities shows that there are similarities and differences (Table 29). Northern University strives to become an international research university, whereas Southern University envisions itself as an elite university in Central Asia. Both universities aim to be integrated in the global educational and research space, to train specialists competitive in the global labor market, and to transfer knowledge to the agricultural industry. As for the mission, Northern University emphasizes its role in economic development of the country, whereas Southern University is more focused on both economic and social development by training highly competitive and socially engaged specialists.

Table 29. Comparison of Vision, Mission, and Strategic Goals

	Northern University	Southern University
Vision	Through the implementation of the mission and strategy, it strives to become an international research university in the field of agro-industrial complex and related industries: with a competitive scientific potential involved in solving priority problems in a wide range of scientific areas; with unique curricula that project the results of scientific research into the educational process, providing training for specialists with fundamental education and developed skills in applying the acquired knowledge in real production; closely integrated into the global research and educational space, having partnerships with the world's leading research universities and research centers of a similar profile; actively introducing scientific results through the educational process, dissemination of knowledge and commercialization of technologies.	An elite university of innovative type, the leader of the agrarian sector of Kazakhstan and Central Asia: implementing research and educational process at the level of international standards in cooperation with the real sector of the economy and ensuring the competitiveness of graduates in the global labor market; to be included in the number of 300 universities in the world ranking of the QS agency; ensuring the integration of education, science and production based on innovations in the agro-industrial complex, the mobility of students and teaching staff; creating new knowledge in the agricultural science of Kazakhstan; guaranteeing the creation of conditions for the development of human capital.
Mission	To generate, implement, disseminate and apply advanced knowledge to improve the quality of life, increase labor productivity and competitiveness of the agricultural industry and other sectors of the economy of Kazakhstan	To create conditions for the formation of a competitive specialist in demand in the agricultural industry and the world research and educational space, as well as the development of a socially oriented, highly cultured, and tolerant personality

Strategic goals	Building the best system of advanced training of specialists and research and pedagogical personnel in Kazakhstan that meets international standards by providing ample opportunities to choose the level, content, form and terms of training based on unique curricula and academic mobility	Development of research and innovation activities of the university in accordance with the priorities of the research, technological and socio-economic development of the country, improving the quality of education, material and technical base, the formation of a highly cultured, socially responsible personality of the graduate

The documents and faculty at both universities suggest that by becoming a research university, it will be possible to adopt, adapt, generate, and transfer new knowledge to the industry. The faculty of both universities believe that training should be based on knowledge of new technologies. To have knowledge of new technologies, the universities should transfer foreign higher education knowledge to update curriculum and content of programs. Some faculty believe that teaching and research should be integrated, that faculty and students should have opportunities to conduct research and experiments.

4.4.4 Knowledge Management in Agrarian Universities

Both universities implement the key missions identified by OECD (2008): human capital development (through teaching); knowledge bases development (through research); knowledge dissemination and using (through interactions with knowledge users); and knowledge maintenance (inter-generational storage and transmission of knowledge). Knowledge dissemination at both universities involves transfer of foreign knowledge and technology and transfer of knowledge and technology generated locally. University faculty at both universities differentiate knowledge from technology. According to the university documents, foreign technology can be directly transferred, whereas foreign knowledge can be adapted to the local conditions. Foreign technology transfer involves codified/explicit knowledge and tacit/implicit knowledge on how to use technology. As tacit/implicit knowledge is not easily transferred, use of technology should be studied and researched by university faculty to adapt it to the local conditions. Unlike faculty at Northern University, some faculty members at Southern University believe in their capacity to develop new knowledge and technology. Those faculty members tend to have a Soviet education, higher academic position and more experience in research and development. This difference in the involvement of faculty in generation of new knowledge might be explained by the number of faculty with higher academic titles and positions and the proximity of the university to the agricultural industry, farms and entrepreneurs. Southern University has more faculty who received Soviet education, hold doctoral degrees and positions of Full Professor. Soviet education in agriculture is associated with high quality training, and teaching integrated with practical training and internships. Southern University is in the southern

part of the country where climatic conditions are favorable for agricultural producers. There are more farms and enterprises that produce agricultural products. Geographical proximity of industry is conducive for university-industry collaboration as the industry is a site for research and development, commercialization of research results, student internship and practice.

4.4.5 Formal and Informal Channels of University-Industry KTT

The findings from documents and interview transcripts suggest that Northern University are actively employing patents and consultations as channels of KTT, whereas contract research, academic spinoffs and startups are not so commonly used. The most common formal channels at Southern University are patents, consultations, and contract research, whereas academic spinoffs and startups are not so common. The faculty at Southern University is using contract research more often compared to the faculty at Northern University. This difference might be explained by the fact that Southern University has more doctoral students, and more Doctors of Sciences working as a faculty than Northern University. Moreover, there are more research projects and more funding of research from non-state sources at Southern University compared to Northern University.

Document and interview analysis revealed that the following informal mechanisms and channels are widely used by both universities, such as training, seminars, conferences, and publications. The findings suggest that university faculty actively use informal channels of KTT, as there are requirements for the faculty to be engaged in them. Some participants from both universities admitted that for career promotion there are high requirements set for the university faculty to be actively involved in training, seminars, conferences, research projects.

4.4.6 Facilitating and Inhibiting Factors for University-Industry KTT

The most frequently mentioned facilitating factor at both universities is personal connections, networking and cooperation with industry as they closely work with farms and agricultural enterprises, providing them trainings, seminars, consultations and sending students to internship. Another important factor at Northern University is support from university administration. The least frequently mentioned facilitating factors at Northern University are knowledge of English, and engaging students to research projects. At Southern University, the least frequently mentioned factors are support from university administration, developed infrastructure and competent government administration. The difference in the perception of participants of both universities about the significance of support from university administration might be explained by the difference in institutional background. University faculty at Southern University tend to be more independent in cooperating with the private sector as their research is more funded from non-state sources compared to Northern University. Moreover, the region where the Southern University is located has more farms and businesses.

Lack of funding or inadequate funding is the most important inhibiting factor at both universities as more than half of the participants mentioned it. The management of both universities also admit that there is not enough funding allocated from the government to research and there is insufficient funding opportunities from the private sector to order research from university. Other most frequently mentioned inhibiting factors related to the lack of funding was lack of infrastructure/equipment to do research at Northern University, whereas it was inadequate support from the government at Southern University. Lack of infrastructure/equipment to do research was not mentioned as an inhibiting factor by participants from Southern University as there is developed research and innovation infrastructure at the university with modern equipment. As for other factors, there were differences in the perceptions of the participants at both universities. Although heavy workload of university faculty was frequently mentioned at Northern University, it was not an important inhibiting factor at Southern University.

The least frequently mentioned inhibiting factor at both universities was issues in grant administration. Some participants from both universities mentioned that there is lack of transparency in the process of grant administration and grants are not effectively allocated. Other least frequently mentioned factors were low salary at Northern University and incompetence of personnel at the university administration at Southern University. In the strategic documents of Northern University, the university management admit that the salary of university faculty is very low. However, low salary was not mentioned by participants at Southern University as their strategic documents state that that salary of university faculty is rising.

4.4.7 The Comprehensive Model of KTT in Agrarian Universities in Kazakhstan

Based on the within-case and cross-case analysis of findings from Northern and Southern Universities, a comprehensive model was developed. This model (Figure 15) represents the process of KTT in agrarian universities in Kazakhstan.

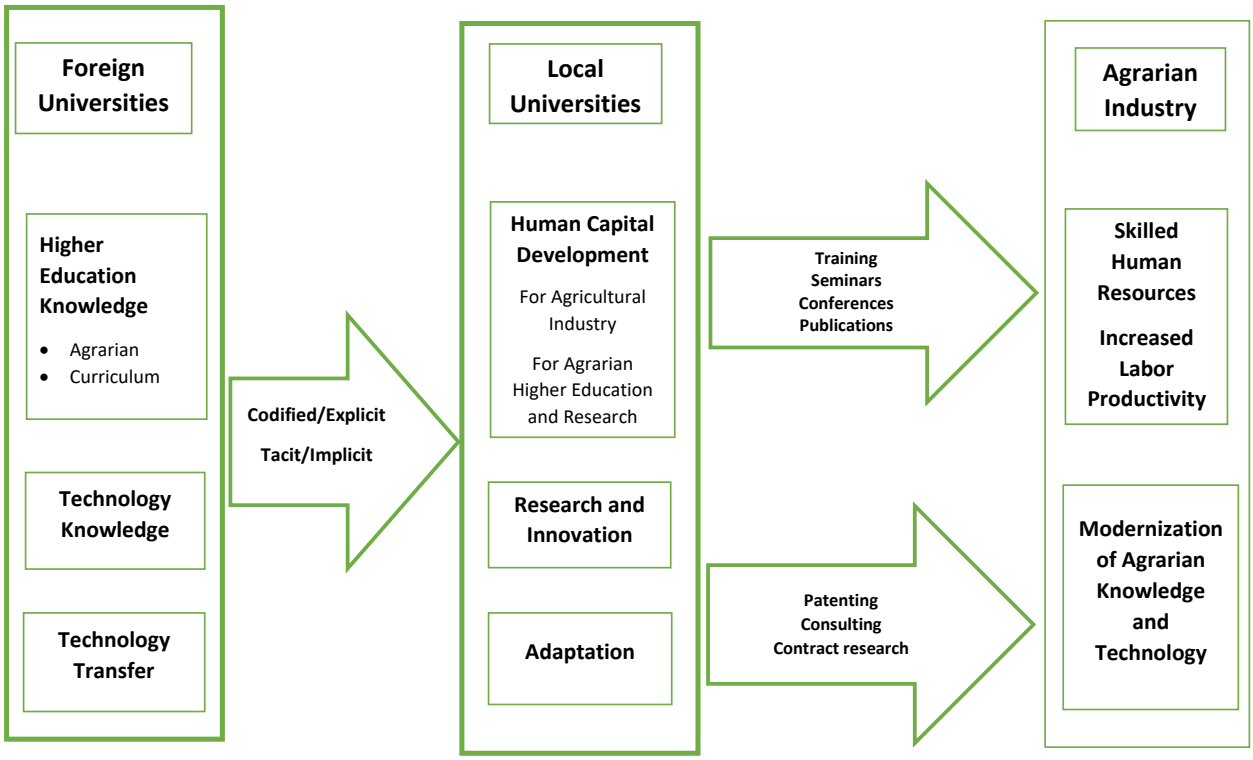

Figure 15.Model of KTT in Agrarian Universities in Kazakhstan

In this model local agrarian universities are the knowledge intermediary, facilitating knowledge and technology sharing and transferring. The process starts with transfer of foreign knowledge and technology from foreign agrarian universities to local agrarian universities, including higher education, curriculum and agrarian knowledge, technology, and knowledge about how to use technology. This knowledge and technology can flow in the form of codified/explicit knowledge and tacit/implicit knowledge. Local agrarian universities need this knowledge and technology for human capital development, research and innovation, and adaptation to the local industry needs. They further transfer knowledge and technology to the local industry through formal and informal channels of transfer, such as training, seminars, conferences, publications, patents, consultations, and contract research. As a result, the agrarian industry gains modernized agrarian knowledge and technology, skilled human resources, and increased productivity.

The model (Figure 16) presents enabling and inhibiting factors in the process of KTT from local agrarian universities to the agricultural industry in Kazakhstan.

