Academic Dissertation

The Soviet Forestry Industry in the 1950s and 1960s: A Project of Modernization and Technology Transfer from Finland

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Abstract

This study is devoted to technology transfer from the West (primarily from Finland) to the Soviet forestry industry during a period of rapid modernization under the rule of Nikita Khrushchev during the 1950s and 1960s. Under Khrushchev, the USSR sought to "catch up and overtake America". However, in the post-war period the Soviet Union suffered from a dearth of technology and expertise, and technology transfer from more developed foreign industries became a crucial aspect of modernization. Despite geopolitical competition and a vast ideological divide, Khrushchev aimed to transfer updated Western technologies to the USSR in different forms and practices. The Soviet Union established scientific-technical connections with several countries. The main source of modern technologies and machinery needed for paper and pulp production in particular was neutral Finland, which could be considered as "a window" to Western technological achievements for the Soviet Union. Exemplifying unique relations of West and East in the Cold War, Finland sold many techniques and provided expertise within the framework of scientific-technical cooperation.

This dissertation examines the role that technology transfer from the other side of the Iron Curtain played in Soviet modernization from 1955 to 1964. How did technical cooperation with a Western country develop in the context of the Cold War? How and in what forms did Soviet institutions and engineers transfer technologies? How did they deal with more advanced machinery and new expertise? How did they apply the new technologies and how did Soviet domestic research develop? Did these technologies help renew machinery, launch new production and enhance the development of the industry, as expected? If not, why? And, in general, did these foreign technologies lead to technological modernization? In answering these questions, the dissertation sometimes refers to previous periods in order to trace continuities and change.

Examining a vast collection of archival and published sources and using methods of the history of technology, the dissertation is focused on the forestry industry, which was one of key fields for expected positive changes in Khrushchev`s modernization. Its technological improvement was necessary not only for the increase of pulp and paper production to meet expanding consumption demands; the forestry industry was also a supplier for a large number of other both civilian and military industries, the latter of which received particular importance during the Cold War. Several plants and factories annexed after the Second Would War (in particular from Finland and the Baltic states) provided for the production of new sorts of pulp

needed for military use, and technological modernization of these factories as well as launching new production in other Soviet enterprises was seen as a crucial action for the development of many other industries. Cold War forestry technologies, thus, exemplified their capacity to be "a site of exchange", enabling cooperation among different industries, engineers, scientists and institutions.

The dissertation illustrates that technologies from Finland and from the West via Finland played a significant role in the Soviet economy while creating a need for continuing transfer. The Soviet leadership aimed to create its own innovations to launch domestic production of the newest technologies. While Soviet engineers succeeded in implementing some technologies, they failed to develop Soviet ones. The Soviet industry remained dependent on cooperation with countries with more advanced industry. The main reasons for this were shortages of raw materials. In addition, technical expertise in industrial enterprises contributed to this dependence. Additionally, within the USSR, there were barriers to technology transfer between institutions. Generally, the successful implementation of Western technologies was possible only when all the details, machinery and expertise, needed for the technology were transferred. At the same time, as a framework for cultural encounters, transfer entailed cultural impacts on Soviet engineers which helped them become more reflexive about work conditions and management practices at Soviet enterprises.

Tiivistelmä

Tämä väitöskirja tarkastelee teknologian siirtoa länsimaista (erityisesti Suomesta) Neuvostoliiton metsäteollisuuteen Nikita Hruštšovin modernisaatiopolitiikan kaudella 1950- ja 1960-luvuilla. Ajanjakso on merkittävä osa Neuvostoliiton modernisaation historiaa, sillä aikakautta leimasivat erilaiset suunnitelmat ja pyrkimykset "saavuttaa ja ohittaa Amerikka". Toisen maailmasodan jälkeen Neuvostoliitto oli länsimaisia kilpailijoitaan jäljessä teknillisessä osaamisessa sekä uusien ja edistyneiden tekniikoiden kehittämisessä. Siksi teknologian siirtoa kehittyneistä talouksista pidettiin tärkeänä keinona Neuvostoliiton vanhakantaisen metsäteollisuuden uudistamisessa. ”Lännen” ja ”idän” kilpailusta ja ideologisesta vastakkainasettelusta huolimatta Hruštšovin politiikka pyrki tuomaan maahan länsimaisia teknologioita eri muodoissaan. Vaikka Neuvostoliitto solmi sopimuksia tieteellis-teknillisestä yhteistyöstä eri valtioiden kanssa, oli sellu- ja paperiteollisuudessa modernin teknologian päälähteenä puolueeton Suomi, joka oli Neuvostoliitolle "ikkuna" lännen teknologiaan. Myydessään Neuvostoliitolle suuren määrän tekniikoita clearing-kaupalla ja tarjotessaan asiantuntijuutta tieteellis-teknologiseen yhteistyöhön puitteissa Suomi oli ainutkertainen esimerkki kylmän sodan itä-länsisuhteista.

Väitöskirjassa tutkitaan, mikä merkitys teknologian siirolla rautaesiripun yli oli Neuvostoliiton metsäteollisuuden modernisaatiossa vuosina 1955–1964. Miten teknillinen yhteistyö Neuvostoliiton ja länsimaan välillä oli organisoitu kylmän sodan kontekstissa? Millä tavoin ja missä muodoissa neuvostoliittolaiset instituutiot ja insinöörit tuottivat maahan uusia teknologioita? Miten pidemmälle kehitettyjä koneistoja ja uudenlaista asiantuntijuutta otettiin käyttöön? Miten moderneja teknologioita kyettiin hyödyntämään Neuvostoliiton olosuhteissa, ja miten kansallinen tutkimus Neuvostoliitossa kehittyi? Auttoivatko maahan tuodut teknologiat uudistamaan koneistoja, käynnistämään uutta tuotantoa ja kehittämään teollisuudenaloja, kuten oli odotettu, ja miksi? Kykenikö Neuvostoliitto kaiken kaikkiaan modernisoimaan teollisuuttansa näissä olosuhteissa? Vastatessaan edellä mainittuihin kysymyksiin tutkimus sivuaa myös varhaisempia ajanjaksoja ja pyrkii näin nostamaan esille jatkuvuuksia ja katkoksia eri historiallisten vaiheiden ja prosessien välillä.

Tutkimus nojaa laajaan arkistoaineistojen ja julkaistujen lähteiden kokonaisuuteen ja sen pääkohteena on metsäteollisuus, joka oli Hruštšovin modernisaatiokauden avainaloja ja monien odotusten perusta. Neuvostoliitossa uskottiin, että maan teknologinen edistyminen oli välttämätöntä paperin ja selluloosan tuotannon kasvattamiseksi sekä näiden tuotteiden

kulutukseen liittyvien vaatimusten täyttämiseksi. Tämän ohella metsäteollisuus toimi puolivalmisteiden toimittajana useammalle siviili- ja sotateollisuusalalle, joista jälkimmäiset olivat erityisen merkittävässä asemassa kylmän sodan aikana. Neuvostoliiton alueisiin toisen maailmansodan jälkeen liitetyt tuotantolaitokset (erityisesti Suomesta ja Baltian maista) tekivät mahdolliseksi uudentyyppisen sellun tuotannon. Näiden tuotantolaitosten modernisoiminen ja tuotannon käynnistäminen muualla maassa katsottiin ratkaisevaksi tekijäksi myös muiden teollisuudenalojen kehittämisessä. Kylmän sodan metsäteollisuuden teknologioita tuleekin tarkastella eräänlaisina vaihdon areenoina ("a site of exchange"), jotka mahdollistivat eri toimialojen, insinöörien, tieteenharjoittajien ja instituutioiden yhteistyön.

Tämä tutkimus havainnollistaa suomalaisten ja Suomen kautta tuotujen länsimaisten teknologioiden merkittävää roolia Neuvostoliiton taloudessa, joka kuitenkin lopulta jäi teknologian siirrosta riippuvaiseksi. Vaikka neuvostojohdon pyrkimyksenä oli luoda oma teknologinen perusosaaminen ja siihen nojaava modernien teknologioiden tuotanto, menestyivät neuvostoliittolaiset insinöörit lähinnä länsivalloista tuotujen teknologioiden käyttöönotossa mutta eivät omien teknologioiden kehittämisessä. Neuvostoliton teollisuus jäi riippuvaiseksi yhteistyöstä muiden maiden kanssa. Pääsyynä tähän oli tuotantolaitosten puutteellinen varustaminen raaka-aineilla sekä raja-aidat instituutioiden välillä. Teknologioita pystyttiin ottamaan käyttöön onnistuneesti vain silloin, kun kaikki teknilliset yksityiskohdat, koneistot ja teknologian hyödyntämiseen vaadittava asiantuntijuus siirrettiin. Huomionarvoista on myös se, että teknologian siirto eräänlaisena kulttuurisen kohtaamisen muotona vaikutti insinöörien ja tieteenharjoittajien ajatteluun ja antoi heille uudenlaisia lähtökohtia tarkastella johtamista ja työelämän käytäntöjä neuvostojärjestelmässä.

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Contents

List of original articles

This dissertation is based on the following articles:

I Kochetkova, E. (2016). Seeing the Forest and the Trees: Western Forestry Systems and Soviet Engineers, 1955 – 1964. *Technology and Culture*, 57(3), pp. 586-611.

II Kochetkova, E. (2016). "A Shop Window Where You Can Choose the Goods You Like": Finnish Industrial and Trade Exhibitions in the Soviet Union, 1950s-1960s. Manuscript.

III Kochetkova, E. (2015). A History of Failed Innovation: Continuous Cooking and Soviet Pulp Industry, 1940s - 1960s. *History and Technology,* 31(2), pp. 103-132.

IV Kochetkova, E. (2018). Industry and Forests: Alternative Raw Materials in the Soviet Forestry Industry from the Mid-1950s to the 1960s. *Environment and History*. Forthcoming.

The publications are referred to in the text by their roman numerals.

