Inward Technology Transfer and Competitiveness: The Role of National Innovation Systems with a Special Focus to the Ethiopian Air Force

Tsegaye Adugna

A Thesis Submitted to the Department of Technology and Innovation Management

School of Humanities and Social Science

Presented in Partial Fulfillment of the Requirement for the Degree of Master's in Technology and Innovation Management

Office of Graduate Studies

Adama Science and Technology University

June 2024

Adama, Ethiopia

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Advisor: Tsegaye Mulugeta (PhD)

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Declaration

I hereby declare that this Master Thesis entitled “Inward technology transfer and competitiveness: the role of national innovation systems with a Special Focus to the Ethiopian Air Force” is my original work. That is, it has not been submitted for the award of any academic degree, diploma or certificate in any other university. All sources of materials that are used for this thesis have been duly acknowledged through citation

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Recommendation of Advisors

I, the advisor(s) of this thesis, hereby certify that I have read the revised version of the thesis entitled **"Inward technology transfer and competitiveness: The role of national innovation systems with a Special Focus to the Ethiopian Air Force"** prepared under my guidance by **Tsegaye Adugna** submitted in partial fulfillment of the requirements for the degree of Masters of Science in Technology and Innovation Management. Therefore, I recommend the submission of a revised version of the thesis to the department, following the applicable procedures. .

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Co-advisor	Signature	Date

Approval Page of M.Sc. Thesis

I, the advisor of the thesis entitled "**Inward technology transfer and competitiveness: the role of national innovation systems with a Special Focus to the Ethiopian Air Force"** and developed by Tsegaye Adugna, hereby certify that the recommendation and suggestions made by the board of examiners are appropriately incorporated into the final version of the thesis.

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We, the undersigned, members of the Board of the thesis by **Tsegaye Adugna** have read and evaluated the thesis entitled **"Inward technology transfer and competitiveness: the role of national innovation systems with a Special Focus to the Ethiopian Air Force"** and examined the candidate during open defense. This is, therefore, to certify that the thesis is accepted for partial fulfillment of the requirement for the degree of Master of Science in Technology and Innovation Management.

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List of Acronyms and Abbreviations

ETAF - Ethiopian Air force

FDI - foreign direct investment

ITT - international technology transfer

JCC - Job Creation Committee

MInT - Ministry of Innovation and Technology

MoSHE - Ministry of Science and Higher Education

MoTI - Ministry of Trade and Industry

NIS - National innovation system

R&D - Research and development

TT - Technology transfer

ABSTRACT

This paper examines the role of national innovation systems in the inward transfer of technology that has underpinned the transformation of ETAF capacity in recent decades. The ETAF capacities that have benefited most from inward technology transfer have national innovation systems that have strengthened their 'national absorptive capacity and competitiveness. This study's scope was limited to channels of technology transfer and the role NIS in ETAF East Shoa, Bishoftu/Harer meda. Cross- sectional survey research design was adopted, the unit of analysis was purposively selected and data were collected from 80 respondents of Ethiopian Air Force in east shoa, Bishoftu through a validated questionnaire was established and the data was analyzed using simple descriptive statistics. The research was assessed the inward technology transfer channels. The results showed that the joint ventures and licensing are the most important and appropriate channels of technology transfer. The study's findings show national innovation system, positively affects inward technology transfers and competitiveness. The study recommended that The Ethiopian government to improve its national innovation system (NIS) by accurately defining the role of the government and the interaction and linkages among the main actors NIS.

Keywords: ***Inward Technology transfer, Channels of Technology Transfer*** *and* ***National Innovation System.***

CHAPTER ONE

INTRODUCTION

1.1 Background of the study

Technology transfer is the process of exchanging proficiency, skill, abilities, knowledge, experience, industrial production techniques, manufacturing techniques, and services provided by the governments or academic institutions to the end customer in order to ensure that science and technical advances are available to a wider range of consumers who can then further improve and use the technology (Gobena et al., 2021). Enterprises, which implement active strategies of technological development, have the greatest significance for the economy and ensure better conditions for the transformation of obtained technologies into new products or processes. The accumulation of technological capacities is the main aspect of the technological convergence of less developed countries (Ciborowski & Skrodzka, 2020).

According to (Transfer & Planning, 2016), general effectiveness of technology transfer activities in Tanzania includes the competitiveness of both FDI inflows and physical transfer of technologies, the country was ranked by Global Competitiveness reports at position 99 out of 144 countries in 2014/15, 108 out of 144 countries in 2015/16 and 96 out of 144 countries in 2016/17. This implies that in exception to FDI inflows, Tanzania is not competitive in term of technology adaptation or assimilation. Another fact to be noted is that transfer of technology through FDI inflows is only limited to the transfer of the high tech for large-scale firms, therefore the approach has limited impact to SMEs development.

In study of (Ahmedova, 2020)(Ahmedova, 2020), the highest is the share of technology transfers in the high-tech sectors. National Statistical Institute (NSI) data for 2019 show that 35% of technology transfers are made in the information technology sector. The pharmaceutical sector is second with 32% and the medical sector with 17%. In industry, the relative share of technology transfer is 5%, well below the EU average of 28%. In research and development, technology transfer is 8%. Sector others accounted for 3% of technology transfer. According to Lopes et al., (2022) in 2021 military expenditure in sub-Saharan Africa, total $20.1 billion, 4.1 per cent higher than in 2020, but 14 per cent lower than in 2012. The increase in 2021 was the first in sub-Saharan Africa since 2014 and was primarily driven by Nigeria, the biggest spender in the sub-region. Between 2020 and 2021,

Nigeria raised its military spending by 56 per cent, to reach $4.5 billion. In 2021 Kenya, Uganda and Angola were, respectively, the third, fourth and fifth largest military spenders in sub-Saharan Africa. Over the decade 2012–21, Kenya and Uganda have both faced insurgencies that have influenced their military spending. Between 2012 and 2021, military expenditure rose by 203 per cent in Uganda but remained relatively stable in Kenya (down by 4.5 per cent). Military spending by Angola fell by 66 per cent over the same period.

Ethiopia has attempted the transfer of various modern and noticeable technologies, since the era of Emperor Regimes. Emperor Tewodros (1840-1867) was Eager to introduce European technology into his country; especially Emperor Tewodros had tried to establish a firearms industry in Ethiopia. Emperor Tewodros' awareness of the need for mechanical and other innovations in the military field had caused him to accept with enthusiasm an offer by the former European protestant missionary. Finally, by using several technically minded foreigners and missionary, He established large workshop at Gafat. At 'Gafat', these and other foreigners worked together fairly and harmoniously (Gatew, 2011). Furthermore, Emperor Haile Selassie in Ethiopia introduced a number of technologies. Some of the major technologies like military aircraft have been acquired in 28 August 1929 in the form of turnkey projects, international technology co-operation, and recently through Direct Purchase of Naked Technology, Joint Venture.

When Derg came to power, the country's diplomatic ties were diverted to the Eastern bloc. And lots of technologies and communications were brought to the country from North Korea, East Germany and the USSR (Gatew, 2011). As the policy discouraged private participation and innovation, and as the economy was under government control, the country was almost alien to innovations. During the Derge regime, all the policies, plans and programs was towards promoting socialism that prohibits private investment from both foreign and domestic sources. The Soviet Union, which was providing assistance to Somalia, switched sides and agreed to provide substantial economic and military aid that proved to be decisive. As a result, the Air Force received a large number of aircraft for fighter, helicopter, transport roles, in the 1977.

In the 1980s, non-Soviet aircraft were also acquired. Several L-39C jets were acquired from Czechoslovakia for jet transition training. In addition, SF-260TP trainers were acquired from Italy in two batches to replace the aging Safirs, and two L-100 Hercules transport aircraft, the civilian version of the military C-130 Hercules transport, were acquired

through Ethiopian Airlines. The forces of the Ethiopian People's Revolutionary Democratic Front (EPRDF) overran the Derg's army and took control of the country in 1991. The unexpected outbreak of war with Eritrea in June 1998 led to a significant change in the ETAF and Su-27 air superiority fighters were acquired along with advanced versions of the Mi-35 helicopter gunships. The Ethiopian Air Force (ETAF) has taken delivery of two Russian-built Su-30K Flanker-F multi-role fighters and an unspecified number of Turkish-made Bayraktar Akinci unmanned combat air vehicles (Ethiopian National Defense Force,2024).