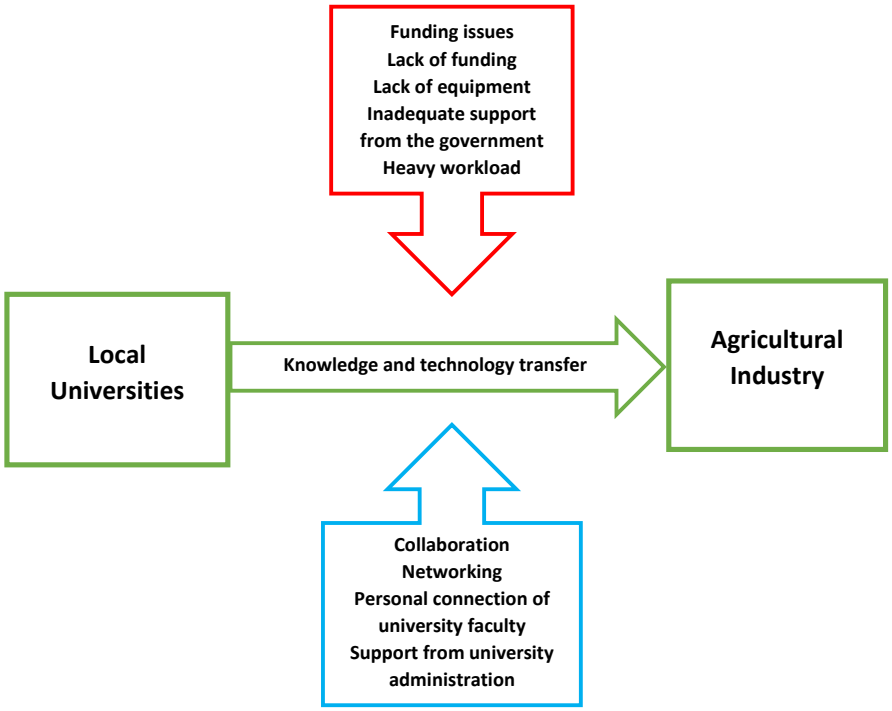

Figure 16.Factors Enabling and Inhibiting University-Industry KTT

The red box on the top represents important inhibiting factors in agrarian universities in Kazakhstan, particularly funding issues, lack of funding, lack of equipment, inadequate support from the government and heavy workload of faculty. The most critical factor that was revealed from the findings was related to funding. The blue box below represents key enabling factors such as collaboration, networking and personal connections with industry, and support from university administration.

4.4.8 Summary

This section presented cross-case analysis of findings from Northern University and Southern University. Faculty at both universities understand KTT as transfer of foreign knowledge and technology that is adapted to the local conditions and transferred further to the industry. University faculty are more involved in informal channels of KTT than formal channels. Main channels of formal KTT at both universities are patents and consultations. The most important enabling factor affecting the process of KTT is networking and personal connection with industry. Key inhibiting factor at both universities is lack of funding or inadequate funding. These findings will be discussed with reference to the literature and the research questions in the next chapter.

CHAPTER 5. DISCUSSION

5.1 Introduction

This chapter discusses the findings of this study in relation to the research questions, the conceptual framework, and the literature previously reviewed on the topic. It consists of four parts related to each of the following research questions: Central Question: What is the role of universities in the process of agricultural knowledge development and technology transfer in Kazakhstan? RQ1: How do universities understand the purpose of KTT in Kazakhstan? RQ2: What are the specific mechanisms, channels and pathways of university-industry KTT in Kazakhstan? RQ3: What are the inhibiting and facilitating factors for university-industry KTT in Kazakhstan?

The first part deals with the overarching research question, which is concerned with the role of agrarian universities in KTT. The findings identified tension between "Global homogenization versus glocalization" which will be unpacked in this chapter. The second part discusses the purpose of KTT in agrarian universities focusing on the tension between "Foreign" versus "local" knowledge and technology. The third part discusses the use of formal and informal channels in agrarian universities. Finally, the last part discusses factors that facilitate and inhibit the process of KTT in agrarian universities in Kazakhstan.

5.2 The Role of Agrarian Universities in Innovation: Global Homogenization versus Glocalization

Globalization has significant impact on higher education policy around the world, particularly it has transformed the role of higher education in global, regional, and national economies. The strategic documents of both agrarian universities emphasize the role of universities in the country's development as "Kazakhstan" and "development" were among the most frequent words in the documents. The universities have a vision of contributing to/ participating in the phenomena known as globalization of the knowledge economy. On the one hand, globalization is bringing "homogenization" of policies and practices into Kazakhstan with the increasing flow of ideas, technology, and people (Spring, 2014). Spring (2014) argues that international organizations are the main promoters of the globalization of the knowledge economy:

> The growth of worldwide educational institutions, networks and discourses has led to similar national educational agendas, particularly the concept of education as an economic investment. IGOs [Intergovernmental organizations], such as the United Nations, OECD, and the World Bank, are promoting global educational agendas that reflect discourses about job preparation, economic development, and multiculturalism (p. 4).

This is supported by the reports of international organizations that focus on the role of education in globalization and knowledge economy such as *The Knowledge-based Economy* (OECD, 1996), *Knowledge for Development* (World Bank, 1998), *Tertiary Education for the Knowledge Society* (OECD, 2008), *Higher Education to 2030: Globalization* (OECD, 2009) and *Innovating Education and Educating for Innovation* (OECD, 2016). The report *Higher Education to 2030: Globalization* states, "Higher education drives and is driven by globalization. It trains the highly skilled workers and contributes to the research base and capacity for innovation that determine competitiveness in the knowledge-based global economy. It facilitates international collaboration and cross-cultural exchange" (OECD, 2009, p. 13). Thus, international organizations have a common global discourse that promotes the increasing role of education in the globalized knowledge economy.

There is an alignment between global discourses, the Kazakhstani national agenda, and institutional policies in higher education and research sectors of Kazakhstan. Rizvi and Lingard (2009) believe that national policies and agendas are increasingly being affected by globalization. This is evident from the government strategic policies and programs in Kazakhstan such as *State Program for the Development of Education and Science (SPED) for 2020-2025 and The Concept of Development of the Agricultural Industry of the Republic of Kazakhstan for 2021-2030.* According to *SPED for 2020-2025,* one of the main goals is "to increase the contribution of science to the socio-economic development of the country" (p. 59). *The Concept of Development of the Agricultural Industry* states that one of the main priorities for the development of the agricultural industry until 2030 will be "the strengthening of scientific support and the introduction of innovative developments" (p. 28). This national agenda is present in the strategic documents of both agrarian universities as they both refer to the "Triple Helix" model practiced in developed countries. Etzkowitz and Leydesdorff (2000) are the pioneers who suggested this model to understand university-industry-government relations, where the university has a key role in an economy driven by knowledge and innovation. Thus, we see that the focus of the strategic documents of both agrarian universities on innovation and economic development is part of the national agenda and political discourse influenced by globalization.

On the other hand, there is a phenomenon of "glocalization" when cultural preconditions influence the way global policies and practices are adopted, adapted, or rejected. The ambitious goals and bold initiatives set by national policymakers are not always adopted and implemented by the society. Peters (2007) argues that "knowledge cultures" should be considered in studying knowledge economies as they are important for understanding cultural preconditions. He states that "knowledge cultures are based on shared epistemic practices, they

embody culturally preferred ways of doing things, often developed over many generations" (p. 23). In other words, the flow of ideas is influenced by conditions that are inherent in a culture. Furthermore, Moss et al. (2007) suggested that the extent of individualism/collectivism present in the culture of a nation influences the knowledge management practices of the society.

The influence of the cultural preconditions is evident in the case of Kazakhstan. Prior to the establishment of the Soviet regime in Kazakhstan, Kazakhs lived a unique nomadic way of life with communal land ownership. As Brown (1998) described,

> Typical of nomadic cultures, Kazakhs had no tradition of land ownership. Instead, most economic activity centered on animal husbandry and annual migration. Nor was Kazakh culture particularly rapacious. Aside from herds, personal property was largely limited to what could be carried. (p. 911)

Thus, the land belonged to the tribes and the main source of income was animal husbandry. Due to the nomadic lifestyle, minimalism and egalitarianism were the values characteristic of the Kazakh culture. However, this Kazakh culture would be brutally assaulted by the Soviet regime as Kazakhs were forced to become sedentary in the 1930s. The Soviet regime planned to change the Kazakh culture that was formed during thousands of years by implementing communist ideology. Kazakhstan is the country that suffered the most from the Soviet totalitarian regime among the Central Asian countries (Brown, 1998; Cameron, 2018).

The Soviet legacy is still present where socialism/collectivism and totalitarian state control was the political ideology penetrating all spheres of life. According to Silova (2004), "the collapse of empires often leaves a legacy of political, cultural, and educational institutions, as well as cultural norms and behaviors that continue to exist long after their demise, thus influencing post-socialist transformation processes" (p. 76). During the Soviet period, there was a planned economy, the state owned and controlled all sectors of economy. The central government identified priority areas of economy and allocated state funds. This led to the underdevelopment of certain sectors of economy that were not considered as important. The Encyclopedia Britannica states,

> Unlike market economies, which provide copyright and patent incentives to encourage creative efforts, the Soviet economy relied almost entirely on planned allocations of funds and tasks... Since no market other than the state market existed for inventions, however, areas neglected by planners (e.g., computers and electronics) lagged far behind. (Encyclopedia Britannica, n.d.)

Soviet totalitarian ruling regimes changed the mindset and culture of people so profoundly that they became used to top-down initiatives by authorities, whereas bottom-up initiatives were heavily censured. Freedom of speech and expression was suppressed, and anyone who had a

different view was punished. Entrepreneurship was considered as capitalistic and therefore evil. The OECD (2017) *Review of Innovation Policy in Kazakhstan* states,

> The legacy of the Soviet university system still has considerable bearing on the quality and range of universities' output. This holds true for research outputs in the form of publications but also for the commercialization of research results through patent licensing and other forms of knowledge transfer, such as the creation of start-ups, partnerships with innovative firms or the mobility of skilled personnel between research institutions and these businesses (p. 26).

The limitations of human rights, total state control and ownership, and authoritative central planning had a negative impact on the culture of innovation and entrepreneurship in Kazakhstan. As Brown (1998) argues, "Neither nomadic nor Soviet culture prepared them for an avaricious system based on individual self-interest and the accumulation of personal wealth" (p. 937). Thus, Kazakh culture did not have values that suited the market economy as they did not have entrepreneurial and mercantile traditions (Brown, 1998). Previous studies identified entrepreneurial attitude (Scuotto et al., 2019) and innovation culture (Kirchberger & Pohl, 2014) as important factors for successful KTT. This might explain the low level of overall innovation performance of Kazakhstan and its inefficiency in terms of innovation inputs to outputs (WIPO, 2022). Kazakhstan is also highly dependent on foreign intellectual property as it paid $231 million for the use of intellectual property, whereas it received only $2.86 million for the intellectual property it generated, which is almost 80 times lower (World Bank, 2021). This implies that despite the great aspirations and efforts of the government to develop a national innovation system, there are still cultural aspects that are holding back the progress.

5.3 The Purpose of KTT in Agrarian Universities: "Foreign" versus "Local" Knowledge and Technology

The strategic documents indicate that the two agrarian universities are focused on transfer of foreign, particularly "Western" knowledge and technology rather than local knowledge and technology. As Kazakhstan is an economy in transition, foreign KTT is perceived to be crucial for economic catch-up. This is also aligned with the concepts such as international technology transfer (ITT) and cross-national knowledge transfer (CNKT) (Pandey et al., 2022; Yu et al., 2022). According to these concepts, developing countries need transfer of foreign knowledge and technology to be competitive with developed countries. The catch-up requires not just "cross-national diffusion of currently available technologies but also, development, adaptation, and implementation of newer technologies and diffusion within countries, between geographical areas, and across socioeconomic classes" (Pandey et al., 2022, p. 3). As innovation and technology development requires huge resources inputs, and there is

limited resources and capacities, developing countries prefer to transfer foreign knowledge and technology. The agricultural sector in developing countries is especially in need of technological innovation as they are vulnerable to climate risks, and agricultural productivity is very low (Pandey et al., 2022). Universities are key institutions where companies can obtain new knowledge for technological innovation. Yu et al. (2022) state that "for less-developed countries, the cost of acquiring advanced knowledge via CNKT is far less than the cost of independent innovation, thus allowing them to gain a competitive advantage" (p. 627). That is, for developing countries, it is more cost-effective to transfer foreign knowledge and technology than to generate new knowledge and develop new technology. They can accumulate innovative knowledge through transfer of foreign technology for efficient re-innovation of technology (Yu et al., 2022).