1. Introduction

«Comrades! We live in a wonderful epoch»[1]

Nikita Khrushchev

In 1959, at the 21st meeting of the Soviet Party, the Soviet First Secretary Nikita Khrushchev gave a speech entitled "About the key figures of the development of the national economy in the USSR 1959 - 1969". While describing how wonderful things were in the USSR, he declared that communism would be built soon in the Soviet Union. He predicted the rapid development of Soviet industries, including the most problematic sectors such as, among others, the forestry industry, consumer goods manufacturing, and agriculture. Khrushchev's enthusiasm for a better future can be explained by technological achievements and promises, which constituted, as the Soviet leader believed, the material base required for achieving communism.

After launching Sputnik in 1957, Khrushchev`s proclamation that the Soviet Union was able to "realize the most daring dreams of humanity" seemed to be true.[2] Indeed, this period was a remarkable time for technological development both in the Soviet Union and in other countries. There were substantial changes and rapid technological developments in computing, space engineering, light industry and consumption, and chemistry. Internationally, they had impacts on other industries, stimulating innovations, in particular in the forestry industry. For example, there were the processes of automatization of pulp making due to the development of computer science; manufacturing new types of cellulose due to chemical advancement; making special types of paper for butter and milk packaging, among others. In the Soviet Union, however, technological achievements in some fields, such as space engineering and the military technology, went together with technological backwardness in others, like forestry industry and agriculture. While the former technologies were highly advanced and often the subject of great concern of Western rivals,[3] the latter ones were not competitive and the Soviet leadership strove to upgrade them through its modernization program. Khrushchev`s modernization strategy

[1] *Vneocherednoi XXI s`ezd Kommunisticheskoi partii Sovetskogo Soiuza, 27 ianvaria-5 fevraliia 1959 g.* Stenograficheski otchet (1959). T. 1, Moskva, p. 119.

[2] Ibidem.

[3] Among the most well known examples of such a concern is Nelson, R. (1959). The Simple Economics of Basic Scientific Research. *Journal of Political Economy*, 67(3), pp. 297-306. He argued that the launch of Sputnik had illustrated that the USA did not allocate enough resources to basic scientific research. See more on US university research in the Cold War in Lowen, R. (1997). *Creating the Cold War University.* Berkeley.

sought to develop outdated Soviet industries based on the technological achievements of other countries while stimulating domestic innovations.[4]

Many historians have addressed, as described in chapter 4, the roles of technology transfer in Soviet technological and economic modernization. At the same time, this topic still presents a few lacunas, especially when we speak about marginalized industrial branches. In addition, there are still many questions related to the Soviet use of Western technologies that were transferred to the USSR despite the ideological confrontation between East and West in the Cold War. Western expertise was actively used during the whole Soviet epoch, i.e. in Stalin`s industrialization, during the war of 1941-1944 and afterwards.[5]During the East-West confrontation in the post-war period, it was mainly brought to the USSR in the framework of official cooperation agreements with capitalist counties.[6] Transferred technologies were embedded into techniques, equipment, and know-how and they played a significant role in both launching new production and developing existing manufacturing. Examining these processes – the transfer and implementation of Western technologies as part of Soviet modernization under Khrushchev - helps explain a vast array of themes such as the development of the Soviet industrial sector and innovations, Soviet resource use, communications of Soviet engineers and scientists, Soviet technological politics and East-West communications on different levels across the Iron Curtain, among others (see a layout of the thesis in appendix 5).

Focusing on these issues, this dissertation examines technology transfer from Finland to the Soviet Union, based on the example of the Soviet forestry industry, a backward industry which became a focus of modernization under Khrushchev and gained more applications in the military sector in the Cold War. Finland, a neighboring country and partner of the USSR, provided a large number of forestry industry technologies and techniques brought via trade and scientific-technical cooperation. This dissertation explains the ways in which Soviet research and trade organizations as well as engineers and industrial scientists transferred and implemented Finnish technologies in order to explain Soviet technological modernization as well as the outcomes of these transfers.

[4] See more in Kangaspuro, M. and Smith, J. (2006). Introduction. In M. Kangaspuro and J. Smith, eds., *Modernization in Russia since 1900,* Helsinki, pp. 11–20.
[5] Cohen, Y. (2010). Circulatory Localities. *Kritika*, 11(1), pp. 11-45, among others. See more on Soviet fascination with America in Ball, A. (2003). *Imagining America*. Lanham.
[6] Gould-Davies, N. (2003). The Logic of Soviet Cultural Diplomacy. *Diplomatic History* (27) 2, p. 207.

2. Study objectives and research questions

The aim of this dissertation is to examine technology transfer from Finland to the Soviet forestry industry during the Khrushchev`s modernization project. In so doing, I examine concrete practices of transferring, using and implementing Western technologies and their effects for modernization. This thesis, thus, investigates technological processes and their changes due to political, social, and cultural factors.

This implies answering several sets of research questions such as:

1) Soviet modernization in the forestry industry:

-How did the Soviet forestry industry develop and what were the reasons for its backwardness in the 1950s and 1960s?

-What were the specifics of Soviet resource use? What were its environmental consequences?

-In general, was the Soviet industry capable of modernizing?

2) East-West cooperation and technology transfer:

- How did technical cooperation with a Western country develop in the context of the Cold War?

-In what ways and forms did Soviet institutions and engineers transfer technologies?

-What were the cultural impacts of transfer and encounters between Soviet and Finnish engineers, scientists, and traders across the Iron Curtain?

3) Soviet innovations and implementation of Western technologies:

-What were Soviet technological innovations and what were the reasons for insufficient innovations in the forestry industry?

-How did Soviet engineers and industrial scientists deal with more sophisticated machinery and new expertise?

- How did they apply received technologies in the Soviet sphere?

-Did these technologies help renew machinery, launch new productions and enhance the development of industry, as was expected, and, if not, why?

My thesis is built around four peer-reviewed articles grouped into two main parts:

-mechanisms and practices of transfer (in what forms, by whom and how) and their effects (articles I and II)

-implementation and results (articles III and IV)

The thesis considers the technological modernization of the Soviet forestry industry through an interdisciplinary lens, examining the social and economic developments of the Soviet Union from the perspective of technology in its interplay with cultural, political and environmental factors. To varying degrees, this analysis relies upon the approaches of the history of technology and environmental history, economic and political history, and the history of science, which are all, in essence, interdisciplinary fields. Yet, this study is structured as a history of technology, which is relatively undeveloped within Soviet history. This approach enables me to contribute to the history of technology transfers from the capitalist to the socialist bloc, while also examining domestic innovation as part of technological modernization.

3.Background

3.1. The Soviet modernization project of 1955-1964

In general terms, Khrushchev`s modernization aimed to enhance Soviet technological development, including transforming industries that had long been ineffective. In the 1950s and 1960s, modernization became a frequently used word by actors on a variety of levels (see a discussion of the actors of this thesis in chapter 5). Officials and industry scientists, engineers and workers, used it when referring to different technologies and efforts to stimulate the development of specific industries.[7] In official Soviet pronouncements, the frequently used concept 'scientific-technical revolution' became "a defining characteristic of socialist modernity."[8]

Technological modernization is the focus of this thesis. Technological modernization entails actions taken to improve technology and innovations to achieve increasing sophistication with time. While addressing the literature on various cultural, political, and economic aspects of modernization, this thesis is focused on innovation and technology transfers as part of technological modernization. In the language of Soviet politicians, engineers, and industrial scientists, "to modernize" was a synonym for "to improve" or "to make more advanced."[9] This work accepts that, as Sari Autio-Sarasmo puts it, modernization implied making technologies more advanced in order to "transform extensive economic growth into intensive growth."[10] Nevertheless, this examination of technological modernization does not treat technology as "a matter in itself", but something influenced by and simultaneously influencing society. Because of its nonlinearity, the process of technological modernization is always connected to social, cultural and political changes.[11] Modernization of technology was important in building Soviet modernity and was part and parcel of the Soviet vision of the future.[12]

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[7] Kochetkova, E. (2014). Tekhnologicheskaia modernizatsiia v SSSR v 1950-e-1960-e gg. *Vestnik Permskogo universiteta*, 24(1), pp. 194-205.
[8] Reid, S. (2005). The Khrushchev Kitchen. *Journal of Contemporary History*, 40(2), p. 290.
[9] Kochetkova, E. Op. cit.
[10] Autio-Sarasmo, S. (2011). Knowledge through the Iron Curtain. In S. Autio-Sarasmo and Miklóssy, K., eds., *Reassessing Cold War Europe*. London and New York, p. 66.
[11] Inglehart, R. and Welzel, C. (2005). *Modernization, Cultural Change, and Democracy*. New York, p. 5.
[12] This thesis does not enter a large discussion on the essence of modernity, but examines technological developments that took place in the Soviet industry in the 1950s – 1960s. See more on modernity in Arnason, J. (2000). "Communism and Modernity." *Daedalus*, 129(1), pp. 61-90; Eisenstadt, S.N. "Multiple Modernities." *Daedalus*, 129(1), pp. 1-29 and David-Fox, M. (2015). *Crossing Borders*. Pittsburg. See more on socialist modernity

As early as in May 1955, the aims of modernization were set by a decree of the Central Committee of the Communist Party and the Council of Ministers of the USSR. This decree, titled "On the Improvement of Studying and Implementing the Experience and Achievements of the Advanced Domestic and Foreign Techniques," stated the need to introduce the latest achievements of "advanced science and technology" as well as to produce cheaper and more sophisticated materials and goods.[13] The Soviet project of modernization aimed to develop a more innovative base for competitive production as well as more rational ways of using resources.