Implementation of efficient technological transfer is gaining strategic importance under the current conditions of accelerated transformation of socio-economic processes caused by rampant technological development. In such an environment, technology transfer (TT) becomes an important factor for improving companies' competitiveness through technological advancement and innovations and contributes to socio-economic development of regions and countries (Shmeleva et al., 2021). Berraies and Chaher (2014) argued that the decline in corporate performance cuts across developed, emerging and developing countries; as such, global competition is forcing and determining the strategic spectrum and options. It is therefore imperative that companies respond quickly and innovatively to increase their overall efficiency and effectiveness by transferring/sharing technology. Furthermore, opined that adoption of technology is significant for any organization to achieve operational efficiency and industrial competitiveness (Nicodemus et al., 2019).

The Ethiopian and East Asian experiences have drawn attention to the role of' national innovation systems' in supporting the inward transfer and exploitation of technologies from external sources. The concept of national innovation systems that set of distinct institutions which jointly and individually contribute to the development and diffusion of new technologies and which provides the framework within which governments form and implement policies to influence the innovation process. As such, it is a system of interconnected institutions to create, store and transfer the knowledge, skills and artefacts, which define new technologies (Watkins et al., 2014).

This paper examines the role of national innovation systems in the inward transfer of technology, primarily in Ethiopia and the 'late industrialisers' of the last decades.

1.2 Statement of the Problem

Studies reveals that, technology transfer strategy had been deployed by the most of the advanced South East Asian countries including China, Republic of Korea, Singapore, Japan, Hong Kong and Taiwan to enable a tremendous advancement in science and technology (Dahlman 2007). They have been applying knowledge shifting, copying and reverse engineering strategy to transfer technology and innovation from the Western Countries to their respective countries. One thing, noticeable about the mentioned South Asian countries is that, they managed to not only move out of poverty but also to attain middle and higher income status just within the period of 4 decades (Mwabukojo, 2020). The point here is that technological advancement in Asia went in parallel with economic achievement. In addition, it is true that African countries are still characterize by technology deficit gap and underdevelopment as well as poverty crisis. At some point during (1960's-1970's), the Sub-Sahara African Countries used to be in the comparable level with the South East Asian countries in terms of technological advancement. For instance; the number of the available military Aircraft in Ethiopia in 1975 was 39, similar status and/or few difference number of available military Aircraft in south Asia region like (Singapore, Malaysia, Thailand, Vietnam are 65, 36, 105, 4 respectively (Tan, 2004). Four decades later in 2020 the quantity of Military Aircraft available in Ethiopia recorded insignificant increase to 88 from 39 but in the same period of timeframe, the number of military Aircraft in Asia region increased massively from (65, 36, 105, 4) Aircrafts in 1974 to (234+, 189, 221, 260) in 2020. (Tan, 2004) and (Bitzinger, 2010) This is just a pragmatic example which revealed two aspects; massive rate of technological advancement in Asia region; and technology stagnation in the Sub-Sahara Africa region. However, what matters most is that the Sub Sahara African countries including Ethiopia are not doing enough to pull themselves out of the technological stagnation trap, as the result the technology deficit gap in the Sub-Sahara African countries keep on increasing. Among the factors, which associate with the innovation and technological advancement, is presence of adequate political willingness. Unfortunately, there is limited political will to enhance innovation activities in Ethiopia. The government is playing limited role to enable technology adaptation as well as to enhance innovation activities. Although it has been a long year since the Ethiopian Air Force was established, it is not at the level it should be. Technology transfer needs to be done well so that the Air Force can be competitive and wage war at a distance. However, for many years we have been in a vicious cycle of importing new technology and then

importing another when it is out of date. Consequently, our country has not moved to arming its own technology. Therefore, to ensure competitiveness, which technology transfer channel is the best, what should be the role of the national innovation system; this paper attempts to examine international technology transfer channel. To the best of our knowledge, a number of studies have been conducted on various technological fields. However, there has been a few study of how technology has been transferred in the military aircraft sector. (Yigzaw, 2010) assess the practice and challenges of aircraft acquisition projects in the case of Ethiopian Aviation Sector. (Yifru, 2017) the study was to identify the determinant factors for the success of Ethiopian Airlines and to establish how and to what extent each factor understudy affects its success. (Van Der Heiden et al., 2015), Successful international technology transfer as well as absorption of aerospace technology and knowledge into recipient organizations, depends prodigiously on the types of policy adopted in education and training.

In the study of (Malm, Anna 2016) to extend the current understanding of technology transfer realization connected to related offset within the defense aircraft industry. There are gaps or limitation on the technology transfer Channel only related to offset and location specific studies.

The aim of this study is to indicate which technology transfer channel is the best for the Ethiopian Air Force to be sustainable in East Africa, and what should be the role of the national innovation system.

1.3 Research questions

This study aimed to addresses the problem by answering the following question:

RQ1. What are the Contribution of national innovation systems to technology transfer and competitiveness in Ethiopian Air force?

RQ2. Which are international technology transfer channels best for Air Force?

1.4 Objective of the Study

1.4.1 General objective

The general objective of this thesis is to assess inward technology transfer channels, and identifying the role national innovation systems in Ethiopian Air force.

1.4.2 Specific Objective

The specific objectives we have followed to accomplish the general objectives are:

- To examine the contribution of national innovation systems.
- To examine international technology transfer channels.

1.5 Scope of the study

The scope of the study in this thesis work is to examine international technology transfer channels and the contribution of national innovation systems. The study is only inclusive of sectors like military aircraft in Ethiopian Air force.

1.6 Limitation of the project

In addition to the common limitation such as time and resource constraints, the study has the following limitation: Lack of up-to-date information about each sectors of Ethiopian air force and some of the data would be confidential and absence of empirical evidence particularly in Ethiopian and African context. Also not all sectors are included in the study; therefore, the study is not in a position to generalize to all sectors of Ethiopian Air force.

1.7 Significance of the study

The study is significant because it is expects to provide knowledge on the factors negatively affecting inward technology transfer and competitiveness of Ethiopian Air force. specifically it is useful to: help establish the factors that are consistent in the success of Ethiopian Air Force technology transfer and technological innovation, remind owners of those internal factors since these are directly controllable by the managers of Ethiopian Air Force. Remind owners about those external factors uncontrollable by the managers of Ethiopian Air Force, help as a base for other researches to do research on the topic under study by filling the literature gap in the area and help the policy makers to assess factors hindering technological innovation of Air Force. Importantly, it initiates the concerned organization to reassess its existing practices with a view to encourage technological innovation on aviation industry.

CHAPTER TWO

LITERATURE REVIEW

2.1 Theoretical Literature Review

Technology transfer is generally difficult to quantify or measure because it proceeds inherently in various forms and through diverse channels, and it is difficult to create a specific flow of content and contributions to the market price. As a result, the flow of information and knowledge about technology are varied and wide-ranging and technology transfer should be treated as an essentially multi-lateral process. Technology transfer can be understood as a form of narrow process or general processes in which technological assets are transferred. The narrow definition of technology transfer is a process for conceiving and implementing a new/novel application for an existing technology. The general definition of technology transfer is the set of processes that include all dimensions of the origins and the adoption of expertise, experience, and equipment among, across, and within countries, organizations, and institutions (T.Transfer, U. Planning, 2016). Technology and knowledge transfer from research institutions in to industrial applications forge a link between academia and business with the objective of putting academic research results into practices (Piller et al., 2021). Technology is very essential not only for the growth of small Micro and Enterprises (SMEs) but also for the overall economy of any country(Singh, 2021).