The strategic documents of both universities support the need for both foreign and local KTT. In the first instance the foreign knowledge needs to be acquired from foreign universities. The strategy to achieve this involves partnership with foreign universities to update academic programs and curriculum, to modernize laboratories and equipment, and through faculty and student mobility. Following this, the knowledge obtained needs to be adapted by the local university and then transferred to the local industry. This understanding is aligned with the model proposed by Pagani et al. (2020), called university-to-university KTT model. According to the model, the foreign and local universities act as an intermediary between the foreign and local companies.

The reason universities act as an intermediary between foreign and local companies is that "it is difficult for companies to develop this knowledge internally because the process requires the vivid discussion of results from previous research, as well as careful documentation of attempt and error" (Pagani et al., 2020, p. 420). Moreover, local companies are not able to adopt foreign knowledge and technologies without adaptation, whereas universities have the capacity to adapt foreign knowledge and technology to the local needs. Universities have more resources than local companies to do research and innovation, such as laboratories, research equipment and most importantly, research staff. The importance of agrarian universities as the centers of knowledge production, transmission and dissemination is evident in the study conducted by Toleubayev et al. (2010), where they studied the role of knowledge in the post socialist agrarian crisis in Kazakhstan. They revealed that during the transition period from socialism to capitalism most of the agricultural knowledge produced in the Soviet period was lost due to emigration of agricultural specialists from Kazakhstan. Therefore, the farmers did not have adequate skills and knowledge to operate in the new market economy. The authors argue that knowledge is crucial for the farms to survive and succeed:

> The importance of access to and control over knowledge is highlighted by the key role that former agro-technicians play within the more dynamic farms. Their networks, largely rooted in the knowledge networks of the Soviet past, have proved important for adapting production systems to the new situation. Access to and control over knowledge and the circulation of knowledge in wider networks appears to be more significant than the amount of land and machinery in ensuring the success or survival of the new farming arrangements. (pp. 373-374)

Thus, agrarian universities in Kazakhstan have a particularly important role as knowledge accumulation institutions that restore and renew the lost agricultural knowledge. They are heavily adopting foreign knowledge to fill the knowledge gap and transfer it further to the farms.

However, in this study, not all university faculty agree with the direction outlined in the strategic documents that universities should focus on transfer of foreign knowledge and technology. Some faculty members believe that they have capacity to generate new knowledge and develop their own technology. Those faculty members tend to be older academics trained in the Soviet period, and they have more experience in research, have more publications and patents, and hold higher academic positions. This is not consistent with the findings of a study which explored work experiences and knowledge transfer among Korean academics considering generational differences. The study found that unlike older generations, younger academics use "a wider variety of knowledge-transfer channels, such as journal publications, research collaboration with heterogeneous actors and patent applications" (Lee & Jung, 2018, p. 1654). This implies that in agrarian universities in Kazakhstan older generation of academics are more inclined to generate local knowledge and technology, whereas younger generations tend to favor transfer of foreign knowledge and technology. This might be explained by the trend that younger academics are more global in their outlook, and they are looking internationally for quick answers. In contrast older academics, who received education during Soviet period, have more knowledge and experience in research, and tend to have more connections with local industry, and hence, know the local industry needs better.

The strategic documents of both universities represent that to successfully transfer knowledge and technology to the agricultural industry, in the first place, universities should be reformed and transformed into research universities. They should develop capacity to absorb knowledge and technology from foreign universities and companies to adapt these knowledge and technology to the local environment and transfer them to the local industry. This is peculiar to the higher education system in post-Soviet countries, as universities are transitioning from being solely teaching ones to the ones that do research as well. Therefore, both agrarian

universities have approved the *Development Programs for 2020-2024*, where they refer to the international experience of universities being transformed into "research" universities. This approach is aligned with the experience of research universities around the world that are successful in generating new knowledge and technology. Altbach (2013) explains the increasing focus of national agenda of developing countries on research universities,

> Research universities in developing countries are situated at the top of an academic and intellectual hierarchy and are central to the success of any modern knowledge-based economy. All developing countries need these institutions to participate in the globalized environment of higher education. Thus, understanding the characteristics of the research university and building the infrastructures and the intellectual environment needed for successful research universities is a top priority (p. 329).

In fact, "research" and "international/foreign" are among the most frequent words in the strategic documents of both universities. Rizvi and Lingard (2009) believe that "policy texts are located within and framed by broader discourses, more comprehensive ways of conceptualizing the world" (p. 8). This implies that that the university policy documents analyzed within this study, reflect the global discourse and national agenda that increasingly focus on research universities. Moreover, Rizvi and Lingard (2009) argue that "Policies involve the authoritative allocation of values. Most frequently, policies are designed to steer actions and behavior, to guide institutions and professionals in a certain direction" (p. 8). Thus, the strategic documents not only view research universities as important, but they also have a detailed plan of steps to be taken to transform both universities into research universities.

However, it is evident from the documents and interviews that agrarian universities have not yet embraced the phenomena as academic capitalism and academic entrepreneurship. As the country did not have a chance to experience neoliberal capitalism and knowledge economy, it seems too early to look for the rise of academic capitalism and academic entrepreneurship in Kazakhstan. The universities are in the transitioning period to research universities, whereas becoming entrepreneurial universities is the next phase of the development. The good news is that universities in other post-Soviet countries are increasingly playing a key role in fostering entrepreneurship through "human capital development, cultivating a positive attitude towards entrepreneurship, affecting the perceptions of the knowledge and skills needed to start up a successful business, and knowledge spillovers" (Korostelova & Belitski, 2015, p. 439). This implies that universities in Kazakhstan also have a potential in fostering entrepreneurship and becoming entrepreneurial.

5.4 Formal versus Informal Channels of KTT

The finding on the channels of KTT align with the conceptual framework adopted in this study. The conceptual framework is based on the technology transfer ecosystem and the dynamic model of KTT where formal and informal channels of KTT complement each other. Technology transfer ecosystems are being created at both universities that enable active use of formal and informal channels of KTT among university faculty. Technology transfer ecosystems include research institutes and centers, science and techno parks, incubators, and TTOs. The findings on the use of formal channels of KTT at both universities partly supports the findings of a study conducted to explore the channels of knowledge transfer at Australian universities by Dang et al., (2019). According to the study, contract-based research and commercialization, research centers, and incubators are the formal knowledge transfer channels that are used at Australian Universities. The study revealed that in Australia research centers and incubators have been recently established and have become the most common channels for knowledge transfer. Research centers are used as formal channels in one-way or two-way transfer of knowledge, by disseminating research results to the industry or conducting collaborative research with the industry. As for incubators, their goal is to provide funding opportunities, consultation, and professional support for start-ups (Dang et al., 2019). The findings from Australian Universities are partly reflected in the practices of both Northern and Southern Universities as both have recently established research centers and incubators.

There are nine research centers at Northern University and seven research institutes and two innovation centers at Southern University. As both universities started their transformation into research universities, many public research institutes and centers were given to the universities' management. For example, research centers that were under the National Agrarian Research and Education Center are now part of Northern University. These research centers are employed as formal channels for knowledge transfer, disseminating knowledge and research results, such as selection and breeding achievements, through the extension programs (KATU, 2020). Northern University also has established a student business-incubator in 2021, where students and young researchers can get financial support and consultation for their projects (KATU, 2020). At Southern University, fundamental and applied research is conducted by seven research institutes and 31 research laboratories at university schools. In terms of the commercialization of research results, the university implements a few projects financed by the Center for Technology Commercialization of the Ministry of Education and Science. The university has established research and education centers and Agrarian Research and Technological Park (AgroTechnoPark) where research results are disseminated and transferred to the industry. AgroTechnoPark includes construction bureaus, experimental polygons, a

business center, a business incubator, and a center for student initiatives (KNAU, 2020b). Although the interview findings from both universities revealed that most university faculty are involved in research projects and most have obtained patents, there is no evidence that incubators are a commonly used channel for knowledge transfer by universities.

The finding that patenting are common among the faculty of both Northern and Southern University is consistent with the findings of the study of academic patenting at Korean Universities by Lee (2019). For example, in South Korea, academic patenting is highly prioritized as a technology transfer channel as more codified knowledge means more of a stock of knowledge as capital. Patents are common among the faculty "to gain good evaluations of research performance rather than to activate technology transfer" (Yun et al., 2007, as cited in Lee, 2019, p. 2011). In other words, academic patenting is viewed firstly as a criterion for tenure and career promotion, not as a channel to transfer knowledge and technology. The findings from interviews with university faculty show that most of the obtained patents are not commercialized further by licensing or startups.

In terms of contract research, licensing, academic spinoffs and startups are not so commonly used at both universities, which is aligned with the findings of previous studies (Dang et al., 2019; Hayter, Rasmussen, & Rooksby, 2020). They found that formal channels such as patenting, licensing, and spin-offs were much less used than informal ones. Moreover, formal channels are more associated with capitalism which is less developed in Kazakhstan. However, in terms of contract research, faculty at Southern University tend to be more engaged in contract research than faculty at Northern University. This might be due to the geographic proximity of firms as there are more firms in the region where Southern University is located. This is aligned with the findings of a study in Belgium, which revealed that close location of universities and firms is more likely to lead to contract research (Spithoven et al., 2019).

The findings that at both Northern and Southern Universities, informal channels of KTT are more actively used than formal channels are consistent with the literature on formal and informal channels of KTT (Bradley, Hayter & Link, 2013; Hayter, Rasmussen, & Rooksby, 2020; Lee, 2019; Shaeffer et., 2018). On the one hand, informal channels of knowledge transfer are more common and effective because there are simply more informal channels of knowledge transfer than formal ones (Hayter, Rasmussen, & Rooksby, 2020). There is more implicit/tacit knowledge than codified/explicit knowledge, therefore informal channels are more common than formal ones. There is a formal requirement for university faculty and researchers to have publications in high-ranking international journals to be promoted to higher academic positions (OECD, 2017). Moreover, there is a culture of sharing when knowledge is considered as a public good that explains the prevalence of informal channels compared to the formal ones in

both agrarian universities. Historically, prior to the Soviet era, knowledge was viewed as a common good, most knowledge was tacit and transmitted from a generation to a generation orally. During the Soviet period, knowledge was also considered as a public good, but it was transmitted as written and codified as well as in oral and tacit form.

Previous research shows that informal channels are more effective for knowledge transfer. Bradley, Hayter & Link (2013) argue that the traditional view on KTT focuses on academic patenting as the main formal channel, whereas informal channels are more important in the process. Similarly, the OECD (2017) argues that "the prominence of bibliometric indicators in individual staff evaluation at the expense of other criteria such as partnerships with industry or consultancy services, result in researchers overlooking these knowledge transfer activities which are dearly missing in Kazakhstan" (p. 23). Lee (2019) believes that prioritizing commercialization is not an effective way of knowledge transfer. That is, focusing on only research commercialization, including academic patenting as a channel of KTT is not an effective approach. Lee (2019) found that compared to academic patenting, "academic article publication activity is positively related to research collaboration with researchers in industry or public research institutes" (p. 2007). In other words, compared to obtaining patents, publishing research results in academic journals is more effective in facilitating communication and networking with other researchers.

Formal and informal channels are interconnected and complement each other as formal channels might lead to using informal channels and vice versa. Shaeffer et al. (2018) conducted a qualitative longitudinal study of the use of knowledge transfer channels by university faculty in the fields of pharmacy and robotics. They explain,

> On the one hand, informal links tend to facilitate the development of formal interactions such as research contracts or start-up creation. On the other hand, formal relationships also contribute to increasing researchers' informal social networks which, in turn, might lead to further future collaborations (Shaeffer et., 2018, p. 18).

This is partly supported by the findings from Northern and Southern Universities, as university faculty are engaged in more informal transfer of knowledge and technology to the agrarian industry. For example, through training, seminars, conferences, university faculty establish informal networking links with entrepreneurs, farmers, and other agrarian industry stakeholders. As a result of these informal networking entrepreneurs or farmers approach university faculty for formal university-industry collaboration, which might sometimes lead to research contracts, collaborative research or creating start-up

firms. This implies that university should promote both formal and informal channels of knowledge transfer as they are interconnected and important for successful transfer.