In practice, however, the modernization process was not so straightforward. The Soviet industry might be seen as a "space of modernity,"[14] which was not just a matter of simply "catching up with the West" as the Soviet leader declared and countless lower level officials and actors repeated. It was a multi-faceted undertaking which was realized unevenly and in different ways in different industries and even within the same industries. To illustrate this, I will look at the micro level and examine in closer detail the subject of this dissertation: the forestry industry. In some cases, as in the production of viscose pulp, Soviet engineers proved able to advance technology within the domestic context. In other cases, success was based on the implementation of Western technologies, as in the case of bleached non-viscose pulp. The development of other technologies failed domestically. Instead, as in the case of continuous pulp cooking, production depended on the use of Western technology. Some technologies, like wood-cutting machines, were dependent on Western supplies which required foreign technical components. Finally, as was the case with pulp made from wood wastes and annual plants, some technologies failed and Western experience did not provide solutions. The methods and results of technological modernization were, thus, diverse and uneven.

The Soviet leadership's drive to produce more materials of better quality at a faster pace led to the introduction of new technologies. In many cases, as article III illustrates, the intense focus on fulfilling the plan impeded long-term investment in innovation.

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in Friedman, J. (2015). *Shadow Cold War*. Chapel Hill; Beilharz, P. (2009). *Socialism and Modernity*. Minneapolis and London; Bianchini, S. (2015). *Eastern Europe and the Challenges of Modernity, 1800-2000*. Abingdon and New York; Reid, S. and Crowley, D., eds. (2000). *Style and Socialism*. Oxford and New York; Harrison, M. (2014). Communism and Economic Modernization. In S.A. Smith, ed., *The Oxford Handbook of the History of Communism*. Oxford, pp. 387-406, among others.

[13] *Kommunisticheskaia partiia Sovetskogo Soiuza v rezoliutsiakh i resheniakh s`ezdov, konferentsii i plenumov TsK*. (1985). T. 8. Moskva, pp. 506, 508.

[14] The term "spaces of modernity" is discussed by Miles Ogborn in his analysis of London`s geographies in the 17th and 18th centuries. I accept this term for the Soviet case, given that modernities are multiple and might be approached through "contextualizing their historical geographies and considering the production of a variety of "spaces of modernity". Ogborn, M. (1998). *Spaces of Modernity*. New York, p. 12.

In the planned economy, modernization was centralized and economic management was politicized.[15] Although a vast number of actors at different levels were involved, the institution with central responsibility was the State Committee of the Council of Ministers on New Techniques (Gostekhnika SSSR). After its creation in 1948 to stimulate the development of new technologies, the Committee was reorganized many times. It was closed in 1951 and then reopened in 1955. Like the previous version and like similar, later, institutions, it was responsible for, among other functions, examining and implementing Soviet and foreign technologies and publishing scientific-technical works. With several departments based in different industrial branches, it played an important role in stimulating technological development in factories and research institutions. The modernization and innovation process was, thus, inspired and coordinated by the state through central institutions. In general, as Martin Kragh puts it, "a number of functions that in market economies can be found at the level of the firm – marketing, distribution and R&D – were in the Soviet system either wholly absent or organized at a higher administrative level".[16]

As part of state ideology, modernization meant much more than the benefits of technological development in the USSR. It aimed to exemplify the technological strength of the Soviet regime in the age of competition with the West. Making the state strong in order to be able to dominate economically and militarily was important.[17] Vladimir Kontorovich and Alexander Wein illustrate that Soviet textbooks and readers rarely mentioned the military when speaking about the objectives of Soviet economic development. But, as their research has illustrated, throughout the lifespan of the Soviet regime, military might was the state's primary objective.[18] The forestry industry and, above all, the pulp-making sector was an important factor in increasing the military capacity of the state. At the same time, as the historian Hugh Slotten writes, "the Cold War involved not only a quest for military superiority but also an effort to demonstrate national preeminence in science and technology as a means of asserting global political leadership".[19] Indeed, like the United States, the Soviet leadership held the conviction that the Soviet political and social system "was the best model for the development for human

[15] Harrison, M. Op. cit., p. 387. See more on the structures of Soviet economic performance in Gregory, P. and Stuart, M. (2001). *Russian and Soviet Economic Performance and Structure*. Rutgers and Gregory, P. (2004). *The Political Economy of Stalinism*. Cambridge.
[16] Kragh, M. (2013). The Soviet Enterprise: What Have We Learned From the Archives? *Enterprise and Society*, 14(2), p. 367. As Johan Arnason puts it, "the most salient feature of the Soviet model was a fusion of economic, political and ideological power, embodied in an apparatus that aimed at comprehensive control over all areas of social life". See Arnason, J. (2000). Communism and Modernity. *Daedalus*, 129(1), p. 72.
[17] Harrison, M. Op. cit., p. 392.
[18] Kontorovich, V. and Wein, A. (2009). What Did the Soviet Rulers Maximise? *Europe-Asia Studies*, 61(9), p. 1591.
[19] Slotten, H. (2002). Satellite Communications, Globalizations, and the Cold War. *Technology and Culture*, 43(2), p. 316.

societies."[20] It was expected that society would arrive at communism in twenty years. The Soviet leadership saw modernization as a rapid process which had a definite time frame and could help the Soviet Union take the lead in the international technological competition. For this reason, this thesis examines Khrushchev`s modernization as a project which looked to a future well beyond the time that Khrushchev was in power. In other words, the modernization project of 1955-1964 is defined in this dissertation by a political timeframe. This was a period when Soviet research institutes and enterprises aimed to increase the volumes of production and introduce new technologies to industry in order to beat the West and achieve full communism.

Still, Khrushchev`s modernization project had many connections with earlier and later Soviet technological developments. It resumed and continued previous projects, many of which had been stopped by the war. Indeed, as Alexandr Pyzhikov argues, many of Khrushchev`s statements and goals originated from the late Stalin years and even earlier.[21] As article IV mentions, modernization in the 1950s and 1960s was a return to many earlier ideas about new ways of production and the "non-capitalist experiment" in economic catch-up, ideas that originated in the 1920s and 1930s or even earlier. For example, using wood wastes and annual plants for making pulp and pulp-based products was a return to the idea from the 1930s about the complex use of resources. It meant that all parts of the tree should be used for manufacturing and should, thus, solve the problem of insufficient cuttings and wasteful wood harvesting. Article III presents an even more complicated picture dealing with continuous pulp cooking, which was invented by Soviet engineer Leonid Zherebov as early as in the mid-1930s (while he offered the first vision of this innovation several decades earlier). Despite many attempts to translate successful experiments into industrial production in the 1940s, under Khrushchev, the project was scrapped and similar Swedish equipment was purchased and used instead. In addition, the end of the epoch did not end innovation or the development of technological processes. Practices like automatization, using wood wastes to make pulp, and many others, continued. The impulses of the epoch were slow to die out and remained influential after 1964.

The processes of modernization were, thus, diverse and dependent on many factors related to the specifics of the Soviet technological and economic system. Those processes were defined by the interactions of industrial and research organizations, as well as their communication with the structures which supplied funding, techniques, and raw materials. The general aim of technological modernization was to make Soviet industry highly developed due to the use of sophisticated technologies.

[20] Adas, M. (2006). *Dominance by Design*. Cambridge, p. 247.
[21] Pyzhikov, A. (2002). *Khrushchevskaia ottepel`*. Moskva, pp. 25-26.

3.2. Soviet forests and forestry industry

This thesis proposes to examine as a technological system different operations of wood harvesting, wood working, and wood processing led by different branches of the forestry industry (pulp and paper, cardboard-making and other industries, as well as industries supplying wood, chemicals and techniques). All the processes contributed to the same technological project which implied that different bodies – factories, wood harvesting operations and timber mills, as well as research institutions and producers of techniques - should interact and cooperate. Some industries were dependent on others, as paper was dependant on pulp and both were dependent on wood supplies. For example, pulp production requires harvesting wood which, in turn, requires organizing forest infrastructure, creating techniques for cutting, transportation, and storing raw materials, establishing technological processes for disintegrating wood into constituent parts, and cooking, washing and packaging pulp. Forests and all the technologies related to their industrial use were, therefore, a vital component of the same technological system. The progress of the system as a whole, thus, depended on the performance of its all components. Planned manufacturing was, thus, "a plan of outputs and their use as inputs by others."[22]

Modernization set a number of general aims for the development of industry in 1955-1964. The first goals were articulated in the 1955 decree, and those related to pulp and paper production were reformulated in the 1960 decree "On the Measures to Overcome the Backwardness of the Pulp and Paper Industry." In general, the goals stated the need for significant growth in the production of different pulp-based materials by advancing techniques and equipping industries with more modern machinery. Engineers and scientists, as well as workers, specified these tasks as they defined the concrete problems which slowed the development of the system.

In total, the forestry industry occupied the third place in the Soviet economy based on the number of workers employed (on the number of industrial employees see appendix 1). But in terms of technological development, the forestry industry was a marginalized field during most of the Soviet period. During the industrialization drive of the 1920s and 1930s, several pulp and paper making plants were constructed, often with foreign equipment and technology. Despite this, the industry's capacity did not meet the increasing demands for pulp and pulp-based products for printing, food, construction, military and other industries. In the 1950s and 1960s,

[22] Gregory, P. (2004). *The Political Economy of Stalinism*. Cambridge, p. 15.

Soviet ministries and engineers, as well as the leadership, referred to the forestry industry as backwards, needing improvement (or modernization); they criticized previous policies and developments. Thus, the 1959 decree of the Council of Ministers "On the Improvement of Forestry in the RSFSR" stated that forestry was poorly organized, forests were improperly cut, there were a lot of forest fires, etc.[23] Engineers often used the fact of backwardness in the industry when describing the need for innovation or travel abroad.