The following section argues that successful technology transfer seems to be a more complicated and labor intensive process than previously thought, requiring significant technological modification and additional developments, as well as an adequate legal framework. (Bellais & Guichard, 2006).Firms that engage in foreign information transfer initiatives have significantly and noticeably higher productivity growth, according to estimates from a lively productivity model. While the results do not seem to endorse a compromise between domestic and foreign technology procurement, companies that mix international and domestic adopt new strategies have the greatest influence on productivity, implying that a flexible external technology outsourcing approach mixing local know-how with know-how from abroad is the most successful in increasing productivity. (Belderbos et al., 2012) Because of the crucial assessment of technology's economic and social effect on developing nations, the transition mechanism has become increasingly more

sophisticated and dynamic. (David Harvey, 1984) the effect of environment related patents on economic growth, as well as cross continent technological transitions and structural considerations. Environmental patents may be successfully used thanks for countries' innovative capacities on how they disseminate scientific technologies. Finally, taking a cross-continental look at environmental patents helps one gain a better understanding of current TT patterns. (Ferreira et al, 2019) the method was modelled to establish a forum for discussing a range of quality improvement problems that, if ignored, may have a negative impact on the process's capacity to convey information to mothers in a volume and manner sufficient to produce desired decision-making. The quality improvement and value appraisal systems, it is argued, should obtain further consideration in the push to minimize morbidity and mortality by information transfer (Yassin and Anita et al, 2003). The definitions and concepts of technology transfer have been discussed in many different ways based on the disciplines of research and according to the purposes of the research (Bozeman, 2000). (Gibson & Smilor, 1991) view technology transfer is often a chaotic, disorderly process involving groups and individuals who may hold different views about the value and potential use of the technology. According to them technology often has no definitive meaning or value. Researchers, developers, and users are likely to have different perceptions about the technology. A review of literature on technology transfer reveals that technology transfer is a complex, difficult process even when it occurs across different functions within a single product division of a single company (Zaltman et al., 1973). Technology transfer is commonly acknowledged to be a complex process that needs time to evolve (Agmon and von Glinow, 1981). Technology transition occurs through time, through minor, gradual, and occasionally unplanned changes to the overall research initiative, and is continuously embraced by practitioners(Gobena et al., 2021)..

Definitions of national innovation system; "*The network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies."(Freeman, 1987). "The elements and relationships which interact in the production, diffusion and use of new, and economically useful, knowledge ... and are either located within or rooted inside the borders of a nation state* (Lundvall, 1992). "a set of institutions whose interactions determine the innovative performance ... of national firms." (Nelson, 1993). "The national institutions, their incentive structures and their competencies, that determine the rate and direction of technological learning (or the volume and composition of change generating activities) in a country." (Patel and Pavitt, 1994).

".. that set of distinct institutions which jointly and individually contribute to the development and diffusion of new technologies and which provides the framework within which governments form and implement policies to influence the innovation process. As such it is a system of interconnected institutions to create, store and transfer the knowledge, skills and artefacts which define new technologies." (Metcalfe, 1995)

Innovation broadly pertains to the introduction of new knowledge, technologies and practices, or new combinations of existing knowledge, and their diffusion (Wakeford et al., 2017). According to Oslo manual, (Collecting & Data, 2005) provides a widely used definition: "An innovation is the implementation of new or significantly improved product and process, marketing method, or organizational method in business, workplace organization or external relations"

According to the study of (Freeman, 1995), The measurement and assessment of national innovation systems has centered on four types of knowledge or information flows:

First interactions among enterprises, primarily joint research activities and other technical collaborations. Second interactions among enterprises, universities and public research institutes, including joint research, co-patenting, co-publications and more linkages that are informal. Third diffusion of knowledge and technology to enterprises, including industry adoption rates for new technologies and diffusion through machinery and equipment; and Fourth personnel mobility, focusing on the movement of technical personnel within and between the public and private sectors. Attempts to link these flows to firm performance show that high levels of technical collaboration, technology diffusion and personnel mobility contribute to the improved innovative capacity of enterprises in terms of products, patents and productivity. The Freeman- and the 'Aalborg-version' of the national innovation system-approach (Freeman 1987; Lundvall 1985; Lundvall 1992) aims at understanding 'the innovation system in the broad sense'. First the definition of 'innovation' is broader. Innovation is defined as a continuous cumulative process involving not only radical and incremental innovation but also the diffusion, absorption and use of innovation. Second there are other major sources of innovation than science. Innovation is seen as reflecting interactive learning taking place in connection with on-going activities in production and sales. Therefore the analysis takes its starting point in the process of production and the process of product development assuming, for instance, that the interaction with users is fundamental for product innovation.

Although notions of technological 'catch-up' and economic growth have always been central to the National innovation system (NIS) concept (Lundvall, 2007), the idea was conceived on institutional structures and activities identified in already developed countries (e.g. Japan, USA, Germany, Sweden) with developing countries largely absent from the early literature. Shortly thereafter, however, the NIS concept was applied to so-called newly industrialized countries (e.g. South Korea, Taiwan, and Singapore) and countries of Latin America (e.g. Mexico and Argentina), and has, more recently, been applied to developing countries, both the emerging powers of Brazil, India, China, and South Africa, and more limitedly to less developed countries in Sub-Saharan Africa. The gradual inclusion of developing countries within the NIS discussion has coincided with several interrelated shifts in the NIS literature occurring over the past three decades (Watkins et al., 2014):

1) a move away from macro institutional explanations to a focus on specific system processes, 2) a more recent emphasis on the role of intermediary and non-governmental actors in this regard, and 3) the increasing internationalization of the NIS concept.

These shifts have demonstrated the usefulness of the NIS approach in two respects: first, its ability to take account of socio-economic and political specificities; second, its focus on power relations in discussing innovation and knowledge accumulation.

2.2 Inward Technology Transfer Channels

The possible TT channels can occur through trade in products, trade in knowledge that involve export has some potential for transmitting technological information wherefore on the import side through imported capital goods and technological inputs (Alhababy, 2016). The second TT channel is foreign direct investment that comprises the investment of multinational firm to transfer technological information to their subsidiaries in other country; in due course, this discloses technological information into the hosting country. Finally, intra-national and international movement of experts is another way of technology transfer, this may occur within firms, among joint ventures, or between unrelated firms.

In the study of (Kim L., 1991) analyses, the international technology transfer mechanisms by classifying them into market and non-market mediated. In market mediated, he refers to those mechanisms, which may be determined by the market. The transferor and transferee may negotiate the cost of technology transfer, either embodied in or embodied from the physical equipment. In the non-market mediated mechanisms, technology transfer usually

takes place without formal agreements and payments. He demonstrates the mediated and non-mediated mechanisms of technology transfer in a useful four-cell matrix to identify and evaluate different mechanisms of international technology transfer. Those mechanisms are among the most important technology transfer modes, where the supplier of technology has exercised an active role in directing the technology transfer process. They include control over the quality and quantity of know-how being transferred, and the possible restriction imposed on the use of know-how. The channel of technology transfer indicates those market-mediated modes where the supplier of technology plays a relatively passive role with less control over the way in which technology and know-how being transferred and to the non-market-mediated modes, where the supplier of technology plays either a relatively passive or active role in transferring technological know-how respectively.

Technology could be transferred in different ways; however, most researchers broadly categorized them in two main streams. These are formally market-mediated channels and the informal or non -market-mediated channels.

2.2.1 Market-mediated channels:

The market mediated technology transfer channels involve the formal arms-length transactions between buyers and sellers, and it includes Licensing, Joint Venture, Patent Right, Direct Purchase of Naked Technology (Gatew, 2011). The formal mechanisms of international technology transfer are licensing agreements, direct foreign investment, sale of turnkey plants, joint ventures, co-operative research arrangements, and co-production agreement

Foreign direct investment, According to (Dunning & Lundan, 2008) FDI and portfolio investment are distinct for two main reasons. Firstly, while FDI transfers capital, skills, technology, ethical and social norms and increases access to a foreign market; portfolio investment come along financial capital alone. Secondly, unlike the portfolio investment, in the case of FDI ownership remains in the hands of the investing entity that has power and capable of giving a decision.

Licensing: an agreement that allows a technology recipient to employ the transferred technology as per the conditions that are spelled out by both parties. Licensing is the sale of manufacturing technology by a multinational enterprise (licensor) to a non-controlled entity located outside the home country of the multinational enterprise (licensee) (Telesio

P, 1984). In other words, a licensing agreement is a legal contract under which the licensor confers certain rights upon the licensee for a specified duration in return for certain payments (usually royalties) (Killing, P. J., 1980). License is one of the only a few significant methods of technology transfer between firms and one of the most commonly observed inter-firm contractual agreements (Anand & Khanna, 2000)

Joint Venture: when two or more business entities set-up a third entity that will enable them to produce a good or service jointly, by sharing the enormous expenses of technical, marketing, production and managerial skills. Joint venture agreements have been classified into different types. (Killing, P. J., 1983) distinguishes between two ways in which a local firm in the recipient country can use a joint venture to acquire technical and managerial expertise from a potential technology supplier. One is to form a dominant parent joint venture, which is passive with the technology supplier. (Katz et al., 1996) A well-recognized problem area within a joint partnership of high technology firms, however, is that much of the technological capability is not easily transferrable from one partner to another. This occurs simply because the successful implementation and operationalization of most technologies depends to a great extent on the built-up experiences and expertise of critical personnel such as key scientists, engineers, equipment operators, suppliers, and the like. Much general knowledge is explicit in nature, easily documentable and retrievable through formal written media.