5.5 Facilitating and Inhibiting Factors for University-Industry KTT

According to the conceptual framework of this study, there are facilitating and inhibiting factors at the individual, organizational and system level. At the individual level, personal networking and collaboration with industry were the most frequently mentioned facilitating factor at both universities. University-industry networking and collaboration is mentioned in previous research on factors influencing the process of KTT (Dahlborg et al., 2017; Daniel & Alves, 2020; Ho et al., 2014; Min et al., 2019; Teixeira et al., 2019; Thomas & Paul, 2019; Ye et al., 2019). These studies revealed that networking and cooperation with industry is an important factor for universities to successfully transfer their knowledge and technologies. Thomas and Paul (2019) explain that communication between university and industry builds social capital such as connections, trust, and shared goals, which in turn enable effective knowledge transfer. In case of both universities, it seems that those faculty members who have strong personal networking ties with the industry are more successful in knowledge production and transfer to the industry. However, it should be noted that most of the collaboration resulted from the personal connections and networking rather than from the formal university-industry partnerships. A possible explanation is that, except for grains and eggs, most of the agricultural products, such as vegetables, meat and dairy products are produced by individual farms and small households (ADB, 2018). This suggests that there are more informal contacts between the farmers and university faculty in terms of knowledge sharing. This suggests that university administration should focus on building university-industry partnerships that enable personal networking of university faculty and researchers with the industry.

The next most important factor mentioned at Northern University was support from university administration, which is the factor that belong to the organizational level. This is consistent with the OECD (2017) findings that state:

> Universities have introduced incentives for their staff to engage more actively in research and, this way, initiate a virtuous circle of investment and successful applications in competitive funding schemes. The first type of incentives introduced consisted of potential salary increases and top-up related to successful applications (p. 23).

This is explained by the findings of a study by Huyghe and Knockaert (2015) on how university faculty at German and Swedish universities perceive the influence of university culture on their entrepreneurial intentions. They found that “the more universities emphasize

academic entrepreneurship in their mission compared to research and teaching, the greater research scientists' intentions to engage in spin-off creation and intellectual property rights" (Huyghe & Knockaert, 2015, p. 154). This implies that support from university administration is important for building a culture of entrepreneurship and creativity at the university that enable university faculty to engage in research commercialization and transfer of knowledge and technology. Creating an entrepreneurial culture is particularly important for universities in Kazakhstan because cultures of creativity and entrepreneurship is underdeveloped in the society. Unlike Northern University, support from university administration was the least frequently mentioned factor at Southern University. This suggests that Southern University has more favorable conditions as there are more innovation centers, more doctoral students, more faculty with doctoral degrees, and more funding from non-state sources compared to Northern University.

One of the most frequently mentioned inhibiting factor was inadequate funding. This factor is related to the problems at the system level such as inadequate implementation of regulations and support measures, corruption, market inefficiencies, underdeveloped entrepreneurial environment, etc. (OECD, 2017a; OECD, 2018). Both universities have great aspirations to transform into research universities, however, the strategic documents and faculty indicate that they have limited resources. Research universities need huge funding as they "are expensive institutions. They require more funding than other universities – to attract the best staff and students and to provide the infrastructure necessary for top research and teaching" (Altbach, 2013, p. 329). The problem of funding is acute in Kazakhstan as the government is the main source of funding for R&D (OECD, 2018). The documents and faculty of both universities identified that inadequate funding is inhibiting the process of knowledge production and transfer. This finding supports the findings of previous studies on the determining factors for university-industry KTT. Agricultural productivity is hindered due to a high level of depreciation of research and technological equipment, and a decrease in funding from the government budget (Government of Kazakhstan, 2021; Zhangirova, 2020). Alibekova et al. (2019) explored factors that inhibit university-industry collaboration and technology commercialization among universities in Kazakhstan. They found that the most significant inhibiting factor was lack of funding. This suggests that inadequate funding is a common problem for universities in Kazakhstan, as knowledge codification needs huge resources, such as funding and time. Similar studies conducted in foreign countries also support the significance of funding in all stages of knowledge production and transfer (Daniel & Alves, 2020; Ho et al., 2014; Jung et al., 2015; Muizniece, 2020).

Other most frequently mentioned inhibiting factors related to the lack of funding was lack of infrastructure/equipment to do research at Northern University, whereas it was inadequate support from the government at Southern University. These findings also support the findings of previous research (Jung et al., 2015; OECD, 2017; O'Reilly & Cunningham, 2017; Smirnova, 2016). To be competitive internationally, universities in Kazakhstan need significant investments "to upgrade and modernize research equipment and libraries" (OECD, 2017, p. 23). Jung et al. (2015) argue that lack of equipment and facility is one of the most significant factors that inhibit technology commercialization. O'Reilly and Cunningham (2017) studied factors that affect technology transfer from universities to the industry from the perspective of PIs from Irish Universities. They found that private companies did not have adequate funding for technological innovation that inhibited the process of technology transfer. They elaborate on it:

> With respect to financial constraints, several of the PIs commented on their SME research collaborators having issues throughout the technology transfer process in relation to financing. From their perspective the main difficulty financial constraints raised were reduced options in terms of work programmes for developing the technology, but more importantly the financial constraints regularly introduced risks into the projects (O'Reilly & Cunningham, 2017, p. 281-282).

Similarly, Smirnova (2016) examined barriers to knowledge transfer between universities and telecommunication companies in Kazakhstan. The study revealed that "the lack of fiscal incentives for the business sector to innovate is one of the main factors hindering university–industry interactions in Kazakhstan" (Smirnova, 2016, p. 708). Likewise, the OECD (2017) found that there is inadequate government support for innovation and entrepreneurship in Kazakhstan. As an emerging economy, there are market inefficiencies in Kazakhstan that requires government intervention. Innovation is particularly in need of government support as higher education institutions have insufficient R&D capabilities. Therefore, the government should incentivize private companies to innovate and collaborate with universities to transfer new knowledge and technologies to the industry (Smirnova, 2016).

5.6 Summary

This chapter discussed the research findings in relation to the research questions, the conceptual framework, and the empirical literature. In response to the overarching research question, which is concerned with the role of agrarian universities in KTT, the findings suggest that the two agrarian universities are important players in knowledge production and technology transfer in Kazakhstan. This is consistent with trends in the globalization of knowledge economy, where higher education is at the center of knowledge production and

transmission. However, we see that the model of knowledge economy is not fully fledged in Kazakhstan as its overall innovation performance is below for the level of economic development. This is a demonstration of two phenomena which is globalization and glocalization. On the one hand, there is a process of global homogenization when global discourses are increasingly aligned with national agenda and institutional policies. On the other hand, these global discourses and policies interact with local cultures that lead to social acceptance with adaptation or rejection. In case of Kazakhstan, knowledge economy with academic capitalism and entrepreneurship is encountered with resistance as it contradicts the cultural values.

As for the purpose of KTT in agrarian universities, the dominant view among university faculty is transfer of foreign knowledge and technology which is further adapted to the needs of local industry. Thus, with foreign knowledge and technology the university aims to update its curriculum, modernize laboratories, and contribute to the innovative and technological development of the agrarian industry. To implement these objectives, the universities are being transformed into research universities. This would enable creation of technology transfer ecosystems for promoting active use of formal and informal channels of KTT among university faculty. In terms of factors, at the system level, funding is crucial for research universities to function and succeed in all stages of knowledge production and transmission. At the university level, university-industry collaboration is the most significant factor for effective transfer of knowledge and technology to the industry. Finally, at the individual level, personal connections and networking with the industry is the most important factor among university faculty for engaging in KTT.

CHAPTER 6. CONCLUSION

6.1 Introduction

This chapter presents a summary of the whole thesis by revisiting the aims of the thesis, the problem that motivated the study, restatement of the research question, the summary of research method and findings. Furthermore, implications for policy, practice and further research directions are also discussed. Finally, the significance and contribution of the study, and the limitations of the research are presented.

6.2 Summary of Research Problem, Aim and Research Questions

During the last two decades the government of Kazakhstan has been developing and implementing ambitious initiatives and policies to improve the national innovation system to be competitive in the global economy. However, national and international reports on innovation performance of Kazakhstan revealed low performance of research and innovation systems of the country, and inefficiency in terms of innovation inputs to outputs (WIPO, 2022; NIIP, 2019; OECD, 2017). International organizations and national governments of developed countries understand the importance of higher education and research in innovation and economic development of the regions and countries (OECD, 1996, 2008, 2010; World Bank, 1998). However, there are very few studies on the role of higher education and research in emerging and developing countries. Particularly, there is lack of research on the role of agrarian universities in improving agricultural innovation and productivity in Kazakhstan. The purpose of this study was to explore the role of agrarian universities in the process of KTT in Kazakhstan. The study aimed to examine the specific channels of KTT that were used in Kazakhstan. The study also aimed to investigate challenges that universities faced during the process of KTT and practices that facilitated the process.

The central research question that this study addresses is: What is the role of universities in the process of agricultural knowledge development and technology transfer in Kazakhstan?

The exploration of this question was guided by three sub-questions.

Guiding Question 1: How do universities understand the purpose of knowledge and technology transfer in Kazakhstan?

Guiding Question 2: What are the specific mechanisms, channels and pathways of university-industry knowledge and technology transfer in Kazakhstan?

Guiding Question 3: What are the inhibiting and facilitating factors for university-industry knowledge and technology transfer in Kazakhstan?

6.3 Summary of Research Methods

To answer the research questions, a multiple case study design was implemented, with each university considered as an individual case. Based on the four criteria, the following two

universities were selected as the research sites: Northern University and Southern University. Both universities are the largest universities in their geographic regions, in the north and the south of the country, and operate as hubs for innovative agricultural research and technology in their regions. Both universities were established during the Soviet period, and both are undergoing a transformation into a research university. Document analysis and individual semi-structured interviews were conducted to collect data for this study. Using purposeful sampling as a sampling strategy, potential participants were sent invitations to participate in the study. From those invited potential participants, sixteen faculty members from both universities agreed to take part in the interviews. Ten of the 16 participants were female and six were male. There were almost equal number of male and female participants from Northern University, whereas female participants prevailed from Southern University. The participants from Southern University had higher academic qualifications and positions than the participants from Northern University. Within-case and cross-case thematic analysis was used to analyze data and answer the research questions.

6.4 Summary of Findings

A comprehensive model of KTT in agrarian universities in Kazakhstan was developed and presented to capture the findings generated by this study. The model identifies key actors and products in the process of KTT. The key actors are foreign agrarian universities, local agrarian universities, and the agricultural industry. Kazakh agrarian universities have become the treasurers of agricultural knowledge, restoring and accumulating knowledge lost after the collapse of the Soviet regime. At the same time, Kazakh agrarian universities are trying to modernize the agrarian knowledge by adopting foreign knowledge and technology. Foreign universities offer advanced higher education knowledge and technology knowledge that local universities adopt and adapt for higher education and research, and for agricultural industry. The findings suggest that the management at both universities understand KTT as transfer of foreign knowledge and technology that is adapted to the local conditions and transferred further to the industry. With foreign knowledge and technology, the university aims to update its curriculum, modernize laboratories, and contribute to the innovative and technological development of the agrarian industry.

To implement the objectives and as a response to the challenges raised by neoliberal globalization and knowledge economy, the universities are being transformed into research universities. This would enhance knowledge production and enable creation of knowledge and technology transfer ecosystems for promoting active use of formal and informal channels of KTT among university faculty. However, university faculty are more involved in informal channels of KTT than formal channels. The prevalence of informal channels can be explained by

the cultural aspects such as collectivism, lack of entrepreneurship among academics and viewing knowledge as a public good. Main channels of formal KTT at both universities are patents and consultations.