This thesis describes the forestry industry system as insufficient in the mid-1950s and illustrates that "there was a close connection between the attempt to construct socialist modernity and crisis".[24] Thus, article IV illustrates in detail the dysfunction of wood harvesting, the basic components of the forestry industry, as well as political and scientific attempts to cope with problems. While the Soviet Union was a leading country in terms of volume of wood harvested (see appendix 2), the quality of cut wood was not high due to insufficient infrastructure and badly organized transportation and storage. To a large extent, Soviet work in the forests relied on the GULAG`s involvement in harvesting. In the 1930s and 1940s, the GULAG accounted for up to 50 per cent of all harvesting works.[25] By the beginning of Khrushchev`s modernization, forest operations had not improved significantly.

As articles I and III illustrate, the production of pulp-based materials was also problematic. Previously, GULAG authorities often lead the construction of new pulp and paper factories, such as the Solikamsky sulphite pulp factory (80 percent of workers were prisoners) as well as the Arkhangel`ky and Segezhsky pulp and paper plants.[26] These and other enterprises built in the industrialization of 1930s were large, high-powered, and often equipped with modern machines. In the early 1940s, the NKVD (the Commissariat for Internal Affairs, responsible for administering the main forced labor camps) also led the reconstruction of enterprises in annexed areas, in particular in the formerly Finnish industrial area of the Karelian Peninsula. The enterprises annexed from Finland, the Baltic states and Japan were well advanced technologically before the war. [27] By the beginning of the modernization of 1950s and 1960s, however, most of the machines in these enterprises became outdated and had not been renovated properly. While technical knowledge in the forestry industry was rapidly developing in the post-

[23] Postanovlenie Soveta ministrov «Ob uluchshenii vedeniia lesnogo khoziaistva v lesakh RSFSR// State Archive of the Russian Federation (GARF). F. 510. Op. 2. L. 2.
[24] Merl, S. (2011). The Soviet Economy in the 1970s – Reflections on the Relationship Between Socialist Modernity, Crisis and the Administrative Command Economy. In M.-J. Caltis, D. Neutatz and J. Obertreis, eds., *The Crisis of Socialist Modernity. The Soviet Union and Yugoslavia in the 1970s*. Göttingen, p. 28.
[25] Ivanova, G. (2013). Stalinskii lagerno-promyshlennyi kompleks. In L. Borodkin, S. Krasil`nikov, O. Khlevniuk, red. *Prinuditel`nyi trud v SSSR. Ekonomika, politika, pamiat`*. Moskva, p. 42.
[26] Ibid., p. 39.
[27] See more on these plants in Sutton, A. (1973). *Western Technology and Soviet Economic Development. 1945 – 1965*. Stanford; Kilin, Iu. (1999). *Karelia v politike sovetskogo gosudarstva, 1920–1941*. Petrozavodsk; Autio, S. (2002). *Suunnitelmatalous Neuvosto-Karjalassa. 1928–1941*. Helsinki.

war years in Finland, Sweden, Canada and other countries, the Soviet forestry industry, despite some innovative developments, was mostly characterized by technological slowdown. For example, new methods of making and bleaching pulp, manufacturing whiter and firmer paper, new types of packages, cardboard and other goods were critical problems in the Soviet system. In addition, the consistent problem in production was the lack of professionals in the field. Managers and workers usually remained unmotivated, and as Joseph Berliner puts it, "managers systematically conceal their true production capacity from the planners, produce unplanned types of products, and falsify the volume and quality of production".[28] When the need to fulfill the plan was pressing, the system could not cope with the tasks because of technological drawbacks, delays in supplies of raw materials, lack of qualified workers, and the prioritization of quantity over quality. In some cases, the numbers were completely fabricated.[29]

It is crucial to note here that the dysfunctions of the system did not appear in the 1950s and were inherited from the Stalin era. As I stated above, many technologies developed in the 1950s and 1960s built on already existing ideas or technologies. Some problems, like the insufficient supply of wood for the pulp industry, appeared in the 1920s or earlier and existed during the whole Soviet period.

Many of the system's problems derived from the barriers between different parts of the forestry industry system. These were structural problems in the planned economy. They caused frequent delays in supplying factories with raw materials and technical details. In order to solve communication problems, the government constantly reformed the system of administration by changing the number of ministries and committees or passing functions from one institution to another. A significant change was made in the introductive of administrative reform in 1957. Enterprises were given to authorities of territorial organizations or sovnarkhozes. Within the new territorial entities were branch administrations which provided for the unification of wood harvesting, forestry, wood processing, and pulp and paper industries under the same organization. Subsequently, the Ministry of the Forestry Industry (created in 1946 and reorganized several times before 1957), the Ministry of the Paper and Woodworking Industry (created in 1954) as well as the Ministry of Silviculture (created in 1947) were reorganized in order to solve management deficiencies. These problems lay largely in the ministerial barriers to commodity exchange between enterprises.[30] The main administration for forest management

[28] Berliner, J. (1988). *Soviet Industry from Stalin to Gorbachev*. Aldershot, p. 61.
[29] See more in Kochetkova, E., Pokid`ko, P. (2016). Istoriia zavoda v Iokhannese (Sovetskom) v 1944-1951 gg. *Rossiiskaia istoriia*, 3, pp. 166–176.
[30] Joseph Berliner explains this problem as "a typical instance was the enterprise that possessed excess stocks of some scarce commodity while a neighboring enterprise`s production plan foundered for lack of that commodity; but the redirection of that commodity from the first enterprise to the second was inhibited because they belonged to different ministries". Berliner, J. (1988). Op. cit., p. 98.

became the Main Administration of Forestry and Protective Afforestation, which was responsible for forests in sovnarkhozes. In 1959, new organizations such as The Main Administration for Silviculture and Forest Protection or Glavleskhoz were created in the republics of the USSR except the Belorussian Republic.[31] Thus multifunctional organizations concentrated on wood harvesting, forest protection and other tasks (see a structural scheme of the forestry industry administration in appendix 4).[32] Glavleskhoz should have bound forestry to the forestry industry, in particular by managing supplies of wood from timber mills to industrial enterprises. These bodies acted only in sparsely forested zones while Sovnarkhozes had the same functions in heavily forested areas.[33] In addition, in 1962, the Committee of the Council of Ministers of the USSR on Forestry Industry, Pulp and Paper and Woodworking Industries and Forestry was created.

In total, if we believe the reports of annual inspections of forests, timber mills and industrial enterprises, such reorganizations were not effective. In fact, they did not stimulate innovations and the earlier problems of wood supplies and technology as well as the problems of communication between different institutions and organizations remained. Moving the functions from one body to another was rather a formality and did not change the essential problems of the industry and forest management. This thesis is focused on internal processes of the development of the system, paying attention to the evolution of technology and innovation and the reasons for the slowness of that evolution.

3.3. Soviet technology and innovation

In general terms, technology is knowledge which combines material aspects (techniques) and non-material aspects (know-how). The development of industrial technology happens through innovations and depends on many factors, but first of all on the primary social actors – engineers and industrial scientists as well as workers. The Soviet epoch, starting from the 1930s, saw a movement towards active innovation called rationalization and inventiveness (ratsionalizatorstvo i izobretatel`stvo) as well as towards new methods to speed up work.[34] Starting from the 1930s on, the state encouraged so-called inventors and rationalizers, especially among workers, to make small inventions to help speed up production and manufacture more

[31] *Lesnoe khoziaistvo SSSR za 50 let (1917–1967).* (1967). Moskva.
[32] GARF. F.A510. Opis` 1. L. 2–3, 5.
[33] Richards, E. (1987), ed. *Forestry and the Forest Industries*. Dordrecht.
[34] See more, for example, in Siegelbaum, L. (1988). *Stakhanovism and the Politics of Productivity in the USSR, 1935-1941.* Cambridge; Davies, R.W. and Khlevniuk, O. (2002). Stakhanovism and the Soviet Economy. *Europe-Asia Studies*, 54(6), pp. 867–903, among others.

materials. Archival sources are full of such examples, often describing inventions which helped the workers cope with the outdated techniques and the lack of materials. The movement was directed to making production faster, a dominant aim of the Soviet epoch.[35]

At the same time, the number of inventions which were put into production was very small. In other words, the process of making invention into innovation was problematic and episodic. As Loren Graham has recently argued, this tendency was (and still is) a chronic one: there were a lot of bright inventors in the Russian Empire and the USSR, but their inventions were not translated into production or spread throughout the society or industry.[36] There are a number of explanations for this phenomenon. Graham, for example, argue that liberalizing economic and social reforms was necessary.[37] At the same time, some innovations were successful, like those in the military sphere or early Soviet medicine, which means that the political and economic system as such is not an adequate explanation. Moreover, a case examined in this dissertation illustrates that some inventions were not just simply shelved, but that state and engineers allocated large material and social resources to their development over a long period of time. Thus, article III discusses in detail the invention of Leonid Zherebov, which was seen as promising by state officials although not by some engineers, and which remained on the agenda for more than 20 years.[38]

This dissertation emphasizes that the forestry industry gained an additional meaning in the mid-20th century. In the Cold War context, dividing military and non-military technology became complicated. Cold War technology gained several meanings and uses.[39] As Kristine Bruland and Dave Mowery say, "the emergence of organized industrial research also affected the role of government in the innovation process, as public funding for research grew after 1945 and new public organizations were created to manage innovation for military and other government missions".[40] Article III illustrates this connection in the pulp-making industry which was a supplier for military aviation and gun powder manufacturing. Military connections made some innovations secret and in practice prevented the exchange of knowledge and wider cooperation among research institutions and enterprises required for developing the technology as in the case

[35] On the structures of Soviet innovations see Kolesnikov, A. (2010). *Istoriia izobretatel`stva i patentnogo dela v Rossii. Vazhneishii sobytiia i fakty v istorii otechestvennogo izobretatel`stva.* Moskva.
[36] Asif Siddiki, however, illustrates the success of space innovations, which were based on enthusiasm, imagination and state support. See in Siddiqi, A. (2010). *The Red Rockets` Glare.* Cambridge, New York.
[37] Graham, L. (2013). *Lonely Ideas. Can Russia Compete?* Cambridge.
[38] See for comparison the story of Carl Bosch who spent many years on his successful innovation in Smil, V. (2005). *Creating the Twentieth Century*. New York, p.18.
[39] See more in Leslie, S.W. (1993). *The Cold War and American Science.* New York.
[40] Bruland, K. and Mowery, D. (2015). Technology and the Spread of Capitalism, Cambridge History of Capitalism. In L. Neal and J. Williamson, eds., *The Cambridge History of Capitalism,* vol. 2. Cambridge, p. 82. See also Harrison, M. Op. cit., p. 390.