Patent Right: a legal right to possess monopolistic control over an invention for a stipulated term can be bought and sold. A firm may buy this right for a technology that will help it to round out an existing product line, or in order to get into a new line of business or in order to avoid a legal suit.

Direct Purchase of Naked Technology: the purchase of a product is based on complex technological device from a firm. This process can save considerable research and development, and production costs to the recipient.

Embodied technology transfer: capital goods imports and turnkey plants. A final important channel for inward technology transfer involves the embodied technology transfer that occurs through the import of advanced capital goods and, in some cases, turnkey industrial plants.

2.2.2 Non -market-mediated channels:

It is the second category, the so called the informal channels for foreign technology transfer, is conducted without mediation of the two parties, and basically the technology transfer take place without formal agreements and there is no any direct payments done to the technology owner. The specific technology transfer channels in this category are (Gatew, 2011).

Imitation: Among the different important non-market channels of technology transfer, the most significant one is the process of imitation in which a rival firm learns the technological or design secrets of another firm's formula or products. Imitation may be achieved through product inspection, reverse engineering, de-compilation of software, and even in simple trial and error.

Departure of Employees: Another form of non-market channel for technology transfer is, when technical and managerial personnel's leave the firm, and join or start a rival firm based on the knowledge they acquire over the years from the technology owner. Such competition can be a significant form of information diffusion in industries.

Data in Patent Applications and Test Data: Registered patent applications are available in public databases for a legal right on the subject matter. However, rival firms in principle can read such applications, learn the underlying technologies, develop competing processes, and products that do not violate the claims of the original applicants.

Temporary Migration: Much technology could also be transferred through temporary migration of students, scientists, managerial and technical personnel to universities, laboratories, and conferences located mainly in the developed economies. The challenge for developing countries in this context is their failure to encourage expatriate students and professionals to return home and undertake scientific, educational, and business development activities. (Cavallini et al., 2018) investigate the main directions of intra-European brain drain. The results suggest that highly skilled workers prefer the northern parts of the EU (Sweden, Ireland, Estonia, Denmark and several regions of the UK) and the urban environment. Less attractive regions for such professionals are largely located in Italy. Similar trends in circular migration by level of development of countries were found in the studies of Cseh Papp et al. (2018). Some researchers also identify the main factors that motivate highly skilled workers to look for work abroad: better employment opportunities, higher wages, better living conditions. These are the so-called pull factors of

labour mobility that lead to the immigration of human capital. When mobility concerns highly skilled workers, pull factors play a more important role than push factors. The social and economic conditions of the host regions are one of the most important factors determining the mobility of highly skilled workers. Among these factors are active economic growth, higher wages, strong social security, high per capita wealth, language similarity, cultural similarity, easier access to the labour market, higher employment (EC, 2018). At the same time, a two-pronged approach by researchers to the study of the migration of highly skilled workers is widespread. Thus, (Beaumont et al., 2017) combine two concepts: brain drain (loss of highly educated people) and brain gain (human capital gain). Typically, these concepts are used as opposites, i.e. brain gain in the recipient country is generated by the brain drain for the donor country. Therefore, the study of the issue of brain drain also requires a focus on issues related to the phenomenon of brain gain. According to the generally accepted approach, brain gain is the increase of the number of people in a region/country who have high skills and/or competencies due to immigration (Cavallini et al., 2018).

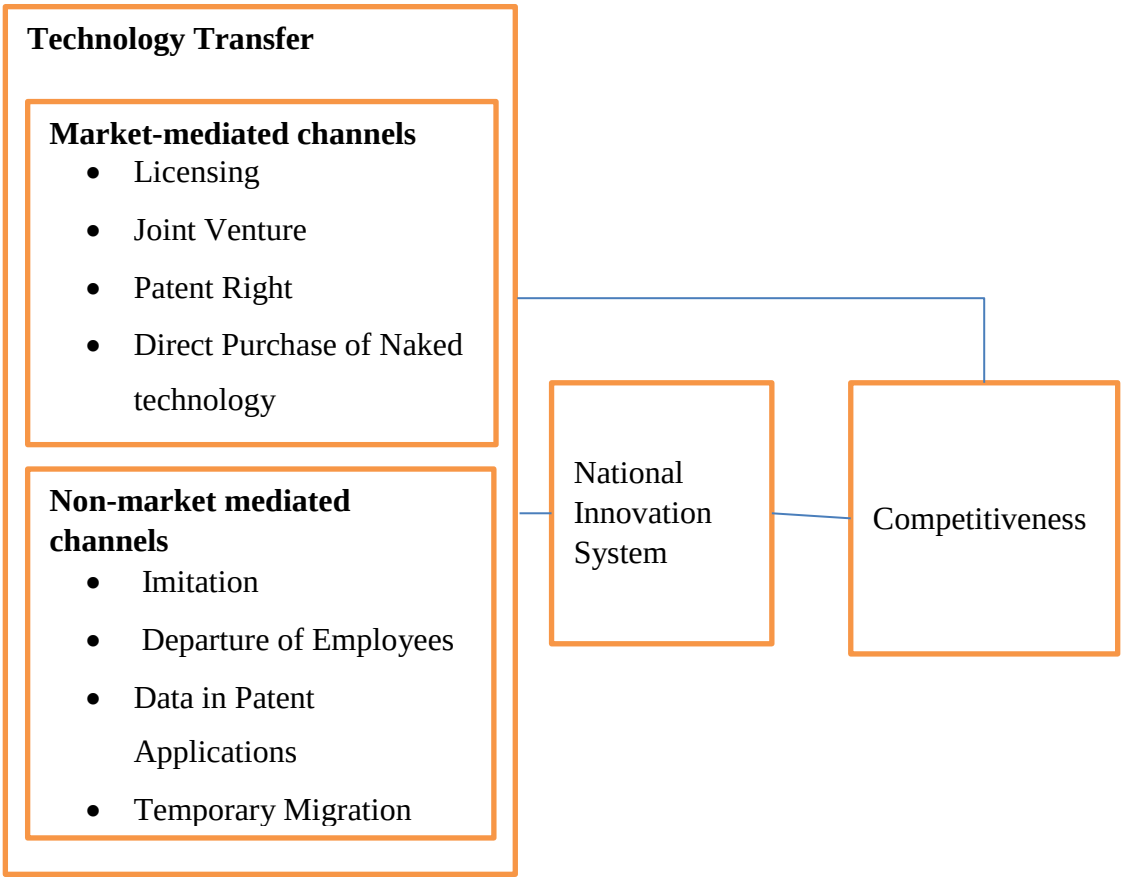

Figure 2-1 Theoretical framework

2.3 Contribution of national innovation systems to inward technology transfer

Although a precise definition of a national innovation system is difficult, previous work on the Japanese and US national innovation systems (Freeman, 1987; Nelson, 1990, 1992, 1993) have defined them as the network of public and private institutions within an economy that fund and perform R&D, translate the results of R&D into commercial innovations, and affect the diffusion of new technologies. More concretely, a national innovation system includes the public agencies that support and/or perform R&D; a nation's universities, which may perform research and play an important role in the training of scientists and engineers; the firms within an economy that invest in R&D and in the application of new technologies; any public programmes intended to support technology adoption; and the array of laws and regulations that define intellectual property rights. (Y. N. Lee, 2015) (S. M. Lee & Trimi, 2018) also pointed to the importance of well-designed national innovation system (NIS) in Korea and Taiwan as the main instrument for the two Asian countries to avoid the middle-income trap, thus contributing to their sustainable socioeconomic development. In particular, Korea has become a model case in recent years, which many developing countries would like to emulate on their journey towards the eradication of poverty and economic industrialization. Among others, the policy instruments that Korea has applied during its early phase of economic development are receiving an increasing policy attention from a growing number of developing countries (Ricote 2007; Lee et al. 2015).