In terms of factors, at the system level, funding is crucial for research universities to function and succeed in all stages of knowledge production and transmission. At the university level, university-industry collaboration is the most significant factor for effective transfer of knowledge and technology to the industry. Other most frequently mentioned inhibiting factors related to the lack of funding was lack of infrastructure/equipment to do research at Northern University, whereas it was inadequate support from the government at Southern University. Finally, at the individual level, personal connections and networking with the industry is the most important factor among university faculty for engaging in KTT.

6.5 Implications for Policy

The comprehensive model of KTT in agrarian universities in Kazakhstan has important implications for policy. According to the model, KTT in agrarian universities is a complex process that involves two stages: international KTT and university-industry KTT. In this process collaboration and partnership of local agrarian universities with foreign agrarian universities and local agricultural industry is the key to successful KTT. This implies that the local agrarian universities should seek to establish ties with the advanced foreign agrarian universities to learn their best policies and practices. To successfully transfer knowledge and technologies, universities should also promote collaboration with agricultural industry, farmers and entrepreneurs at the university and the faculty levels.

The findings revealed that lack of funding is the most important inhibiting factor for KTT. This implies that the government should implement policies that give more autonomy to universities to attract investment from industry, private companies, venture capitalists and philanthropy. In their turn, universities should also take initiatives to seek new funding opportunities from non-government sources (Proof of Concept Centers, venture funds, seed funds, crowdfunding, etc.). Universities should develop and promote their unique organizational identities to play a role in the market. Some participants mentioned that there were not enough research grants. This suggests that more grants for research projects are needed, both from national government and international organizations.

Universities can also attract private sector to finance research projects that might be interesting and profitable for the companies. It is important to consider the interests and demands of the private sector so that the companies can absorb new knowledge and technology. In addition, to enhance innovative development of the industry, the government can introduce fiscal incentives for the companies that collaborate with universities in research and development.

6.6 Implications for Practice

The most important enabling factor mentioned by interview participants was personal connections and collaboration with industry. This suggests that university administration should pay more attention to informal communication between university researchers and companies rather than establishing formal partnerships that do not entail close interaction. Most of the participants interviewed tend to prefer collaborating with local enterprises and farms rather than multi-national corporations. This implies that university partnerships with local enterprises and farms should be promoted and strengthened. There should be a shared medium of communication where companies can explore research projects implemented by university researchers and discuss opportunities for collaboration with them. The university management can organize various events and seminars where representatives from local enterprises and farms are invited. This would give opportunity for university faculty to network and build ties with the industry.

As the process of KTT requires constant communication between the transferor and transferee, channels of transfer are important in the process. The university administration should support informal channels that involve face-to-face communication and interaction such as field days, “open door” days, seminars, and training to transfer tacit knowledge. Moreover, the universities should explore and promote new, alternative channels of KTT such as mobility of researchers, joint laboratories, joint publications and conferences between universities and industry, informal contact within professional networks.

The university should provide various organizational support and financial incentives for university faculty and students to engage in KTT. Some participants mentioned that they needed support from university when they were applying for research grants. This implies that university should organize special seminars or trainings where experienced researchers share their experiences and train younger researchers and students how to apply for research grants. At the project implementation stage, university researchers also have difficulties such as lack of equipment to do research. The university administration should assist researchers to purchase equipment or help to find research institutes that give permission to use their equipment.

Organizational culture and climate are also important in the process of knowledge generation and transfer. The values such as ethical research, creativity, social responsibility, knowledge sharing should be promoted among university faculty and students. Historical, political, and socio-economic context of Kazakhstan shows that there is lack of entrepreneurship among university faculty. Therefore, innovative and entrepreneurial culture should be activated by incorporating innovation and entrepreneurship into the curriculum. Various events, such as tech-day workshops, business plan marathons, and start-up fairs should be organized where

university researchers and students can socialize and network with industry experts and investors. Alumni should also be engaged in these events to broaden the university network.

6.7 Further Research Directions

The study has several limitations that suggest areas for further research directions. First, as the study was focused on KTT from agrarian universities to agricultural industry, it might be difficult to transfer the findings to other universities. This implies that more research is needed on KTT between other universities and industries.

Second, this study represents the perspectives of the universities only through strategic documents and faculty interviews. The perspectives of the university leadership were not available, nor were the perspectives of other stakeholders (the government, industry, investors) in the process of KTT. More research should be conducted that explores the factors that other stakeholders believe are important in the process.

Third, this study explored the factors that influence the process of KTT at multiple levels (the system, organizational and individual). Further studies are needed to examine the factors at each level in more depth. For example, at the system level, lack of funding was the most important factor. This suggests that further research should be conducted on the funding opportunities from private and other non-governmental sources. Moreover, other factors that might be important in different national and institutional contexts should be explored. Cultural preconditions, political, and socio-economic factors that might be significant barriers in the KTT can be also examined.

Finally, further research is needed to examine in more depth the use of formal and informal channels of KTT among university faculty. Future studies can explore individual and institutional factors that affect the preference of certain channels and practices.

6.8 Contribution to Knowledge

This study has contributed to the development of knowledge in higher education and research. As there is gap in knowledge on university-industry KTT in Kazakhstan and Central Asia, the study will contribute to the national and international literature. The findings of the study can be helpful for government policymakers, university management, individual researchers, entrepreneurs and other stakeholders. By developing an understanding of how universities perceive their role and their existing processes for supporting KTT, the study contributed to new knowledge and recommendations to improve the process of university-industry KTT.

The study contributes to the theory by developing a comprehensive model of KTT in agrarian universities in Kazakhstan based on the findings. The model suggests that KTT in agrarian universities in Kazakhstan has two key stages, namely, international KTT and

university-industry KTT. Local agrarian universities act as intermediaries between foreign universities and local agricultural industry. The findings suggest that the two agrarian universities are important players in knowledge production and technology transfer in Kazakhstan. As for the purpose of KTT in agrarian universities, the dominant view among university faculty is transfer of foreign knowledge and technology which is further adapted to the needs of local industry. Thus, with foreign knowledge and technology the university aims to update its curriculum, modernize laboratories, and contribute to the innovative and technological development of the agrarian industry.

In terms of factors, at the system level, funding is crucial for research universities to function and succeed in all stages of knowledge production and transmission. Moreover, cultural preconditions, political and socio-economic factors are also important. At the university level, university-industry collaboration is the most significant factor for effective transfer of knowledge and technology to the industry. Finally, at the individual level, personal connections and networking with the industry is the most important factor among university faculty for engaging in KTT.

6.9 Limitations of the Research

There are several limitations in this study. Due to the specific focus on the industry, it might be difficult to transfer the findings of this study to other sectors of industry. However, the findings can be transferable to agrarian universities in Central Asia and other similar contexts. Another limitation is the number of participants. As this study is qualitative, the number of participants is smaller compared to quantitative studies. However, the qualitative design provides an opportunity to explore the experiences and perspectives of participants in more depth.

One more limitation is that this study is focused on exploring the role of universities in technology transfer from the perspective of university stakeholders (management and faculty), excluding other stakeholders in the process from the government, industry, and business. It is possible that conducting interviews with these individuals might bias my data by over-emphasizing the significance of universities in the process of KTT. However, I believe it is important to interview university faculty as they play key roles in the process.

6.10 Conclusion

This chapter presented the summary of the aim of the thesis, the problem that motivated the study, restatement of research question, the summary of research method and findings. The purpose of this study was to explore the role of agrarian universities in the process of KTT in Kazakhstan. The study aimed to examine the specific channels of KTT that were used in Kazakhstan. The study also aimed to investigate challenges that universities faced during the process of KTT and practices that facilitated the process. To achieve the purpose of the study, a

multiple case study design was implemented, with each university considered as an individual case. The following two universities were selected as the research sites: Northern University and Southern University. Furthermore, implications for policy, practice and further research directions were also presented. Finally, contribution of the study to knowledge, and limitations of the research were discussed. Acknowledging that the study has limitations, it has a potential contribution to existing and new knowledge in higher education and research.

REFERENCES

Aggarwal, V., & Kapoor, M. (2018). Innovation growth from knowledge transfer in international strategic alliances. *Journal of Strategy and Management*, *11*(4), 483-496.

Ahmad, N., Lodhi, M. S., Zaman, K., & Naseem, I. (2017). Knowledge management: A gateway for organizational performance. *Journal of the Knowledge Economy*, 8(3), 859-876.

Ahn, E.S., Dixon, J., & Chekmareva, L. (2018). Looking at Kazakhstan's Higher Education Landscape: From Transition to Transformation Between 1920 and 2015. In J., Huisman, A. Smolentseva, & I. Froumin, (Eds.). *25 Years of Transformations of Higher Education Systems in Post-Soviet Countries (pp. 199-227).* Palgrave Studies in Global Higher Education. Palgrave Macmillan, Cham.

Albahari, A., Klofsten, M., & Rubio-Romero, J. C. (2019). Science and technology parks: A study of value creation for park tenants. *The Journal of Technology Transfer*, 44(4), 1256-1272.

Alibekova, G., Tleppayev, A., Medeni, T. D., & Ruzanov, R. (2019). Determinants of technology commercialization ecosystem for universities in Kazakhstan. *The Journal of Asian Finance, Economics and Business*, 6(4), 271-279.

Altbach, Ph. (2013). Advancing the national and global knowledge economy: the role of research universities in developing countries. *Studies in Higher Education, 38*(3), 316-330.

Asian Development Bank. (2018). *Kazakhstan: Accelerating Economic Diversification.* *https://dx.doi.org/10.22617/TCS189413-2*

Audretsch, D. (2014). From the entrepreneurial university to the university for the entrepreneurial society. *Journal of Technology Transfer*, 39, 313–321.

Autio, E., Kenney, M., Mustar, P., Siegel, D., & Wright, M. (2014). Entrepreneurial innovation: The importance of context. *Research Policy*, *43*(7), 1097–1108.

Aytuganov, K. (2022). A research university is a university that has a strong industrial base. *Kazakhstanskaya Pravda*, *121*, p. 1-4.

Baxter, P., & Jack, S. (2008). Qualitative case study methodology: Study design and implementation for novice researchers. *The Qualitative Report, 13*(4), 544-559.

Belitski, M., Aginskaja, A., & Marozau, R. (2019). Commercializing university research in transition economies: Technology transfer offices or direct industrial funding? *Research Policy, 48*(3), 601-615.

Beyhan, B., Findik, D. (2018). Student and graduate entrepreneurship: ambidextrous universities create more nascent entrepreneurs. *The Journal of Technology Transfer,* 43, 1346–1374.

Bolesta, A. (2022). From socialism to capitalism with communist characteristics: the building of a post-socialist developmental state in Central Asia. *Post-Communist Economies, 34*(1), 71-98.

Bowen, G. A. (2009). Document analysis as a qualitative research method. *Qualitative Research Journal, 9*(2), 27-40.

Bradley, S., Hayter, C., & Link, A. (2013). Models and methods of university technology transfer. *Foundations and Trends in Entrepreneurship, 9*(6), 571-650.

Bramwell, A., & Wolfe, D. (2008). Universities and regional economic development: The entrepreneurial University of Waterloo. *Research Policy, 37*, 1175–1187.

Brescia, F., Colombo, G., & Landoni, P. (2016). Organizational structures of Knowledge Transfer Offices: an analysis of the world's top-ranked universities. *The Journal of Technology Transfer*, 41(1), 132-151.

Breznitz, S. M., Clayton, P. A., Defazio, D., & Isett, K. R. (2018). Have you been served? The impact of university entrepreneurial support on start-ups' network formation. *The Journal of Technology Transfer*, 43(2), 343-367.

Brown, J. R. (1998). Culture, Chaos and Capitalism: Privatization in Kazakhstan. *University of Pennsylvania Journal of International Economic Law, 19*(4), 909-964.

Brown, Ph., Lauder, H. & Ashton, D. (2008). Education, Globalisation and the Future of the Knowledge Economy. *European Educational Research Journal*, 7(2), 131-156.

Bureau of National Statistics. (2023). Key Indicators of Labor Market for 2022. https://stat.gov.kz/ru/industries/labor-and-income/stat-empt-unempl/spreadsheets/

Cameron, S. (2016). The Kazakh Famine of 1930-33: Current research and new directions. *East/West: Journal of Ukrainian Studies, 3*(2), 117-132.