of continuous pulp cooking.[41] Some technologies, however, were trickier and in Alan Dobson's terms, inherited chameleon-like duality; their strategic meaning depended on the situation.[42] For instance, the forestry industry supplied the military, including the army, with packages and paper which were also used in the non-military sphere. This duality caused a lot of questions in the discussions of embargoes in the West and might be observed in the words of Khrushchev. He asked if buttons were strategic goods if they were used in military clothes.[43] One way or another, secrecy was a filter which often hindered the development of innovations, especially those which required broader discussion and advice in non-military industries. To varying degrees in different periods, the scope of Soviet secrecy was broad, and there was a thorough filter on any official information published and transmitted in Soviet Union.[44] It was not only official state censorship but also secrecy on the micro level, even among institutions involved in the same project but with different degrees of access to the secret innovation. For example, the Central Institute for Paper and Pulp (TsNIIB, in 1960–1964 called the All-Union Institute of Pulp and Paper Industry, VNIIB) was one of the leading institutions in research on pulp and paper-making technology. This thesis illustrates that the communication between this and similar institutions and industrial enterprises was not very active and complicated by the need of each to fulfill the plan set by the state.

Innovations were expected to solve the problem of backwardness and facilitate modernization. This is why when domestic innovations did not succeed, Western technology was proposed to substitute for it and to solve the problem of backwardness. In many cases, for engineers, it was easier to start immediate production using foreign technologies, even if they were brought as experiments. Engineers produced and copied as many reports as possible on inspections of these new experimental technologies. In other words, some techniques proposed for imitation were installed at enterprises and used in production, not in research. In practice, however, innovations required time and often took place by way of trial and error.

3.4. Technology transfer

As modern scholarship states, during the Cold War, the Soviet Union was not an autarkic economy, but had many connections with Western Europe, United States, African and Asian

[41] As article III illustrates, there was less secrecy after Khrushchev came to power.
[42] Dobson, A. (2005). Some Thoughts about Concepts and Explanation Relations. In J. Eloranta and J. Ojala, eds., *East-West Trade and the Cold War*, vol. 36. Jyväskylä, p. 26.
[43] Maksimov, A. (1999). Zapiski chernorabochego razvedki. Available at http://www.e-reading-lib.org/chapter.php/149359/21/Maksimov_-_Operaciya__Turnir_._Zapiski_chernorabochego_razvedki.html [Accessed 7 Jan. 2016].
[44] See more in Hutchings, R. (1987). *Soviet secrecy and Non-Secrecy*. London.

countries.[45] There always were some connections between the USSR and Western countries, although with a different form and intensity. The post-Stalin Soviet leadership realized the need for more intensive communication with the outer world than had existed in the early 1950s. In order to win the Cold War competition, the Soviet leadership had to seek out foreign technologies using more channels than before. While countries of the Third World were often a space for implementing Soviet technological projects, the Western world was an important source of new technologies and techniques.

This dissertation analyzes technology transfer as the process of bringing and implementing useful and more sophisticated technologies in a less developed technological system. Transfer entails several processes: 1) crossing national borders and the borders of technological systems by individuals; 2) examining foreign experience; 3) transporting material (techniques and artifacts) and non-material (expert knowledge and social practices) aspects of technologies; 4) adapting and diffusing received technologies. In these processes, both transfer agents and the technologies they bear are vulnerable to changes due to interaction with a wide variety of factors, social (other experts), cultural (other cultures as a set of practices for working and living, languages), technological (other technological systems), economic and political. More precisely, influential agents are constrained by the lack of financial and technological resources, specific political conditions and ineffective bureaucracies, poor infrastructures, etc. [46]

Scholars stress that there were a number of channels for transfers such as diverse forms of trade activities, mutual projects of construction and renovation, visits by engineers to foreign enterprises and research organization, purchase of literature, and espionage. For the Soviet modernization of 1950s and 1960s, all these forms were important. For example, technology transfers from Finland ranged from the purchases of Finnish woodcutters to the construction of the Baikal pulp and paper plant with the active participation of the Finnish company Rauma-Repola.

This thesis is focused on two important processes that until now have not been thoroughly examined in the literature. Compared to the previous epoch, these forms of transfer were more visible in Khrushchev`s time. Articles I and II discuss visits by Soviet forestry industry specialists abroad, primarily to Finland, and one aspect of trade activities, namely Finnish trade and industrial exhibitions held in the USSR. There were more specialists going abroad and more international exhibitions held in the Soviet Union than before. The main actors in all these activities were individuals, in particular officials who made decisions about purchases and sanctioned trips abroad and engineers who selected the required techniques and

[45] See more in Sanchez-Sibony, O. (2014). *Red Globalization*. Cambridge.
[46]Cohen, G. (2004). *Technology Transfer*. California, London, p. 22.

learned new technologies from abroad. These actors were those who transported new technologies and those who implemented them. When travelling abroad and transferring technologies, they, above all industrial scientists and engineers, acquired different roles. Soviet specialists or delegates to foreign countries became both agents of transfer and actors promoting modernization; they acquired new expertise and had a responsibility for spreading and implementing new knowledge. The range of technologies studied in Western countries was broad and concerned various aspects of technological processes in wood harvesting, forest works, and the production of pulp-based materials. For example, the Soviets were interested in methods of cutting, transporting, and storing wood, technologies of bleaching pulp, new paper-making machinery, packaging technology. Although there was a general program of modernization, the concrete technologies to transfer were chosen directly within enterprises and research institutions and were not systematized as a whole program. Instead, there were many separate initiatives to learn about new technologies coming from different parts of the forestry industry system.

Transfer involved a number of actors at different levels.[47] While this dissertation examines primarily specialists – engineers and industrial scientists - (depending on the context, I call them transfer agents, delegates, and system builders) as the key actors, articles I and II also consider organizational aspects of transfer. Technology transfer involved state organizations from the Soviet side, such as the aforementioned Gostekhnika (and similar institutions), ministries, trade organizations as well as the mutual Finnish-Soviet Trade Chamber, which led the organization of trade and industrial exhibitions, and the Finnish-Soviet Scientific-Technical Commission, which was responsible for travels by engineers. It also involved organizations at lower levels such as industrial enterprises, firms, and research organizations, which sent their representatives and collected the results of transfer. But finally, and most importantly, technology transfer was fulfilled by transfer agents or specialists (engineers and scientists) who visited Finnish enterprises.

One of the key questions that follows is the impact of the process of transfer on transfer agents or those who crossed the Iron Curtain. As Kendall Bailes indicates, the 16th Meeting of the Party in 1930 claimed that "the most advanced capitalist technology should be borrowed, but borrowing should not necessary extend to other, particularly organizational, aspects of capitalist economies."[48] The same was true in the 1950s and 1960s under an ideological system that still did not imply bringing anything more than techniques. In other words, the Soviet leadership separated the social and the technological, intending to bring technologies without changing the

[47] See the detailed structures of Finnish-Soviet cooperation in Suomi-SNTL. Raportti Suomen ja Neuvostoliiton välisen yhteistyön metodologiaa koskevasta tutkimuksesta (1980). Helsinki, Osa 1–2.
[48]Bailes, K. (1981). The American Connection. *Comparative Studies in Society and History*, 23(3), p. 440.

society. A relevant question was, as George Holliday formulated it, "do transfers of technology free the East from reliance on imports from the West, or, conversely, do they generate demand for complementary technologies and intermediate goods and for periodic technological updates?"[49] As article I illustrates, transfer of technologies is about the changes of both technology and actors` views. In other words, while being abroad, in Finland or elsewhere, Soviet transfer agents saw other cultural and social environments which challenged their views of Soviet practices and working conditions as well as the general performance of Soviet technological systems. In this sense, technology transfer always means something more than just technology, and includes social and cultural transformations. This illustrates what Bernhard Irrgang says about technology transfer: in his opinion, the transfer can include three components: cultural transfer, technique or technology transfer, and moral or sometimes ethics transfer.[50] For some authors, "for much of Russian history, modernization has been almost synonymous with westernization".[51] My analysis in article I illustrates that to a varying degrees all these components were transferred by Soviet engineers across the Iron Curtain. After coming back, the transfer agents discussed not only the forestry technologies they saw in Finland but also such organizational questions as wages, work hours, labor conditions, relations between workers and managers, and work culture. Although such discussions were not archived with great care and I found only a limited number of them, those that were preserved show the "unintended influences" which technology transfer could cause. [52]

3.5. The Iron Curtain and technological cooperation

This dissertation begins from the thesis that the Iron Curtain was permeable and the Cold War was not just a confrontation between superpowers. This statement has been frequently articulated by the recent historiography. The modern literature, as chapter 4 illustrates, gives many examples of transfers, border crossings and multiple contacts between actors from two blocs. To a large extent, the Soviet Union maintained the impulse to increase the number of contacts despite the Cold War in the late Stalin years. In these years, peaceful coexistence was

[49] Holliday, G. (1984). Survey of Sectoral Case Studies. In S. Gomulka, G. Holliday and A. Nove, eds., *East-West Technology Transfer*. Paris, p. 58.
[50] Irrgang, I. (2007). Technology Transfer and Modernization. What Can Philosopher of Technology Contribute? Available at http://ubiquity.acm.org/article.cfm?id=1331965. [Accessed 10 Dec. 2015].
[51] Kangaspuro, M. and Smith, J. (2006). Op. cit., p. 11.
[52] Autio-Sarasmo, S. (2016). Technological Modernization in the Soviet Union and Post-Soviet Russia: Practices and Continuities. *Europe-Asia Studies*, 68(1), pp. 79–96. As Kristine Bruland and Dave Mowery say, "innovation was spurred by the growth of capitalism, but technology (including but not limited to military technology) had powerful effects on the global spread of capitalism». Bruland, K. and Mowery, D. Op. cit., p. 108.