The government of Ethiopia has successfully implemented its first Growth and Transformation Plan (GTP I) between 2011 and 2015 and soon started to implement the second Growth and Transformation Plan (GTP II), in which the industrial transformation of key sectors has been identified as an important policy goal. In fact, the Ethiopian government envisages to continue upgrading its industrial structure and improving the international competitiveness for a prolonged period, thereby overcoming poverty and achieving the interim goal of becoming a middle-income country by 2025. To achieve this goal effectively as well as promptly, Ethiopia must expand the national innovation capacity to a substantial extent.

The technological capacity and the capability to innovate are an essential element in securing the success of any business entities and national economies. (Innovation, 2019)The main actors in the Ethiopian innovation field include the following institutions and actors with varying yet overlapping roles. The researcher is devoted to an in-depth analysis of the roles and responsibilities the main actors have been assigned to fulfill in the ecosystem of Ethiopia's national innovation activities. The main actors in the Ethiopian innovation field includes Federal Government institutions, Academia, Semi-public Institutions, and Private-sector Support Institutions.

Table 2-1 Summary of Roles and Responsibilities of Main actors in Ethiopian's NIS

Categories	**Actors**	**Role and Responsibility**
Federal Government	MInT	Formulation and implementation of innovation policy
	MoSHE	Indirect influence on innovation through helping universities' innovation activities
	MoTI	Relatively strong influence on innovation activities of industrial sector
	JCC	Coordination of ST-related job creation, in close cooperation with the MInT, MoSHE and MoTI
Semi-Private Sector Institutions	Commercial Banks	Providing loans to innovating companies, large and SMEs
	Microfinance Institutions	Providing loans to micro-enterprises
Academia	Public Universities	Takes the great majority of universities in Ethiopia; Carrying out innovation, funded by MoSHE
	Private Universities	Carrying out innovation, funded partly by MoSHE
	Science and Tech. Universities	Two S&T Universities in Addis Ababa and Adama; Specifically dedicated to Innovation and R&D
Private-sector Support Institutions	Entrepreneurship Development Center	Promote entrepreneurship in the Ethiopian society by raising awareness and providing logistical and partly financial supports
	Chamber of Commerce	No dedicated innovation programs, but support the interests of SMEs and micro-enterprises
	Incubators and Accelerators	Help the companies to conduct innovation and commercialize the outcome of their R&D

Source: *2019/20 KSP Policy Consultation Report*

The government sector possesses the sole power of formulating and implementing innovation-related policies, for which the ministry of innovation and technology (MInT) plays the most important role. The great majority of Ethiopian universities are public universities, and private ones represent only a very small portion of the country's higher education institutions. Interaction between the universities and the industry sector is another important channel where a few significant issues may arise.

Opportunities for Ethiopia's National Innovation System

The Ethiopian National Innovation System shows potential for becoming a promising instrument to secure the sustainable development of the national economy. According to (Ministry of Economy and Finance of Ethiopia and Korea Development Institute policy Consultation Report, 2019), First, a very strong commitment of the Ethiopian government is observed, serving an excellent foundation for a successful expansion of the nation's innovation capacity. In fact, the commitment from the Ethiopian political leadership is visibly translated into national innovation policy. The Ethiopian government has also started to lift restrictive regulations on business conditions, thereby making Ethiopia an attractive destination for foreign direct investment (FDI). Therefore, the conditions for business operation have improved continuously and considerably. The increasing number of FDI firms will contribute to increased opportunities for local companies to interact with FDI firms, which would lead to strengthened technology transfer from the latter to the former. Third, the sheer fact that nearly one million young people are graduating from the university and 70% of them are majoring in Science, Technology, Engineering and Mathematics, which is a strong signal that the Ethiopian ecosystem for innovation is unlikely to face issues in recruiting capable and ready researchers and innovators. A stable supply of R&D personnel is essential for a successful pursuit of national innovation policy. Fourth, while industrial transformation requires an upgrading of the national innovation capacity, the agricultural sector, which was traditionally the leading sector of the Ethiopian economy, reveals a strong need for innovation and possesses certain potential for successful innovation. Fifth, with increasing FDI, the importance of Ethiopian diaspora will be expanded considerably. In particular, recruiting capable human resources is crucial, especially in the early phase of national innovation strategy, as was the case in Korea with the establishment of the Korea Institute of Science and Technology in 1966. The Ethiopian diaspora who are active in foreign universities and laboratories should be encouraged to

return to their home country and contribute to the economic and societal development of the nation.

2.4 Empirical Literature Reviews

In the study of (Maskus, 2004) empirical studies of licensing behaviour are rare but tend to show a strong impact of patent rights on the volume of royalties and license fees, taken as a measure of technology flows (Ferrantino, 1993). Most recently, Yang and Maskus (2001) regressed the real volume of license fees for industrial processes paid by unaffiliated foreign firms to U.S. firms in 26 countries in the years 1985, 1990, and 1995 on the Ginarte-Park patent index. Controlling for market size, human capital, and openness, they discovered that such fees were positively and significantly affected by patent rules and enforcement, and that a one-percent rise in the index would increase licensing volumes by 2.3 percent on average. (Ć, I. T, 2023), the study confirm the close links between the migration of highly skilled workers and the competitiveness and economic growth of the country. The analysis found that the immigration of workers with higher education has a significant impact on strengthening the competitiveness and economic development of countries.

Technology licensing Data on the growth and destination of technology licensing flows are much scarcer than those for foreign investment, but licensing appears to have been an important channel for technology transfer during the postwar period to economies as diverse as South Korea, India, Japan, Brazil, and Thailand. OECD members' licensing receipts grew by 6% annually during the 1970s, exceeding the growth rate of DFI outflows during that period (OECD, 1988). Capital goods imports on occasion have complemented technology transfer through licensing. During the 'high-growth era' of the 1950s and 1960s, the Japanese government developed complementary policies for capital goods imports and inward technology licensing (Mowery & Oxley, 1995).

According to (Transfer & Planning, 2016), general effectiveness of technology transfer activities in Tanzania includes the competitiveness of both FDI inflows and physical transfer of technologies, this implies that in exception to FDI inflows, Tanzania is not competitive in term of technology adaptation or assimilation. Another fact to be noted is that transfer of technology through FDI inflows is only limited to the transfer of the high tech for large-scale firms, therefore the approach has limited impact to SMEs development.

In study of (Ahmedova, 2020), the highest is the share of technology transfers in the high-tech sectors. National Statistical Institute (NSI) data for 2019 show that 35% of technology transfers are made in the information technology sector. (Nelson, 1992) further argues that international competitiveness and innovative performance build on overall strength in training scientists and engineers, and in the adoption of technology, rather than reliance on concentrated investments in 'strategic' sectors. (MIT, 2019) the engagement of Ethiopian innovative firms in R&D activities is not significant. This entails that the majority of innovative firms do not support their innovation with research and development.

CHAPTER THREE

RESEARCH METHODOLOGY

This section gives clue on what methods of data collection, data types and analysis were used to collect and process the data.

3.1 Research Method

3.1.1 Study area and subject

The study was conducted in head office of Ethiopian Air force located in Oromia East Shoa, Bishoftu /Harer Meda/. Harer Meda has the head office and air divisions and is located close to Addis Abeba

3.1.2 Research design

The research design of the thesis was descriptive research method. Both qualitative and quantitative approach was designed to investigate the problem under study.

3.2 Data sources and type

Quantitative approach was designed to investigate the problem under study. The framework used by the study to direct the data collection method was cross-sectional data. Cross-sectional data collection involves gathering information at a certain point in time, primarily through the use of questionnaires to collect quantitative or qualitative data. Cross section data type 2024 was used for this study. Secondary data by reviewing documents had been used, on the other hand, data gathered from official of Ethiopian Air force through interview was analyzed qualitatively to crosscheck the finding. The questionnaire was used to collect data from supervisors, technicians and squadron heads of Ethiopian Air force.

3.3 Sampling Design

3.3.1 Target Population

For this study, the sampling frames was selecting two squadron’s, and two depot maintenance units that categorized in supervisors, technicians and squadron heads of Ethiopian Air force purposively.