Cameron, S. (2018). *The Hungry Steppe: Famine, Violence, and the Making of Soviet Kazakhstan*. Cornell University Press.

Calcagnini, G., Favaretto, I., Giombini, G., Perugini, F., & Rombaldoni, R. (2016). The role of universities in the location of innovative start-ups. *The Journal of Technology Transfer*, 41(4), 670-693.

Cantwell, B., & Kauppinen, I. (Eds.) (2014). *Academic capitalism in the age of globalization*. Johns Hopkins University Press.

Chatterjee, D., Leisyte, L., Dasappa, S., & Sankaran, B. (2018). University research commercialization in emerging economies: a glimpse into the 'black box'. *Science and Public Policy*, 45(3), 361-372.

Cheng, E. C. (2020). Knowledge transfer strategies and practices for higher education institutions. *VINE Journal of Information and Knowledge Management Systems*, 51(2), 288-301.

Clark, B. (1998). The entrepreneurial university: Demand and response. *Tertiary Education and Management, 4*(1), 5-16.

Clark, B. (1998). *Creating entrepreneurial universities: Organizational pathways of transformation*. Elsevier.

Clark, B. (2004). Delineating the character of the entrepreneurial university. *Higher Education Policy, 17,* 355–370.

Cohen, L., Manion, L., & Morrison, K. (2009). *Research methods in education*. Routledge.

Cornell University, INSEAD, & WIPO. (2019). *The Global Innovation Index 2019: Creating Healthy Lives—The Future of Medical Innovation*. Ithaca, Fontainebleau, and Geneva.

Creswell, J. (2013). *Qualitative inquiry and research design: Choosing among five approaches* (3rd ed.). Sage.

Creswell, J. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches* (4rd ed.). Sage.

Criaco, G., Minola, T., Migliorini, P., & Serarols-Tarrés, C. (2014). "To have and have not": Founders' human capital and university start-up survival. *The Journal of Technology Transfer*, 39(4), 567-593.

Cunningham, J., Menter, M., & Young, C. (2017). A review of qualitative case methods trends and themes used in technology transfer research. *The Journal of Technology Transfer*, 42, 923–956.

Cunningham, J.A., Lehmann, E.E., Menter, M. & Seitz, N. (2019). The impact of university focused technology transfer policies on regional innovation and entrepreneurship. The *Journal of Technology Transfer*, 44, 1451–1475.

Dahlborg, C., Lewensohn, D., Danell, R., & Sundberg, C. J. (2017). To invent and let others innovate: A framework of academic patent transfer modes. *The Journal of Technology Transfer*, 42(3), 538-563.

Dang, Q. T., Jasovska, P., Rammal, H. G., & Schlenker, K. (2019). Formal-informal channels of university-industry knowledge transfer: The case of Australian business schools. *Knowledge Management Research & Practice*, 17(4), 384-395.

Daniel, A., & Alves, L. (2020). University-industry technology transfer: The commercialization of university's patents. *Knowledge Management Research & Practice*, 18(3), 276-296

De Moortel, K., & Crispeels, T. (2018). International university-university technology transfer: Strategic management framework. *Technological Forecasting and Social Change*, 135, 145-155.

Encyclopedia Britannica, n.d. Property. In Britannica.com dictionary. Retrieved June 12, 2023 from https://www.britannica.com/topic/Soviet-law/Property

Etzkowitz, H. (2008). *The Triple Helix: University-Industry-Government Innovation in Action*. Routledge.

Etzkowitz, H., & Leydesdorff, L. (2000). The dynamics of innovation: from National Systems and ‘‘Mode 2’’ to a Triple Helix of university–industry–government relations. *Research Policy, 29*, 109-123.

Etzkowitz, H., Webster, A., Gebhardt, Ch., & Terra, B. (2000). The future of the university and the university of the future: Evolution of ivory tower to entrepreneurial paradigm. *Research Policy, 29*, 313-330.

Etzkowitz, H., Ranga, M., Benner, M., Guaranys, L., Maculan, A. M., & Kneller, R. (2008). Pathways to the entrepreneurial university: Towards a global convergence. *Science and Public Policy, 35*(9), 681-695.

European Commission. (2017). *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: A renewed EU agenda for higher education*. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52017DC0247

European Commission. (n.d.). Horizon Europe. In ec.europa.eu. Retrieved in June 12, 2023 from https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe_en

Ferretti, M., Ferri, S., Fiorentino, R., Parmentola, A., & Sapio, A. (2020). What drives the growth of academic spin-offs? Matching academics, universities, and non-research organizations. *International Entrepreneurship and Management Journal*, 16(1), 137-163.

Fisch, C. O., Hassel, T. M., Sandner, P. G., & Block, J. H. (2015). University patenting: A comparison of 300 leading universities worldwide. *The Journal of Technology Transfer, 40*(2), 318-345.

Fitzgerald, C., & Cunningham, J. A. (2016). Inside the university technology transfer office: Mission statement analysis. *The Journal of Technology Transfer*, 41(5), 1235-1246.

François, V., & Philippart, P. (2019). A university spin-off launch failure: Explanation by the legitimation process. *The Journal of Technology Transfer*, 44(4), 1188-1215.

Gerbin, A., & Drnovsek, M. (2016). Determinants and public policy implications of academic-industry knowledge transfer in life sciences: A review and a conceptual framework. *The Journal of Technology Transfer*, 41(5), 979-1076.

Given, L. M. (Ed.). (2008). *The Sage encyclopedia of qualitative research methods*. Sage Publications.

Goel, R. K., & Göktepe-Hultén, D. (2018). What drives academic patentees to bypass TTOs? Evidence from a large public research organisation. *The Journal of Technology Transfer,* 43(1), 240-258.

Goethner, M., Wyrwich, M. (2020). Cross-faculty proximity and academic entrepreneurship: the role of business schools. *The Journal of Technology Transfer,* 45, 1016–1062.

Good, M., Knockaert, M., Soppe, B., & Wright, M. (2019). The technology transfer ecosystem in academia. An organizational design perspective. *Technovation, 82-83, 35-50.*

Good, M., Knockaert, M., & Soppe, B. (2020). A typology of technology transfer ecosystems: how structure affects interactions at the science–market divide. *The Journal of Technology Transfer, 45(5), 1405-1431*.

Government of Kazakhstan. (2012). *The Concept of Innovation Development of the Republic of Kazakhstan until 2020.* 30 July 2012, No. 990.

Government of Kazakhstan. (2016). *State Program on the Development of Education and Science in the Republic of Kazakhstan 2016-2019*. 1 March 2016, No. 205.

Government of Kazakhstan. (2018). *State Program of Agricultural Development for 2017-2021*. 12 July 2018, № 423.

Government of Kazakhstan. (2019). *State Program on the Development of Education and Science in the Republic of Kazakhstan 2020-2025*. 27 December 2019, № 988.

Government of Kazakhstan. (2021). *The Development Concept of Agricultural Industry for 2021-2030*. 30 December 2021, № 960.

Govind, M., & Küttim, M. (2017). International knowledge transfer from university to industry: A systematic literature review. *Research in Economics and Business: Central and Eastern Europe*, 8(2), 5-25.

Grimm, H. M., & Jaenicke, J. (2012). What drives patenting and commercialisation activity at East German universities? The role of new public policy, institutional environment and individual prior knowledge. *The Journal of Technology Transfer*, 37(4), 454-477.

Grimpe, C., & Fier, H. (2010). Informal university technology transfer: A comparison between the United States and Germany. *The Journal of Technology Transfer, 35*(6), 637–650.

Guba, E. G., & Lincoln, Y. S. (1989). *Fourth generation evaluation*. Sage.

Hayter, C. (2016). Constraining entrepreneurial development: A knowledge-based view of social networks among academic entrepreneurs. *Research Policy*, 45, 475–490.

Hayter, C., Fischer, B. & Rasmussen, E. (2022). Becoming an academic entrepreneur: how scientists develop an entrepreneurial identity. *Small Business Economics*, 59, 1469–1487. https://doi.org/10.1007/s11187-021-00585-3

Hayter, C., Lubynsky, R., & Maroulis, S. (2017). Who is the academic entrepreneur? The role of graduate students in the development of university spinoffs. *The Journal of Technology Transfer*, 42(6), 1237-1254. DOI: 10.1007/s10961-016-9470-y

Hayter, C., Nelson, A., Zayed, S., & O'Connor, A. (2018). Conceptualizing academic entrepreneurship ecosystems: A review, analysis and extension of the literature. *The Journal of Technology Transfer, 43*(4), 1039-1082. https://doi.org/10.1007/s10961-018-9657-5

Hayter, C., Rasmussen, E., & Rooksby, J. (2020). Beyond formal university technology transfer: Innovative pathways for knowledge exchange. *The Journal of Technology Transfer, 45(1), 1-8.* https://doi.org/10.1007/s10961-018-9677-1

Ho, M. H. C., Liu, J. S., Lu, W. M., & Huang, C. C. (2014). A new perspective to explore the technology transfer efficiencies in US universities. *The Journal of Technology Transfer*, 39(2), 247-275.

Hossinger, S. M., Chen, X., & Werner, A. (2020). Drivers, barriers and success factors of academic spin-offs: A systematic literature review. *Management Review Quarterly*, 70(1), 97-134.

Huyghe, A., & Knockaert, M. (2015). The influence of organizational culture and climate on entrepreneurial intentions among research scientists. *The Journal of Technology Transfer*, 40(1), 138-160.

Iqbal, A., Latif, F., Marimon, F., Sahibzada, U. F., & Hussain, S. (2019). From knowledge management to organizational performance: Modelling the mediating role of innovation and intellectual capital in higher education. *Journal of Enterprise Information Management, 32*(1), 36-59.

Jacob, M., Lundqvist, M., & Hellsmark, H. (2003). Entrepreneurial transformations in the Swedish University system: the case of Chalmers University of Technology. *Research Policy, 32*, 1555-1568.

Jessop, B. (2017). Varieties of academic capitalism and entrepreneurial universities: On past research and three thought experiments. *Higher Education, 73*, 853–870.

Jessop, B. (2018). On academic capitalism. *Critical Policy Studies, 12*(1), 104-109.

Jones, D., & Patton, D. (2018). An academic challenge to the entrepreneurial university: The spatial power of the 'Slow Swimming Club'. *Studies in Higher Education*, 45, 375-389.

Jung, H., & Kim, B. K. (2018). Determinant factors of university spin-off: the case of Korea. *The Journal of Technology Transfer*, 43(6), 1631-1646.

Jung, M., Lee, Y., & Lee, H. (2015). Classifying and prioritizing the success and failure factors of technology commercialization of public R&D in South Korea: Using classification tree analysis. *The Journal of Technology Transfer, 40*, 877–898.

Kazakh AgroTechnical University. (2020). *Development Program of Kazakh AgroTechnical University for 2020-2024*. https://kazatu.edu.kz/ru/pages/universitet/o-nas/videnie-missia-strategia

Kazakh National Agrarian University. (2019). *Development Strategy of Kazakh National Agrarian University until 2023*. https://www.kaznaru.edu.kz/page/strategiia/?link=damu_strategiiasy_453&lang=ru

Kirchberger, M. A., & Pohl, L. (2016). Technology commercialization: A literature review of success factors and antecedents across different contexts. *The Journal of Technology Transfer, 41*(5), 1077–1112.

Kirby, D. (2006). Creating entrepreneurial universities in the UK: Applying entrepreneurship theory to practice. *Journal of Technology Transfer, 31*, 599–603.

Kolb, C., & Wagner, M. (2018). How university spin-offs differ in composition and interaction: a qualitative approach. *The Journal of Technology Transfer*, 43(3), 734-759.

Korosteleva, J., & Belitski, M. (2017). Entrepreneurial dynamics and higher education institutions in the post-Communist world. Regional Studies, 51(3), 439-453.

Krauss, S. E. (2005). Research paradigms and meaning making: A primer. *The Qualitative Report, 10*(4), 758-770.