first mentioned as a new principle of Soviet foreign politics.[53] This concept was further developed by Khrushchev, who made it the most important vision of Soviet officialdom. In general terms, peaceful coexistence declared that while continuing competition in the non-military sphere, the states should retain a focus on military competition. In fact, as the famous "kitchen debate" had illustrated, this competition in living standards "closely linked guns and kitchens."[54] The Soviet leader and officials declared their commitment to peaceful coexistence in their addresses to capitalist, socialist, and neutral countries. In particular, Soviet intervention in the decolonized countries of the Third World was often justified by mentioning cooperation and the Soviet desire to pursue peaceful coexistence.[55]

These politics carried a number of implications. First, the Soviets desired to transfer technologies and purchase equipment for modernization under peaceful coexistence. As Khrushchev said, "if we took all the positive features of the capitalist economy and translated them into socialist soil, we would get socialist results."[56] This meant the belief that communication with the West would not bring anything ideologically unintended and it would be possible to differentiate technology from politics. This relates to Lauren Graham's comments about Soviet and Russian innovation in his recent presentation at the Economic Forum in Saint Petersburg. According to him, the problem of Soviet/Russian innovative politics is the desire to get milk without a cow or to have sophisticated technologies without changing the social and political system.[57] Indeed, the Soviet leadership saw technological development as a process separate from political development.

Second, this intention met some obstacles in embargoes set by the capitalist bloc. Established in 1949 to control the flaw of strategic goods to the socialist countries, the Coordinating Committee for Multilateral Export Controls (CoCom) set three embargo lists promoted by the US government. In 1950, list 1A included 167 goods strictly prohibited for selling to the USSR like military, oil and chemical equipment, as well as techniques related to the production of atomic energy.[58] In 1954, the first list included 500 items. Later, however, actual trade activities witness many changes despite the developing Cold War. As Alan Dobson writes, by the late 1950s, the embargo began to weaken and became mostly symbolic. At that

[53] See more in Pyzhikov, A. Op. cit.
[54] Oldenziel, R., de la Bruheze, A. and de Wit, O. (2005). Europe`s Mediation Junction. *History and Technology*, 21(1), p. 109.
[55] See more on the geopolitical game in the Third World in Westard, *O.A. (*2007*). The Global Cold War*. Cambridge.
[56] Rosenberg, V. (2005). *Soviet-American Relations, 1953–1960.* Jefferson, p. 147.
[57] Graham, L. (2016). Moloko bez korovy. Available at https://www.youtube.com/watch?v=T9AABp4PA_4. [Accessed 28 Aug. 2016].
[58] McGlade, J. (2005). CoCom and the Containment of Western Trade and Relations. In J. Eloranta and J. Ojala, eds., *East-West Trade and the Cold War*, vol. 36, Jyväskylä, p. 49.

time, it was clear that the embargo had failed to retard Soviet economic development while embargo restrictions remained the only effective means of signaling about East-West tensions.[59]

Some European industrial producers shared the leadership's attitude of concern about the flow of strategic and high technology to the USSR, a potential competitor. To some extent, such concerns might be found in Swedish forestry newspapers in the late 1950s, the years of the peak of Soviet modernization. These publications mentioned significant achievements of the USSR in the forestry industry and the rational use of forest resources. They said that the Swedish foresters "would have to recognize a serious competitor in a couple of decades."[60] Such concerns could be explained by Soviet propaganda, or they might derive from the fact the authors could travel to the USSR and see the best Soviet exemplars. At the same time, there were opposite opinions. Other producers, in particular Paul Chambers, the head of Imperial Chemical Industries in Britain, argued in 1966 for the superiority of the private capitalist economy over the totalitarian economy. As he said, "factories… established on today`s technologies would become backward in several years."[61] These conclusions were probably just an assumption as the real state of things in the USSR, including the forestry industry, was hidden behind the Iron Curtain; those who came to the USSR were shown only best samples and best enterprises. But, indeed, if one considers the rapidly developing chemistry internationally from the 1950s-1960s on, this position was reasonable.

I assume that Finnish producers had similar views on the possibility of technological development in the USSR. Some Finnish engineers were convinced that the Soviet industry lagged behind and could not provide anything useful for Finnish manufacturing. As Soviet specialist Kholmovskyi said, once talking with a Finnish engineer who travelled to the USSR, he heard that "there was nothing new to learn in the Soviet Union". He concluded: "It is, thus, clear to them, that they can learn nothing new from us in the field of sawmilling." Some respondents who gave interviews for my research also admitted that there was a significant gap between the Finnish and Soviet technological systems.[62]

Different channels of technology transfer were formalized and usually took place within negotiated forms of cooperation between the USSR and a foreign country. In the case of Finland, there were two basic forms of cooperation which enabled transferring technologies from Finnish

[59] Dobson, A. (2010). From Instrumental to Expressive. *Journal of Cold War Studies,* 12(1), p. 109. Frank Cain also provides a deep investigation of conflicts between the USA and Britain on the question about embargo. See more in Cain, F. (2007). *Economic Statecraft.* Oxon, pp. 5–6.

[60] Älbäck, A. Skogsbruk och trävarvövelse i allmanhet. Sigtunastiftelsens Klipparkiv. Avd. Q8; Störingar från öster Ryssarna tränger. Sigtunastiftelsens Klipparkiv. Avd. Q8.

[61] McElheny, V. (1966). East-West Exchanges of Technology Increase Rapidly. *Science*, 153, p. 157.

[62] Stenogramma zasedaniia Prezidiuma tekhnicheskogo soveta Ministerstva lesnoi promyshlennosti SSSR po dokladu A.N. Kholmovskogo o komandirovke v Finliandiiu// Russian State Archive of the Economy (RGAE). F. 7637. Op. 1. D. 3288. L. 49.

industrial enterprises and research institutions to the Soviet Union. In 1950 Finland, became the first capitalist country to sign a five year trade agreement with the Soviet Union.[63] Its share in Soviet imports of equipment for the forestry industry was quite significant (see appendix 3). The agreement continued trade activities on the bilateral basis set in 1945, now established for a longer time period. This meant that deals between the governments were made with no payment in hard currency, i.e. national money did not cross the state borders. In this exchange of goods, the overall cost of Finnish exported products was to correspond to the cost of Soviet goods evaluated in a non-convertible currency. Such payments were fulfilled by the Bank of Finland and the Soviet Bank for Foreign Trade (Vneshtorgbank) in rubles. Trade items were defined by five-year trade agreements, and additional treaties were signed every year to specify the items based on the current situation and the needs of each country. Additionally, in 1955, the countries signed an agreement on cooperation in science and technology. This agreement defined several forms of exchange of professional knowledge such as trips by engineers to a partner country, exchange of scientific-technical literature, joint conferences, and more.[64] For the Soviet government, the trade with capitalist Finland was important in terms of showing to the world that the socialist system was capable of cooperating with the West. It fit with the policy of peaceful coexistence and demonstrated that the USSR was promoting a peaceful relationship with capitalist countries while simultaneously competing in agricultural, scientific, technological, and other non-military spheres.

The most complicated task is to evaluate the degree to which the Soviets managed to transfer needed technologies and the influence of those technologies on the Soviet modernization project. As they discussed this difficult question, researchers provided a large number of interpretations. The following chapter examines a set of related questions in the Cold War and modernization literature.

[63] The agreement caused a controversy among Finnish and West European politicians about the Finnish independence and internal affairs. See also on Finnish exports and imports in the paper industry in Heikkinen, S. (2000). Paper to the World. Helsinki.
[64] *Sovetsko-finliandskie otnosheniia, 1948–1983 gg*. (1983). Moskva, pp. 22–23.

4.Review of the literature

Given that there are vast literatures on both transfers and modernization, I focused my dissertation research on the scholarship on technology transfers from West to East as part of studies on Soviet science and technology and economic performance. This part examines the key developments of studies on transfers with the emphasis on how approaches and views have changed over time, what questions have been investigated and what aspects still remain uncovered. This chapter examines the literature on technology transfer to the USSR in chronological order in order to illustrate the main tendencies in how scholars understood Soviet technologies, transfers and East-West interactions. It analyzes literature which deals with channels and results of transfer, Cold War interactions, as well as Soviet innovations.

4.1. The USSR and Western technology: Views of the Cold War literature

Technology transfers from West to East in the Cold War have been the topic of considerable investigation starting from the second half of the twentieth century. When the conflict between the Cold War blocs came into the fore, many researchers began to examine 'the other' and its internal processes. To a large extent, this interest was spurred by governments and the military sector, which provided a great deal of finances for research of the Soviet Union, in particular in the USA.[65] As David Engerman shows, the establishment of the Iron Curtain in the late 1940s made the American government pay particular attention to studying the Soviet Union.[66]Although there was a wide range of disciplines, such as literature, language, and history, involved, science and technology studies were among the central concerns for those studying what was happening in the Eastern bloc. Technology transfer from West to East caught the attention of researchers, although there were not a lot of reliable sources available from the Soviet Union. Using materials that show quantities of technologies sent to the USSR could shed some light on its scientific-technological development. For instance, George Holliday, the author of a fundamental work on Western technologies in Soviet military capacity, mainly analyzed Soviet journals and volumes on trade and statistical materials.[67] Indeed, "it was hard to find any

[65] Davies, R. (2010). The Economic History of the Soviet Union Reconsidered. *Kritika*, 11(1), p. 146.
[66] Engerman, D. (2009). *Knowing Your Enemy*. Oxford, p. 98.
[67] Holliday, G. Op. cit.

solid ground from which to evaluate the Soviet economy because even bad data on the Soviet economy were hard to come by".[68] In addition, academic and analytical works on technology were to provide knowledge for military authorities and for policy makers.