3.3.2 Sampling techniques and Sample size

The total sample size used in the study was 130 participants. The total sample was determined by taking 7% sample error for the squadrons and depot maintenance units of ETAF. Therefore, the sample size for squadrons and depot maintenance units of ETAF were calculated by Using Yamane (1967) formula

$$n = \frac{N}{1 + (N \times e^2)} \quad (1)$$

N-total population = 130

e-the margin error in the calculation = 7%

n-the sample size = 80

$$n = \frac{130}{1 + (130 \times 0.07^2)} = 79.41$$

This research was used non-random sampling technique of Purposive-sampling methods. Its value lies in selecting information-rich cases to gain a deeper understanding of the situation when random sampling is not possible.

In addition, four key informants (commandants, and one R&D director) were included purposively for interviews. Finally, the response rate of the sample respondents of squadrons and depot maintenance units from ETAF was 100%

3.4 Methods of data Analysis

The research has employed a descriptive method of data analysis in order to analyze the data that would be collected through questionnaire and interview. The collected data was analyzed with the help of STATA software. To analyze the status of technology transfer channels and contribution of national innovation system in ETAF, descriptive/ parametric statistics (mean) is used. The different indicators to show the status of Technology Transfer channels are licensing, Joint Venture, Patent Right, Direct Purchase of Naked Technology, Imitation, Departure of Employees, Data in Patent Applications, Temporary Migration

The indicators to measure the contribution of national innovation system to technology transfer. Support an organization/institution, which may perform research and play an important role in the training of engineers and Technicians, Support the organization within an economy that invest in R&D and in the application of new technologies and Any organization programs intended to support technology adoption. Also the array of laws and regulations that define intellectual property rights and Formulation and implementation of innovation policy

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Characteristics of Respondents

From the sample ETAF, 80 sample respondents were included. Several explanatory variables such as gender, work experience, education background as well as area of occupation were included in the data in which the sample industries are currently engaged in order to describe the inherent background of the respondents of ETAF.

Table 4-1 Gender of respondents

gender of resp.	Freq.	Percent
Female	6	7.50
Male	74	92.50
Total	80	100.00

Source: Own survey, 2024

Note: 80 respondents representing ETAF

As it is shown, on table 4.1 that 74(92.5%) of the sample respondents were men, and the remaining 6(7.5%) were women. This suggested that there is virtually low female involvement in aviation technology transfer. According to the report, men and women should contribute differently to technology transfer. In study of, (Marintseva et al., 2022) Lack of role models for young girls and women in aviation", the problem of gender discrimination and societal stereotype that believes that the pilot is purely male type of job are dominant among the negative ones.

Table 4-2 Educational level of respondents

Edu-level	Freq.	Percent
B. degree	60	75.00
Diploma	12	15.00
Masters	8	10.00
Total	80	100.00

Source: Own survey, 2024. ***Note: 80 respondents representing ETAF***

As it shown, on table 4.2, in terms of education level of respondents, were diploma 15%, Bachelor degree 75% and 10% masters. It is clear that majority of the respondents have first degree implying that the education status in the organization is still at lower level. Due to the high cost of training and there are few colleges and universities in our nation that offer it, and there is a shortage of trained or educated workers.

Table 4.3, Concerning the position of respondents in the ETAF 10% are commandant/head, 20% Supervisor /crew chief and the rest 70% are technicians, were as ETAF established before 88 years.

Table 4-3 Position of respondents

position of resp.	Freq.	Percent
Commandant	8	10.00
Supervisor	16	20.00
Technician	56	70.00
Total	80	100.00

Source: Own survey, 2024

Note: 80 respondents representing ETAF

Table 4-4 Work experience of respondents

work experience	Freq.	Percent
1-5 years	7	8.75
5-10 years	25	31.25
More than 10 years	48	60.00
Total	80	100.00

Source: Own survey, 2024

Note: 80 respondents representing ETAF

According to table 4.4, in terms of work experience of respondents between 1-5 years are 8.75%, between 5-10 years are 31.25% and 60% are more than 10 years. This suggests that the bulk of sample respondents have more than 10 years or more of job experience. This suggests that increased work experience causes the population in the study area to grow, placing significant pressure on the technology transfer and competitiveness. Accordingly,

data was collected from those ETAF squadrons and depot maintenance group. In addition, interview was conducted with ETAF leaders. Hence, the next section deals about the result obtained from the survey.

4.2 **Channels of Inward Technology Transfer and Competitiveness**

Joint ventures and strategic alliances. The recent decays have witnessed another significant development in the international operations of firms from the industrial economies:

The growth of joint ventures and 'strategic alliances' linking firms from one or more countries (See, Agreement between, Ethiopia–United States in 1953, 1957, 1960, 1961, Ethiopia–Russia in 1964, 1998, 2021 Ethiopia–Czechoslovakia in 1980 and Ethiopia–United Arab Emirates in 2021). Many of the strategic alliances are concerned with the manufacture of Spare parts of Aircraft and overhauls of different types of Aircrafts and even joint development of new products. (Iskanadarani et al., 2013) the majority of Petrochemical technologies have been transferred mainly through joint venture companies in Saudi Arabia. Joint venture companies consider and control many internal and external aspects to assure a successful technology transfer. They are thus an important channel for international technology transfer.

Table 4-5 East African countries patent Applications

Country Name	Patent applications			
	2001-2010	2011-2015	2016-2021	Total
Chad	0	0	0	0
Eritrea	0	0	0	0
Ethiopia	23	25	43	91
Kenya	380	654	1318	2352
Rwanda	0	50	27	77
Tanzania	0	1	0	1
Sudan	949	785	1305	3039
Somalia	0	0	0	0
Uganda	37	24	88	149

Source: own analysis, Data from World Development Indicators, 2024

In tables 4.5 also indicate that a large share of patent applications are taken out by just four countries, with around 98% of all patent applications taken out by our four countries in all sectors. The Sudan is again the most important innovator as measured by patent applications. The Kenya is also a strong innovator in all sectors. For Uganda and Ethiopia, however all sector is the one where they patent medium intensively.

Table 4-6 Channels of Inward Technology Transfer

Form	**Variables**	**Number of respondents**							
		Category	SA (5)	A (4)	N (3)	DA (2)	SD (1)	Total	**Mean**
Market-mediated channels	Licensing	Fre.	35	31	3	5	6	80	4.05
		Per.	43.75	38.75	3.75	6.25	7.5	100	
	Joint Venture	Fre.	19	39	4	12	5	80	3.675
		Per.	23.75	48.75	5	18.75	6.25	100	
	Patent Right	Fre.	12	26	12	24	6	80	3.175
		Per.	15	32.50	15	30	7.5	100	
	Direct Purchase of Naked Technology	Fre.	13	36	17	7	7	80	3.5125
		Per.	16.25	45	21.25	8.25	8.25	100	
Non-market mediated channels	Imitation	Fre.	16	25	12	25	2	80	3.35
		Per.	20	31.25	15	31.25	2.50	100	
	Departure of Employees	Fre.	24	37	7	9	3	80	3.875
		Per.	30	46.25	8.75	11.25	3.75	100	
	Data in Patent Applications	Fre.	21	37	13	5	4	80	3.825
		Per.	26.25	46.25	16.25	6.25	5	100	
	Temporary Migration	Fre.	14	22	14	21	9	80	3.1375
		Per.	17.50	27.5	17.50	26.25	11.25	100	
								Grand	**3.575**

Source: Own survey, 2024

Note: 80 respondents representing ETAF, SA= Strongly Agree; A= Agree; N=Neutral; DS=Disagree; SD= strongly disagree.

The first objective of this study was sought to evaluate international technology transfer channels. Based on this, Table 4.6 above shows that the majority of respondents strongly agreed and agreed with the technology transfer channel's licensing mechanism.

Regarding to the channel of inward technology transfer mean value 4.05, 3.875, 3.825, 3.675, of respondents were high perception that licensing, departure of employees, data in patent applications, joint venture respectively.

The data analysis shows that most respondents feel that licensing gives them opportunities to consolidated inward technology transfer. Also they felt that the Joint Venture more important mechanism for inward technology transfer. They perceived that the departure of employees and direct purchase of naked motivated them to inward technology transfer.