Lecluyse, L., Knockaert, M., & Spithoven, A. (2019). The contribution of science parks: A literature review and future research agenda. *The Journal of Technology Transfer*, 44(2), 559-595.

Lee, S. J. (2019). Academic entrepreneurship: Exploring the effects of academic patenting activity on publication and collaboration among heterogeneous researchers in South Korea. *The Journal of Technology Transfer*, 44(6), 1993-2013.

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. Sage.

Link, A. N., Siegel, D. S., & Bozeman, B. (2007). An empirical analysis of the propensity of academics to engage in informal university technology transfer. *Industrial and Corporate Change, 16*(4), 641–655.

Mathisen, M. T., & Rasmussen, E. (2019). The development, growth, and performance of university spin-offs: A critical review. *The Journal of Technology Transfer*, 44(6), 1891-1938.

Matt, M. & Schaeffer, V. (2018). Building Entrepreneurial Ecosystems Conducive to Student Entrepreneurship: New Challenges for Universities. *Journal of Innovation Economics & Management, 25*, 9-32.

M'chirgui, Z., Lamine, W., Mian, S., & Fayolle, A. (2018). University technology commercialization through new venture projects: An assessment of the French regional incubator program. *The Journal of Technology Transfer*, 43(5), 1142-1160.

Marginson, S. (2009). The knowledge economy and higher education: A system for regulating the value of knowledge. *Innovación Educativa*, 9(47), 63-71.

Marginson, S. (2010). Higher education in the global knowledge economy. *Procedia-Social and Behavioral Sciences*, 2(5), 6962-6980.

Martinelli, A., Meyer, M. & von Tunzelmann, N. (2008). Becoming an entrepreneurial university? A case study of knowledge exchange relationships and faculty attitudes in a medium-sized, research-oriented university. *Journal of Technology Transfer, 33*, 259–283.

Merriam, S. B. (1998). *Qualitative research and case study applications in education*. Jossey-Bass.

Meyer, M. (2006). Academic inventiveness and entrepreneurship: On the importance of start-up companies in commercializing academic patents. *The Journal of Technology Transfer*, 31(4), 501-510.

Min, J. W., Vonortas, N. S., & Kim, Y. (2019). Commercialization of transferred public technologies. *Technological Forecasting and Social Change*, 138, 10-20.

Miranda, F. J., Chamorro, A., & Rubio, S. (2018). Re-thinking university spin-off: A critical literature review and a research agenda. *The Journal of Technology Transfer*, 43(4), 1007-1038.

Moss, G., Kubacki, K., Hersh, M., & Gunn, R. O. D. (2007). Knowledge management in higher education: A comparison of individualistic and collectivist cultures. *European Journal of Education*, 42(3), 377-394.

Muizniece, L. (2021). University autonomy and commercialization of publicly funded research: The case of Latvia. *Journal of the Knowledge Economy*, 12(3), 1494-1516.

Munshaw, S., Lee, S. H., Phan, P. H., & Marr, K. A. (2019). The influence of human capital and perceived university support on patent applications of biomedical investigators. *The Journal of Technology Transfer*, 44(4), 1216-1235.

Mussagulova, A. (2021). Newly independent, path dependent: The impact of the Soviet past on innovation in post-Soviet states. *Asia Pacific Journal of Public Administration*, 43(2), 87-105.

National Academy of Science of the Republic of Kazakhstan. (2018). *National Report on Science*. https://nauka-nanrk.kz/ru/about/nac-doc.html

National Academy of Science of the Republic of Kazakhstan. (2019). *National Report on Science*. https://nauka-nanrk.kz/ru/about/nac-doc.html

Organisation for Economic Cooperation and Development. (1996). *The Knowledge-Based Economy*. https://one.oecd.org/document/OCDE/GD%2896%29102/En/pdf

Organisation for Economic Cooperation and Development. (2008). *Tertiary education for the knowledge society*. https://www.oecd-ilibrary.org/education/tertiary-education-for-the-knowledge-society_9789264046535-en

Organisation for Economic Cooperation and Development. (2010). *The OECD Innovation Strategy: Getting a Head Start on Tomorrow*.

Organisation for Economic Cooperation and Development. (2015). *Strengthening agricultural co-operatives in Kazakhstan*. https://www.oecd.org/global-relations/agricultural-co-operatives-in-kazakhstan.htm

Organisation for Economic Cooperation and Development. (2016). *Innovating Education and Educating for Innovation: The Power of Digital Technologies and Skills*. https://www.oecd-ilibrary.org/education/innovating-education-and-educating-for-innovation_9789264265097-en

Organisation for Economic Cooperation and Development. (2017a). *OECD Reviews of Innovation Policy: Kazakhstan 2017*. https://www.oecd.org/publications/oecd-reviews-of-innovation-policy-kazakhstan-2017-9789264270008-en.htm

Organisation for Economic Cooperation and Development. (2017b). *Reviews of National Policies for Education: Higher Education in Kazakhstan 2017*. https://www.oecd-ilibrary.org/education/higher-education-in-kazakhstan-2017_9789264268531-en

Organisation for Economic Cooperation and Development. (2018). *SME and Entrepreneurship Policy in Kazakhstan 2018*. OECD Studies on SMEs and Entrepreneurship. https://doi.org/10.1787/9789264301450-en

Organisation for Economic Cooperation and Development. (2019a). *Innovation, Productivity and Sustainability in Food and Agriculture: Main Findings from Country Reviews and Policy Lessons*. OECD Food and Agricultural Reviews. https://www.oecd.org/publications/innovation-productivity-and-sustainability-in-food-and-agriculture-c9c4ec1d-en.htm

Organisation for Economic Cooperation and Development. (2019b*). University-Industry Collaboration: New Evidence and Policy Options.* https://www.oecd.org/fr/innovation/university-industry-collaboration-e9c1e648-en.htm

Organisation for Economic Cooperation and Development. (2021). *Agricultural Policy Monitoring and Evaluation 2021: Addressing the Challenges Facing Food Systems.* https://www.oecd-ilibrary.org/agriculture-and-food/agricultural-policy-monitoring-and-evaluation-2021_2d810e01-en

Olssen, M., & Peters, M. A. (2005). Neoliberalism, higher education and the knowledge economy: From the free market to knowledge capitalism. *Journal of Education Policy*, 20(3), 313-345.

Pagani, R. N., Zammar, G., Kovaleski, J. L., & Resende, L. M. (2016). Technology transfer models: Typology and a generic model. *International Journal of Technology Transfer and Commercialisation*, 14(1), 20-41.

Pagani, R. N., Ramond, B., Da Silva, V. L., Zammar, G., & Kovaleski, J. L. (2020). Key factors in university-to-university knowledge and technology transfer on international student mobility. *Knowledge Management Research & Practice*, 18(4), 405-423.

Pandey, N., de Coninck, H., & Sagar, A. D. (2022). Beyond technology transfer: Innovation cooperation to advance sustainable development in developing countries. *Wiley Interdisciplinary Reviews: Energy and Environment, 11*(2), 1-25.

Peters, M. A. (2003). Classical political economy and the role of universities in the new knowledge economy. *Globalisation, Societies and Education*, 1(2), 153-168.

Peters, M. A. (2007). Higher education, globalisation and the knowledge economy: Reclaiming the cultural mission. *Ubiquity*, 8(18), 1-27.

Peters, M. A., & Humes, W. (Eds.). (2003). Education in the knowledge economy. *Policy Futures in Education, 1*(1), 1-19.

Petrides, L., & Nguyen, L. (2006) Knowledge management: Challenges and Opportunities for Education Institutions. In A. S. Metcalfe, (Ed.), *Knowledge Management and Higher Education: A Critical Analysis, Idea Group Publishing*, 21-33. http://dx.doi.org/10.4018/978-1-59140-509-2.ch002

Philpott, K., Dooley, L., O'Reilly, C., & Lupton, G. (2011). The entrepreneurial university: Examining the underlying academic tensions. *Technovation, 31*, 161–170.

Pugh, R., Lamine, W., Jack, S., & Hamilton, E. (2018). The entrepreneurial university and the region: What role for entrepreneurship departments? *European Planning Studies*, 26(9), 1835-1855. DOI: 10.1080/09654313.2018.1447551

Pusser, B., Kempner, K., Marginson, S., & Ordorika, I. (2012). *Universities and the public sphere*. Routledge.

Quarchioni, S., Paternostro, S., & Trovarelli, F. (2022). Knowledge management in higher education: A literature review and further research avenues. *Knowledge Management Research & Practice*, 20(2), 304-319.

Rizvi, F., & Lingard, B. (2009). Globalizing education policy. Routledge.

Schaeffer, V., Öcalan-Özel, S., & Pénin, J. (2018). The complementarities between formal and informal channels of university–industry knowledge transfer: a longitudinal approach. *The Journal of Technology Transfer, 45(1), 31-55.*

Schulte, P. (2004). The entrepreneurial university: a strategy for institutional development. *Higher Education in Europe, 29*(2), 187-191.

Scott, P. (2011). The university as a global institution. In R. King, S. Marginson, & R. Naidoo (Eds.), *Handbook on Globalization and Higher Education (pp. 59-76)*. Edward Elgar Publishing.

Scott, P. (2016). Higher education and the knowledge economy. In R. Barnett, P. Temple, & P. Scott (Eds.), *Valuing Higher Education: An Appreciation of the Work of Gareth Williams.* Trentham Books.

Scuotto, V., Del Giudice, M., Garcia-Perez, A., Orlando, B., & Ciampi, F. (2020). A spillover effect of entrepreneurial orientation on technological innovativeness: An outlook of universities and research based spin offs. *The Journal of Technology Transfer,* 45(6), 1634-1654.

Silova, I. (2004). Adopting the language of the new allies. In G. Stener-Khamsi (Ed). *The global politics of educational borrowing (pp. 75-87).* Teachers College Press.

Slaughter, S., & Leslie, L. (1997). *Academic capitalism: Politics, policies, and the entrepreneurial university*. The Johns Hopkins University Press.

Slaughter, S., & Leslie, L. (2001). Expanding and elaborating the concept of academic Capitalism. O*rganization, 8*(2), 154-161.

Slaughter, S., & Rhoades, G. (2004). *Academic capitalism and the new economy: Markets, state, and higher education.* The Johns Hopkins University Press.

Smirnova, Y. (2016). University–industry knowledge transfer in an emerging economy: Evidence from Kazakhstan. *Science and Public Policy, 43*(5), 702–712.

Smolentseva, A., Huisman, J. & Froumin, I. (2018). Transformation of Higher Education Institutional Landscape in Post-Soviet Countries: From Soviet Model to Where? In J., Huisman, A. Smolentseva, & I. Froumin, (Eds.). *25 Years of Transformations of Higher*

Education Systems in Post-Soviet Countries (pp. 1-43). Palgrave Studies in Global Higher Education. Palgrave Macmillan, Cham.

Spring, J. (2014). *Globalization of education: An introduction* (2nd ed.). Routledge.

Starman, A. (2013). The case study as a type of qualitative research. *Journal of Contemporary Educational Studies*, 1, 28–43.

Swamidass, P. M. (2013). University startups as a commercialization alternative: lessons from three contrasting case studies. *The Journal of Technology Transfer*, 38(6), 788-808.

Swamidass, P. & Vulasa, V. (2009). Why university inventions rarely produce income? Bottlenecks in university technology transfer. *The Journal of Technology Transfer*, 34, 343-363.

Tang, M., Walsh, G. S., Li, C., & Baskaran, A. (2021). Exploring technology business incubators and their business incubation models: case studies from China. *The Journal of Technology Transfer*, 46(1), 90-116.

Teece, D. J. (1977). Technology transfer by multinational firms: The resource cost of transferring technological know-how. *The Economic Journal*, 87(346), 242-261.

Teixeira, S. J., Veiga, P. M., & Fernandes, C. A. (2019). The knowledge transfer and cooperation between universities and enterprises. *Knowledge Management Research & Practice*, 17(4), 449-460.