The first works on technological transfers were written by Western economists and political scientists and were primarily focused on purchases of technical equipment by the Soviet Union. Written during the Cold War, they aimed to determine whether Soviet industry was capable of overtaking Western development using Western resources. All the papers of the 1950s–1980s can be roughly divided into two positions: alarmist and conservative. These positions took differing views of the role of Western technologies in prospective Soviet technological and economic development. Some authors argued that Western technologies played a significant role in Soviet technological development and, thus, created a basis for Soviet competitiveness with the West. Others, the majority of researchers, stressed that the Soviet system was a priori incapable of technological modernization and no one attempt to bring Western updated technologies could contribute to it significantly. The latter position was in the framework of so-called totalitarianism in Soviet studies. Totalitarianism was based on the idea that the Soviet project was finite, did not allow any place for substantial reforms, and would finally result into collapse.[69]

Anthony Sutton, perhaps one of the most influential researchers in the field, is the author of a series of volumes on East-West technology transfer published between the late 1960s and early 1970s. All of his three books aim to show the high degree of Soviet dependence on Western imports. He examines different channels of bringing Western technologies – concessions in the 1920s, technical-assistance agreements in the pre-war Stalin period, Lend Lease, large transfers from German industry and Finnish reparations in the immediate post-war years, as well as later imports. He argues that all the Soviet industries were built on the basis of copying Western technologies that had been transferred in different ways, and that it helped the Soviet government accumulate resources when required in critical moments (like in the case of rapid industrialization or withstand the Hitler`s attack). His main viewpoint, of quite alarmist nature, says that the West had built up Soviet industrial and military capabilities and actually "constructed and maintain a first-order threat to Western society".[70] These words would be adapted by some authors and political actors as an argument against intensive trade with the

[68] Engerman, D. Op. cit., p. 98.
[69] See, for example, Pipes, R. (1964). The Formation of the Soviet Union, 1917—1923. Cambridge; Malia, M. (1994). The Soviet Tragedy, New York.
[70] Sutton, A. (1968). *Western Technology and Soviet Economic Development. 1917–1930*. Stanford, p. 419. Sutton, A. (1971). *Western Technology and Soviet Economic Development. 1930–1945*. Stanford; Sutton, A. (1973). *Western Technology and Soviet Economic Development. 1945–1965*. Stanford.

Eastern bloc. Sutton also warned about the double nature of any technology: even automobile manufacturing equipment might contribute to the military sphere.

In the decades to follow, many expressed a commonly accepted idea that the Soviet Union was characterized by economic and technological stagnation and crises. By contrast, the authors of the 1950s and 1960s were inclined to describe the Soviet Union as a real danger which was experiencing rapid economic development. Indeed, as Philip Hanson, representative of the Birmingham research tradition of economic history, noted, before the early 1970s the Soviet economy was rarely described as in crisis. From his point of view, however, even in the Brezhnev era, the Soviet economy experienced stable growth, but in essence was ineffective and could not retain its pace without the impulses from capitalism.[71]It was Khrushchev who had allowed future stagnation as he weakened political control, on which the system was very dependent. This statement is close to what Russian economist Grigory Khanin proposed later as the main feature of the 1950s, an epoch of the "Soviet economic miracle." He contended that it was the period when the Soviet Union became a superpower in terms of the military, science and economy. This progress was based on both domestic research and, in part, on transfers, but reforms (introducing the territorial principle of management or sovnarkhozy) and poorly organized management hindered further development. In general, Khanin holds accountable the unqualified actions of the Soviet leadership for preventing progress.[72]Quite briefly, however, he mentions – and it seems crucial to me - that despite the general growth of volumes, the quality of Soviet goods was low.[73]

Hanson examines Western imports and technology transfers. In the Khrushchev era, the volume of trade with the West increased many times, but this was also a period when the Soviet Union began to position itself as an important player in the Third World. Actually, Hanson tends to develop a balanced view of the role of Western technologies in the Soviet economy, arguing that, "to stress this reliance on foreign technology is not to denigrate Soviet indigenous RDI efforts".[74] He believes that parts of Soviet industries (like space engineering) were built on domestic potential while others (such as plastics and the chemical industry in general) were Western-built. Later works, based on newly opened archival materials in post-Soviet Russia,

[71] Hanson, P. (2003). *The Rise and Fall of the Soviet Economy*. London, p. 251.
[72] Khanin, G. (2002). Desiatiletie triumfa sovetskoi ekonomiki. Gody piatidesiatye. *Svobodnaia mysl`*, 4, p. 30–38.
[73] On the individual consumer interests in the USSR after Stalin in general see in Bönker, K. (2016). Talking with the Consumer. *Laboratorium*, 8(1), pp. 30–57; Reid, S. (2005). The Khrushchev Kitchen: Domesticating the Scientific-Technological Revolution. *Journal of Contemporary History,* 40(2), pp. 289–316. On industrial consumers see Berliner, J. Op. cit.
[74] Hanson, P. (2003). *The Rise and Fall of the Soviet Economy*. London, p. 61. His other works include Hanson, P. (1974). *Advertising and Socialism.* London; Hanson, P. (1981). *Trade and Technology in Soviet-Western Relations*, London.

argued that even the military and space success was to a large extent created due to German innovations transferred immediately after the war.[75]

A vast part of Cold War literature, however, claimed that transfers took place widely, but were not decisive for Soviet economic or technological development. For instance, Marshall Goldman, the author of several books on the Soviet economy, considered that the USSR was "a more competitive threat to countries like Brazil and the Philippines with their low technology items than to the OECD countries [Organization for Economic Co-operation and Development] with their more sophisticated products".[76] He tried to prove that the Soviet Union lagged behind and could not be a real threat to the West, even if it received a lot of Western technologies. Timothy Luke, professor of political science at the Virginia Polytechnic Institute, even proposed to examine the Soviet Union as an "underdeveloped superpower". Applying the world-system approach, he placed the Soviet Union into the semi-peripheral niche, which was dependant technologically and industrially. He said that Soviet industry could not accumulate the resources of more advanced superpowers in away that could help them catch up the developed societies.[77]

Angela Stent, a foreign policy expert, has contended that the basic problem of all the socialist countries lay in that their systems "could not absorb and diffuse Western technology efficiently" and "the cost of some technology imports may have been more than the benefit".[78] She wrote that even if a country of CMEA would buy all the computers it wished, it could not achieve optimal use of them because socialist systems did not provide an access for innovations. Thus, it was a system that could consume the results of innovations, but not adapt innovations themselves.[79] Professor Daniel Burghart in his monograph "Red Microchip", devoted to the computer industry, explained it more explicitly. He said that transfer of any technology basically requires appropriate infrastructure. In other words, sending a car into a country that had no proper roads, fuel, or manufacturing of details would have a negligible effect. In addition, the recipient society should be "capable of recreating the technology or building upon it".[80]He also considered the channels of transfer and espionage as one of the most productive ways of knowing about capitalist technologies. Similar conclusions were drawn in works on other cases. For example, the Soviet forestry industry and technology transfer was examined in Brenton Barr

[75] Siddiqi, A. (2000). *Challenge to Apollo*. Washington; Siddiqi, A. (2009). Germans in Russia. *Osiris,* 23(1), pp. 120–143. See also Augustine, D. (2007). *Red Prometheus*. Cambridge, Massachusetts and London.
[76] Goldman, M. (1983). *USSR in Crisis*. New York, London, p. 134.
[77] Luke, T. (1985). Technology and Soviet Foreign Trade. *International Studies Quarterly*, 29(3), pp. 327–353. Compare with what was happening in so called "the rest" (countries of Asia, Latin America and the Middle East), in the terminology of Alice Amsden. Amsden, A. (2001). *The Rise of "The Rest"*. New York.
[78] Stent, A. (1989). Technology Transfer to Eastern Europe. In Griffith, W., ed., *Central and Eastern Europe.* Boulder, p. 79.
[79] Ibidem.
[80] Burghart, D. (1992). *Red Microchip. Technology Transfer, Export Control and Economic Restructuring in the Soviet Union*. Dartmouth, Aldershot, pp. 16–17.

and Kathleen Braden's monograph. They stressed that selling wood helped finance Western transfer in the post-war years. Answering the main question set in the work – why, despite technology transfer, the Soviet forestry sector remained backward – the authors stressed the lack of investment and ineffective organization of the industry.[81] These authors, thus, emphasized the incapability of the Soviet system and its key elements to adapt technologies and work on its own. Inefficient management and lack of infrastructure only made things worse.