On the other hand, the majority of the participants had low perception of the impact of channels/mechanism on their technology transfer. For example, they had low perception that patent right, imitation, direct purchase of naked technology and temporary migration.

4.3 **Comparing technology transfer channel and Competitiveness**

The above discussion of technology transfer mechanism underscores the variation among countries in the importance of different channels of inward technology transfer. Joint Venture, mechanism that is more important channel for inward technology transfer. In addition, Licensing appears to have been an important channel for technology transfer and Capital goods imports on occasion have complemented technology transfer through licensing.

Despite the significance of direct purchase and departure of employees as a channel for the transfer of advanced technologies, its importance within the development of Ethiopian air force differs significantly.

Though the relative importance for any single economy of these channels of inward technology transfer appears to change over time, the contrasts suggest that the channel of technology transfer alone is far from sufficient to explain its dynamic effects on the host economy. A number of enabling conditions must also be met, some of which depend on the institutions connected to an economy's national innovation system, such as national economic policy instruments.

It appears from the previous discussion of some technology transfer mechanisms that no single method is appropriate for all situations. Methods vary depending on the nature of the technology and the specific circumstances prevailing in each case. The effectiveness of the different approaches differs in terms of the ability of the technology recipient to learn and to acquire increased technological know-how. It is generally the combination of the desire

of the transferor to supply technology and know-how in a particular form and the ability of the receiver to acquire it in that form, which determines the mechanism of transfer in a particular case.

In the study of (Innovation, 2019) Over the past decade, Ethiopia's NIS and International Competitiveness has been a global race towards the expansion of the national innovation capacity by supporting start-up activities in the area of technological advancement. The number of newly established technology start-ups have increased at an average growth rate of 15% from 2010 to 2018, reaching about 18,000 globally. In a parallel movement, the amount of corresponding funding has grown at an annual rate of 21% in the same period and reached USD 190 billion. It is remarkable that they have been able to create 17 million jobs solely in 2018, and nearly 2.8% of world GDP can be attributed to the value-added activities conducted by technology start-up companies.

In the discussion above, we cannot say that this one is better single mechanism of technology transfer. As a result, using many routes for technology transfer simultaneously boosts competitiveness.

One can generally identify that joint ventures and licensing agreements are the most important channels of technology transfer to ETAF.

4.4 **The contribution of national innovation system on inward technology transfer**

The Ethiopian ecosystem of national innovation is still in an infantile stage of its development and therefore reveals a number of weaknesses. So far, the role and responsibilities of main actors are relatively well-defined, but the coordination mechanism is not fully established yet. Also, UNCTAD (2015; 80) pointed out that the Ethiopian S&T policy "has evolved in a fragmented manner" and was not well integrated with the national goal of successful industrial transformation. However, the establishment of the Ministry of Innovation and Technology as of 2019 can be regarded as a meaningful start of a more coordinated policy development and implementation. The MInT attempts to set a common goal accepted by all stakeholders of the National Innovation System, which is an essential element in the success of policies. According to (Innovation, 2019)The assessment of the current innovation ecosystem in Ethiopia demonstrates; the interaction and linkages among the ecosystem actors are relatively weak. At last, if most respondent responded to lift side,

just the factor is important NIS for inward technology transfer otherwise; the factor is not important NIS for inward technology transfer.

Regarding this issue result obtained from survey were presented in the following table 4.7. Four, Likert scale was used to gather data, that is importance of national innovation system for inward technology transfer expressed as Not relevant (experienced) - 1, Low-2, Medium-3, & High- importance-4. Then the two lift side (not experienced and low importance) and right side scales (medium and high degree of importance) are summed together to indicate whether the contribution of national innovation system are important or not for inward technology transfer.

Table 4-6 The contribution of national innovation system on inward technology transfer

No	Variables		Number of respondents(n=80)					
			4	3	2	1	Total	Mean
1	Support an organization/institution, which may perform research and play an important role in the	Fre	36	27	9	8	80	2.1375
		Per.	45	33.75	11.25	10	100	
	Support the organization within an economy that invest in R&D and in the application of new technologies	Fre	26	32	11	11	80	1.9125
		Per.	32.50	40	13.75	13.75	100	
	Any organization programs intended to support technology adoption	Fre	30	21	10	19	80	1.775
		Per.	30	26.25	12.50	31.25	100	
	The array of laws and regulations that define intellectual property rights.	Fre	17	23	20	20	80	1.4625
		Per.	21.25	28.75	25	25	100	
5	Formulation and implementation of innovation policy	Fre	21	23	12	24	80	1.5125
		Per.	26.25	28.75	15	30	100	
							Grand	**1.76**

Source: Own survey, 2024 ***Note: 80 respondents representing ETAF***

NE- (Not Experienced)-1, L - (Low)-2, M - (Medium)- 3, H - (High)-4

As shown above on the table 4.7, the grand mean value for contribution of NIS is 1.76 implies that it's an important role to inward technological transfer. Likewise, Support an organization/institution, which may perform research, play an important role in the training of engineers and technicians 2.1375, and support the organization within an economy that invest in R&D and in the application of new technologies 1.9125 are important, contribution of National Innovation System to inward technological transfer. Also, any

organization programs intended to support technology adoption 1.775 are important contribution of National Innovation System to inward technological transfer.

On the other hand, the array of laws and regulations 1.4625 and Formulation and implementation of innovation policy 1.5125 is less contribution of National Innovation System to inward technological transfer.