Thomas, A., & Paul, J. (2019). Knowledge transfer and innovation through university-industry partnership: An integrated theoretical view. *Knowledge Management Research & Practice*, 17(4), 436-448.

Tierney, W., & Lanford, M. (2016). Conceptualizing Innovation in Higher Education. In M.B. Paulsen (Ed.), *Higher Education: Handbook of Theory and Research* (pp. 1-40). Springer, Cham.

Tokbergenov, I. (2021). Research is being integrated into the educational process. *Bilimdi el, 41*(295), 1-5.

Toleubayev, K., Jansen, K. & van Huis, A. (2010). Knowledge and agrarian de-collectivisation in Kazakhstan. *The Journal of Peasant Studies, 37*(2), 353-377.

United Nations, Department of Economic and Social Affairs, Population Division (2019). *World Population Prospects 2019: Highlights* (ST/ESA/SER.A/423).

van Vught, F. (2009). The EU Innovation Agenda: Challenges for European Higher Education and Research. *Higher Education Management and Policy, 21*(2), 1-22.

Veer-Ramjeawon, P., & Rowley, J. (2019). Embedding knowledge management in higher education institutions (HEIs): A comparison between two countries. *Studies in Higher Education*, 45(11), 1-17.

Wang, W., & Lu, S. (2021). University-industry innovation community dynamics and knowledge transfer: Evidence from China. *Technovation*, 106, 1-14.

Ward, D. (2008). Globalization, Public Policies and Higher Education in Weber, L. E., & Duderstadt, J. J. (2008). *The Globalization of Higher Education*, VI Glion Colloquium. Economica.

Wong, P., Ho, Y., & Singh, A. (2007). Towards an ‘‘Entrepreneurial University’’ Model to support knowledge-based economic development: The Case of the National University of Singapore. *World Development, 35*(6), 941–958.

Wood, L. M., Sebar, B., & Vecchio, N. (2020). Application of rigour and credibility in qualitative document analysis: Lessons learnt from a case study. *The Qualitative Report*, 25(2), 456-470.

World Bank. (1998). *World development report 1998/1999: Knowledge for development*. https://elibrary.worldbank.org/doi/abs/10.1596/978-0-1952-1118-4

World Bank. (2016). *Kazakhstan Agricultural Sector Risk Assessment*. https://openknowledge.worldbank.org/entities/publication/e0132fc0-1686-5666-be8e-b5c45bdb42cb

World Bank. (2021). *Charges for the use of intellectual property, payments (BoP, current US$) – Kazakhstan.* [Data set]. World Bank. https://data.worldbank.org/indicator/BM.GSR.ROYL.CD?locations=KZ

World Bank. (2021*). Charges for the use of intellectual property, receipts (BoP, current US$) – Kazakhstan.* [Data set]. World Bank. https://data.worldbank.org/indicator/BX.GSR.ROYL.CD?locations=KZ

World Intellectual Property Organization (WIPO) (2022*). Global Innovation Index 2022: What is the future of innovation-driven growth?* https://www.wipo.int/global_innovation_index/en/2022/

Wright, M., Siegel, D.S. & Mustar, P. (2017). An emerging ecosystem for student start-ups. *The Journal of Technology Transfer*, 42, 909–922.

Ye, Y., De Moortel, K., & Crispeels, T. (2020). Network dynamics of Chinese university knowledge transfer. *The Journal of Technology Transfer*, 45(4), 1228-1254.

Yu, H., Zhang, J., Zhang, M., & Fan, F. (2022). Cross-national knowledge transfer, absorptive capacity, and total factor productivity: The intermediary effect test of international technology spillover. *Technology Analysis & Strategic Management*, 34(6), 625-640.

Yusof, M., & Jain, K. (2010). Categories of university-level entrepreneurship: A literature survey. *International Entrepreneurship Management Journal, 6*, 81–96.

Zhangirova, R. (2020). Innovations in Agricultural Sector Development of Kazakhstan. *Problemy agrorynka* [Problems of agromarket], January-March, 27-33.

Appendix A. Letter to Rectors

Dear Sir/Madam,

I am Zhanar Mazbulova, from Nazarbayev University. I am a PhD candidate with an interest in university-industry knowledge and technology transfer. I am writing to you to seek your permission to conduct a research study at your university. I would like to know about specific mechanisms, channels and pathways of knowledge and technology transfer, as well as challenges that universities face during the process of knowledge and technology transfer and practices that are facilitating the process. The information gained from this research may help to improve the process of university-industry knowledge and technology transfer.

I am planning to interview university management and faculty members. The ethics approval was granted by the NUGSE Research Committee on 14.01.2021. I have attached the information sheet that I will send to our participants, for your information.

I am writing to kindly ask for your permission to conduct the study at your university. I will be glad to share the findings of the study with you upon its completion. Of course, no information can be provided about the participants. Their identity will remain confidential, in accordance with ethics requirements. Please email me to confirm your approval.

Please do not hesitate to contact me if you require any further information. My contact details are given below. Alternatively, you may contact my main advisor Professor Elaine Sharplin (+7 777 192 99 61) if you have additional concerns.

Best regards,

Zhanar Mazbulova
PhD Candidate
+7 705 622 0272

Appendix B. Information Sheet

EXPLORING UNIVERSITY-INDUSTRY
KNOWLEDGE AND TECHNOLOGY TRANSFER: A CASE STUDY OF
TWO AGRARIAN UNIVERSITIES IN KAZAKHSTAN

I am Zhanar Mazbulova, from Nazarbayev University. I am a PhD candidate with an interest in university-industry knowledge and technology transfer. I would like to invite you to take part in a study of university-industry knowledge and technology transfer in Kazakhstan. I would like to know about specific mechanisms, channels and pathways of knowledge and technology transfer, as well as challenges that universities face during the process of knowledge and technology transfer and practices that are facilitating the process. The information gained from this research may help to improve the process of university-industry knowledge and technology transfer.

There are minimal risks associated with participation in this project. You will be invited to talk with me individually. The interview will take up to 60 minutes. I would like to record the interview if you agree to this. You will be provided with a copy of the interview to review for accuracy.

What you need to know about the research process?

- You can change your mind and choose not to participate in the research at any time.
- I can remove or delete any information you have contributed if you decide to withdraw up until the project has been published.
- This research has been approved by the ethics committees at Nazarbayev University.
- Your individual interview contributions will be strictly confidential. You will not be identified in any way.
- The data from this project will be stored securely at Nazarbayev University and will only be accessed by the researcher. The data will not be supplied to any other person or organisation. The data will be stored for a minimum period of 5 years, after which it will be destroyed.

If you would like to find out more information, I can be contacted anytime. When you have had time to read this information sheet, please sign the consent forms and tick the boxes to indicate if you are willing to participate and if you are willing to have the interview recorded.

Yours sincerely,
Zhanar Mazbulova
PhD Candidate

Appendix C. Informed Consent Form

EXPLORING UNIVERSITY-INDUSTRY
KNOWLEDGE AND TECHNOLOGY TRANSFER: A CASE STUDY OF
TWO AGRARIAN UNIVERSITIES IN KAZAKHSTAN

DESCRIPTION: You are invited to participate in a research study to explore the role of universities in the process of knowledge and technology transfer in Kazakhstan, specific mechanisms, channels and pathways of knowledge and technology transfer, as well as challenges that universities face during the process of knowledge and technology transfer and practices that are facilitating the process. You will be asked to answer semi-structured interview questions, the interviews will be audio-recorded and a verbatim transcription will be made and analysed later. I will secure all data and only share the information with my supervising committee. All data will be kept in a locked cabinet and password protected laptop at my residence for the period of time required by Nazarbayev University. I will be the only one with access to the data stored in my private laptop.

TIME INVOLVEMENT: Your participation will take approximately 1 hour.

RISKS AND BENEFITS: The risks associated with this study are spending personal time of the participants during the working hours. The benefits which may reasonably be expected to result from this study are, firstly, this study can also inform government policy and decision-makers in Kazakhstan, as well as in other post-Soviet and post-colonial countries undergoing political, economic and social transition. By developing an understanding of how universities perceive their role and their existing processes for supporting knowledge and technology transfer, the study will be able to generate new knowledge and recommendations to improve the process of university-industry knowledge and technology transfer. Secondly, the findings of this study will be helpful for the development of future policies aimed at facilitating university-industry knowledge and technology transfer and fostering innovation. This research could be applicable to countries that are initiating innovation policies through university-industry knowledge and technology transfer. Thirdly, considering the scarcity of studies on university-industry knowledge and technology transfer in the post-Soviet space, this study will contribute to international literature on knowledge and technology transfer from within a non-western context. Your decision whether or not to participate in this study will not affect your employment.

PARTICIPANT'S RIGHTS: If you have read this form and have decided to participate in this project, please understand your participation is voluntary and you have the right to withdraw your consent or discontinue participation at any time without penalty or loss of benefits to which you are otherwise entitled. The alternative is not to participate. You have the right to refuse to answer particular questions. The results of this research study may be presented at scientific or professional meetings or published in scientific journals.

CONTACT INFORMATION:

Questions: If you have any questions, concerns or complaints about this research, its procedures, risks and benefits, contact Main Advisor for this student work, Dr. Elaine Sharplin, elaine.sharplin@nu.edu.kz

Independent Contact: If you are not satisfied with how this study is being conducted, or if you have any concerns, complaints, or general questions about the research or your rights as a participant, please contact the NUGSE Research Committee to speak to someone independent of the research team at +7 7172 709359. You can also write an email to the NUGSE Research Committee at gse_researchcommittee@nu.edu.kz

Please sign this consent from if you agree to participate in this study.

- I have carefully read the information provided;
- I have been given full information regarding the purpose and procedures of the study;
- I understand how the data collected will be used, and that any individual interview information will be seen only by the researchers and will not be revealed to anyone else. Information collected during the focus group cannot be guaranteed to be confidential, but every attempt will be made to de-identify your contribution;
- I understand that I am free to withdraw from the study at any time without giving a reason;
- With full knowledge of all foregoing, I agree, of my own free will, to participate in this study.
- I give permission to audio record my answers.
- a. Yes b. No

Signature: _____ Date: _____

The extra copy of this signed and dated consent form is for you to keep.

According to the law of the Republic of Kazakhstan an individual under the age of 18 is considered a child. Any participant falling into that category should be given the Parental Consent Form and have it signed by at least one of his/her parent(s) or guardian(s).

Appendix D. Interview Protocol (For University Faculty)

	Research questions	Interview Questions
1	RQ1: How do universities understand the purpose of knowledge and technology transfer in Kazakhstan?	1. Are you involved in transferring knowledge and technology to industry? 2. How relevant to industry do you think that your research findings are? 3. Where the knowledge and technology that you develop could be used? 4. How widely do you expect your findings to be used in the future? 5. How far should researchers, if at all, be involved in research commercialization? 6. How do you think about the roles of science and universities in innovation and technology transfer?
2	RQ2: What are the specific mechanisms, channels and pathways of university-industry knowledge and technology transfer in Kazakhstan?	1. What is your university's/institute's strategy for research commercialization and technology transfer? 2. How have the processes of knowledge and technology transfer changed over time at your university/institute? 3. What do you think of the ways in which your kinds of research findings are commercialized? 4. How effective are the relationships of the researchers with the university administrators who help to organize commercialization? And with equivalent staff of the companies who may use your findings? 5. Who else, if anyone, is involved with you in commercialization and technology transfer and how effective are your relationships with them?
3	RQ3: What are the inhibiting and facilitating factors for university-industry knowledge and technology transfer in Kazakhstan?	1. What do you regard as being the determinant factors in the commercialization of your university's/institute's research? 2. What do you see as your university's/institute's main strengths and weakness as regards the commercialization of its research findings? 3. What do you think the most important characteristic of the successful commercialization of university research are? And the main problems involved? 4. What in your experience are the most and least effective aspects of your relationships with industry? 5. What in your experience are the most and least satisfactory aspects of your relationship with industry? 6. Do you have any further comments on the processes of university-industry knowledge and technology transfer in Kazakhstan?