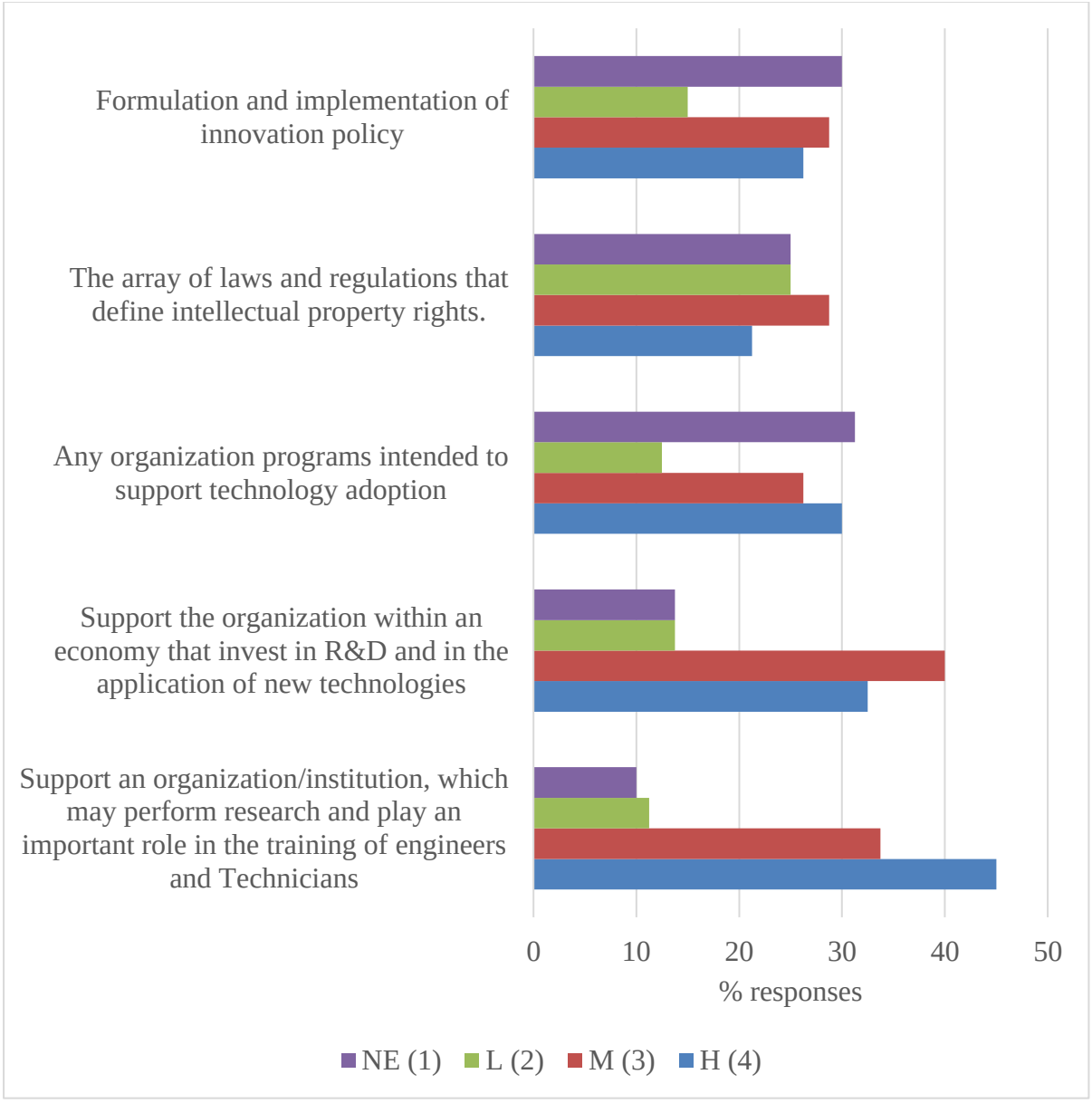

Figure 4-1 contribution of NIS to technology transfer

SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

5.1. Summary of findings

The main objective of this study was to find out which channels or mechanism of inward technology transfer was appropriate for ETAF that located in east Shoa, Bishoftu. The squadrons, Research and Development directorate and depot maintenance of ETAF located around east Shoa, Bishoftu were included in the study. Licensing, joint venture, patent right, direct purchase of naked, imitation, departure of employees, data in patent applications, temporary migration are considered. Licensing and joint venture shows suitable channels of inward technology transfer in ETAF.

The findings shows that Licensing, joint venture, departure of employees, data in patent applications had highly perceived and patent right, direct purchase of naked, imitation, temporary migration low perceived of technology transfer.

In addition to this, the study tried to assess the contribution of national innovation system to inward technology transfer in ETAF. It was finally found that the contribution of national innovation system to inward technology transfer in ETAF is weak and the interaction between National Innovation System and ETAF is also found weak.

Though the government attempts to strengthen domestic companies to absorb and assimilate new technologies through different channels of technology transfer, its performance so far has been very low. This could be due to different reasons, such as the poor controlling system of the government organizations, the weak relationship between companies, the weak implementation of innovation policy, and geopolitics of horn of Africa.

5.2. Conclusion

It can be concluded that, technology transfer channels, one may not find a direct answer to the question of which mechanism of inward technology transfer is more appropriate for the successful acquisition of foreign technology.

The choice of an appropriate method for inward technology transfer depends on some important factors. They include the stage of development and absorptive capacity of the

recipient country, the nature of technology being transferred, and the motivation and strategy of the supplier of technology.

Therefore, the most appropriate channel of technology transfer would be the one in which the recipient can effectively acquire the complete package of technology. These include joint ventures (share ownership and control), licensing agreements (the ownership and management responsibility with the host country, but with the supervision of the licensor), franchise contracts (sale of the use of the brand name and technical and managerial support), management contracts (supply of management personnel together with technical and managerial training for the local personnel. One can generally identify that joint ventures and licensing agreements are the most important channels of technology transfer to ETAF.

Support an organization/institution, which may perform research, play an important role in the training of engineers and technicians 2.1375, and support the organization within an economy that invest in R&D and in the application of new technologies 1.9125 are important, contribution of National Innovation System to inward technological transfer.

The importance of a national innovation system in mediating the inward transfer of technology from international sources underscores the interaction between national institutions and international trade and technology flows. The study's findings show national innovation system, positively affects inward technology transfers and competitiveness.

5.3. Recommendations

Regarding the channels of inward technology transfer due to the influence of global geopolitics, it is difficult to legally enable transfer technology, so it is important to strengthen and implement imitation (copying and reverse engineering) and motivate innovators.

The Ethiopian government to improve its national innovation system (NIS) by accurately defining the role of the government. After in-depth analysis of Ethiopia’s current situation with economic development and related policy initiatives as well as the country’s emerging national innovation system.

The interaction and linkages among the main actors NIS are relatively weak. So that the government to improve the interaction of the main actors of national innovation system.

Finally, the study recommended that The Ethiopian government to improve its national innovation system (NIS) by accurately defining the role of the government and the interaction and linkages among the main actors NIS.

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Appendix

Questionnaires and interview guide

Adama Science and Technology University

School of graduate studies

Masters of Technology and Innovation Management (TIM) program

i. Questionnaire

To be filled by Ethiopian Air force.

My name is Tsegaye Adugna, a post graduate student in Adama Science and Technology University (ASTU), MSC in Technology and Innovation Management. This questionnaire is part of my thesis and is aimed for academic purpose only. My thesis title is "**Inward technology transfer and competitiveness: the role of national innovation systems with a Special Focus to the Ethiopian Air Force"** Dear participants of this Questionnaire, as someone currently involved in this thesis, I would greatly appreciate a few minutes of your time to respond to the questionnaire. All information provided by you will be treated as strictly confidential. The questionnaire will only take 30 minutes to complete. Please fill it carefully and be a part of the solution of the problems regarding technology transfer in the country. Your participation is very much appreciated and will allow us to focus on critical issues related to inward technology transfer and competitiveness of Ethiopian Air force.

Please tick (√) or provide your own answers where applicable.

Thank you in advance for your indispensable cooperation to spare invaluable time and energy to complete these questionnaires.

I. Demographic background

1. Gender: 1. Male ☐ 2. Female ☐
2. Your education level: Diploma ☐ Bachelor degree ☐ Master's degree and above ☐
3. Current position:
   Commandant/Managerial ☐ Supervisor /crew chief ☐ Technician ☐
4. Total experience in the position:
   More than 10 years ☐ 10-5 years ☐ 5-1 years ☐ less than 1 year ☐

Institution/organization profile:

1. Institution/organization name……..
2. Year of establishment ……..
3. Main product types…….

II. Which are the best appropriate mechanism (channels) of technology transfer, in your institution

Form	Questions	Strongly agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly disagree (1)
Market-mediated channels	Licensing					
	Joint Venture					
	Patent Right					
	Direct Purchase of Naked Technology					
Non-market mediated channels	Imitation					
	Departure of Employees					
	Data in Patent Applications					
	Temporary Migration					

Do you think there are other methods of technology transfer in your institution? Yes ☐ No ☐

If your answer is yes, please mention

…….....

.....

.....

III. What is the contribution of national innovation system on inward technology transfer, specially for air force

Please put a check Mark (√) in the box

No	Likert scale items	3	2	1	0
1	Support an organization/institution, which may perform research and play an important role in the training of engineers and Technicians				
2	Support the organization within an economy that invest in R&D and in the application of new technologies				
3	Any organization programs intended to support technology adoption				
4	The array of laws and regulations that define intellectual property rights.				
5	Formulation and implementation of innovation policy				

KEY: 3 = High 2 = Medium 1= Low 0 = Not experienced (Not existed so far the services)

ii. Interview

My name is Tsegaye Adugna. Thank you for giving me your time. This interview aims at searching **Inward technology transfer and competitiveness: The role of national innovation system with a special case of Ethiopian Air force.** i.e. my post graduate thesis. The purpose of this interview is to add the government points of views regarding the problems related with the inward technology transfer and competitiveness to the research. All information provided by you will be treated as strictly confidential.

1. Name of the government organization: ……
2. position of the respondent: …….
3. The key missions of the organization…….
4. Is there an independent office which works at controlling and creating suitable environment for technology transfer?.....
5. If yes, at what level? ..... Directorate level/ team level/ or other?.....
6. What key purposes does it have? ……
7. What are the main methods your organization uses to create technology transfer linkages between manufacturing companies? ……
8. How do you measure if technology is transferred or not? Is there any controlling system? …….
9. What is the extent of the progress of technology transfer reported each year? ……
10. Is there any capacity building programs given to recipients (local firms) to be able to absorb technology? If yes mention……
11. Are there any governmental and private stakeholders working with your organization? If yes, mention them? ……..
12. Is your relationship strong enough to meet your plans?.....
13. What are the problems related with inward technology transfer? …….
14. Do you think the government policies and strategies are suitable to motivate TT? …
15. Is the structure of national innovation system and development departments at each government sector organizations compatible? …….
16. What are the main channels of technology transfer? ……..

17. What should be done by the government to face the problems? ……..
18. How competitive is the Ethiopian Air Force in East Africa?

Thank you again for your cooperation to complete this interview.