Kendall Bailes devoted his research to transfers, the implementation of adopted technologies, and research development in the Soviet Union. Although his works are focused primarily on transfers from the USA before WWII, many of his conclusions are applicable to later periods. He wrote that the Soviet government understood the competitive nature of capitalism and played off capitalist firms in their competition with each other.[82] The Soviets were very selective in choosing Western experience and chose only the most authoritarian methods (like Taylorism), but rejected American commercial ones.[83] This showed that the Soviet government under Stalin strove for independence and the development of its own research. The latter, however, was not very successful because of organizational features within Soviet industry. Bailes argued that "the barriers to successful innovation in terms of social relations of the technostructure [existed] both internally and in its dealing with other major groups of Soviet society."[84] He listed a comprehensive set of problems with technological innovations in the Stalinist period such as an urgent need to adapt foreign technologies; the lack of capitalist competition; terror against some innovators; the ideological goal of stimulating technological innovation not only by the intelligentsia but by workers as well; the scarcity of skilled workers; the strong tradition of pure research; the organizational split between research, development and product; and, finally, the weak influence of economists' innovations. The main reason, however, as Bailes says, lay in the disconnect between production and industrial research, as many scientists were focused on investigations which had little connection with the practical industrial sector.[85]

Joseph Berliner has thoroughly described the structures of the Soviet research and development sector. His analysis includes the formal and informal organization of Soviet

[81] Barr B. and Braden, K. (1987). *The Disappearing Russian Forest*. London, p. 65. A Soviet émigré writer Gennadii Andreev (Khomiakov) supports this vision. In the 1930s he was imprisoned and after deliberation worked in the forestry industry. In his autobiographic work "Gor`kie vody" he says that "because of overexploitation of forest resources and imports of timber abroad, the Bolsheviks wanted to get currency", required for industrialization. He says that the Soviet policy was lead by the idea of "a loan from forest" (*zaem u lesa*) which meant extracting as many forest resources as possible and, thus, lead to exhaustion of resources. Andreev, G. (1954). *Gor`kie vody*. Available at http://litresp.ru/chitat/ru/%D0%90/andreev-gennadij-andreevich/gorjkie-vodi. [Accessed 31 Oct. 2016].
[82] Bailes, K. (1981). The American Connection Ideology and the Transfer of American Technologies to the Soviet Union. *Comparative Studies in Society and History*, 23(3), p. 434.
[83] Ibid., p. 440.
[84] Ibid., p. 338.
[85] Ibid., p. 345. See also Bailes, K. (1978). *Technology and Society under Lenin and Stalin*. Princeton.

enterprise, incentives and decision-making, planning and management and other components of the Soviet economic and technological systems. From his point of view, the problem of Soviet innovations was having a plan which did not correspond to current developments. In other words, innovations required time while the plan required acceleration and, always, the plan was "the first objective of management".[86] At the same time, new technology requires considerable new resources and new supplies. Because of problems of supplies in the planned system, innovations just aggravated "the already tight supply situation". As Berliner argues, workers were trained to work with the already-in-use equipment and bringing new techniques and educating people to work with it was the responsibility of the workers themselves. This is why workers prevented bringing new technology and were inclined instead to renovate old equipment. Introducing new technologies was not promising in that the plan could be changed from above.[87] Berliner explains the typical features of Soviet production and management, exploring the economic climate in which they operate.[88]

In general, Cold War papers imply a strong divide between the blocs and stress the role of technology transfer from one side to another as an important factor of East-West interactions. Most works were focused on the macro level and particularly transfer through trade as part of state relations. Some others tried to analyze internal technological and social processes within the system to understand its specifics on the micro level.

4.2. The USSR and Western technology: Modern conceptions

In the age of perestroika and after the collapse of the Soviet regime, the focus of researchers shifted considerably to the question of the reformability of the Soviet economic system and the reasons for its collapse. The analysis mostly revolved around the last decade of the USSR and Gorbachev`s reforms in particular.[89] From an economic perspective, the researchers brought to the fore the reform of the system itself. Was it capable of embracing

[86] Berliner, J. Op. cit., p. 202.
[87] Ibid., p. 80.
[88] Ibid., p. 94.
[89] In the 1990s in order to comprehend the reasons of Soviet demise, many Russian authors published their reflections on Soviet economy, perestroika, glasnost` and other questions in journals. To a large extent the discussion was encouraged by journalists. These debates often appealed to historical aspects, in particular, the discussion on Stalinism was quite active. A comprehensive overview of these works is given in Cheltsova, A. Fenomen "stalinizma" v otechestvennoi istoriografii. *Rodnaia istoriia*. Available at http://rodnaya-istoriya.ru/index.php/vspomogatelnie-i-specialnie-istoricheskie-nauki/istoriografiya/fenomen-stalinizma-v-otechestvennoie-istoriografii.html. [Accessed 10 Feb. 2016].

innovations? Many said that the Soviet Union would be saved not only due to technology transfer but by importing Western management styles and, especially after the Chinese transformation of socialism was realized, even by incorporating elements of the capitalist system. Historian Steven Kotkin, for example, argued that it was communist ideology which hindered Soviet economic progress and believed that the planned economy could be reformed in essentials without introducing full private property and market prices.[90] Bringing in technological pieces without changing the way they were adapted was a drop in the bucket, and could not help the Soviet Union to compete with the West. Paul Gregory also argued that the problems were in the economic system itself: poor planning, lack of knowledge of planners, unreliable supplies, etc.[91]Stepping from modernist approach, Stephen Cohen took an opposing view in arguing that the Soviet Union was capable of reforming.[92] Russian historians also gave their input to the discussion, addressing historical developments of Soviet technology. For example, the economic historian Vladimir Shestakov, discussing Soviet socio-economic policy in the 1950s and mid-1960s, said that borrowings from the West had always been partial and could not influence the economic or political system as such. He insisted that only market, civil society and basic changes could bring positive changes, but technological transfers just masked growing gaps as the Soviet Union lagged behind the West.[93]

Generally speaking, however, in the years following the Soviet collapse, the second half of the 1990s–early 2000s, the number of papers on technology transfers decreased and the question seemed to lose relevance. This decline, at the same time, preceded the proliferation of new perspectives and approaches, both in terms of explaining Soviet technology and mechanisms of transfer. Also, we may find a strong focus on the micro level and increasing turn to examining separate cases. Despite discussing the intensity of technological transfers from West to East, many works of the Cold War period did not position them as something going beyond state level. In turn, recent researchers have argued that while the Cold War was indeed a confrontation on the macro level, there was widespread scientific, technological and cultural cooperation on the micro level, proving the permeability of the Iron Curtain. These works investigate the activities of individuals in order to show their roles in technological and economic development. The focus on interactions through the gaps in the tentative border between the two blocs gained tremendous importance and became seminal for many researchers. At the same time, other socialist states began to receive more attention and the Soviet Union is

[90] Kotkin, S. (2001). *Armageddon Averted*. Oxford, pp. 2–3.
[91] Gregory, P. (2004). *The Political Economy of Stalinism*. Cambridge.
[92] Cohen, S. (2011). *Soviet Fates and Lost Alternatives*. Columbia. Among other works written within the modernist paradigm is Daniels, R. (1998). Russia's Transformations. Lanham.
[93] Shestakov, V.A. (2006). *Sotsial`no-ekonomicheskaia politika sovetskogo gosudarstva v 1950-e – seredine 1960-kh gg*. Moskva, p. 178.

not the exclusive site for research any more. Further, not only West-East but East-West transfers are under consideration. Among such works it is worth mentioning articles by Karen Freeze, showing how Czechoslovak textile technologies were developed and transferred successfully to the West. She proved that the centrally planned economy had positive effects, in particular in the textile industry as it led to integration among researchers, engineers, machine builders, and machine users in the textile industry. Her analysis also concluded that the Iron Curtain was permeable and allowed contacts between people from the two blocs.[94]

Focus on the permeability and forms of interactions between individuals and small institutions was articulated and significantly developed within the project "Knowledge through the Iron Curtain – Transferring Knowledge and Technology in Cold War Europe" conducted at the Aleksanteri Institute in Helsinki in 2007–2009. This, as well as some other projects, put an emphasis on the role of small European countries on both sides of the Iron Curtain both as recipients and transmitters of technologies as well as intermediary actors in the interactions and transfers between East and West.[95]

Among the results of this new approach were papers by Sari Autio-Sarasmo, who helped develop the understanding of transfers and interactions in the Cold War. In the volume, "Reassessing Cold War Europe," she and Katalin Miklóssy characterized the Cold War as interactions on the micro level which were shaped primarily in the mid-1950s and 1960s. In the Khrushchev era, it became apparent that the Soviet Union needed Western technological aid and, thus, aimed to establish more contacts with foreign countries.[96] In her chapter "Knowledge through the Iron Curtain," Autio-Sarasmo examined two cases of cooperation between the Soviet Union and Western countries – Finland and West Germany – within the sphere of scientific-technical cooperation. She said that this kind of cooperation "proved to be highly effective" in terms of transferring knowledge and technology, but "the significance of these transfers in terms of impact on the economic modernization process or economic growth, however, remained

[94] Freeze, K. (2007). Innovation and Technology Transfer during the Cold War. *Technology and Culture*, 48(2), pp. 249–285; Freeze, K. (2012). Czechoslovak Theater Technology under Communism. *Technology and Culture*, 53(2), pp. 442–460. See also on knowledge transfers and developments in the Eastern bloc in Bockman, J. (2002). Eastern Europe as a Laboratory for Economic Knowledge. *The American Journal of Sociology*, 108(2), pp. 310–352; Bockman, J. (2008). Scientific Community in a Divided World. Comparative Studies in Society and History, 50(3), pp. 581–613.

[95] Cold War Research Group. Available at http://www.helsinki.fi/aleksanteri/cwrg/. [Accessed 10 Sep. 2014}. Other projects to be mentioned are Tensions of Europe (a book serial Making Europe: Technology and Transformations, 1850-2000 was a result of grand project on technology in building Europe); the research project "The Earth Under Surveillance. Climate Change, Geophysics and the Cold War Legacy" headed by Simone Turchetti and their special issue of British Journal for The History of Science, devoted to transnational history of science. See more Herran N., Boudia S. and Turchetti, S. (2012). Transnational History and the History of Science. *The British Journal for the History of Science*, 45(3), pp. 319–336; among others.

[96] Autio-Sarasmo, S. and Miklóssy, K. (2011). Introduction: The Cold War from a New Perspective. In S. Autio-Sarasmo and K. Miklóssy, eds. *Reassessing Cold War Europe*. London and New York, p. 5. See also Mikkonen, S. and Koivunen, P., eds. (2015). *Beyond the Divide*. New York and Oxford.

rather low".[97] Actually, the main effect of this kind of interaction, though initiated on the macro level, was the creation of channels for trade and multileveled cooperation among individuals and small groups. In other works, Autio-Sarasmo discussed Soviet modernization and the role of contacts between East and West. Thus, she stressed that "due to the dependence on foreign technology and problems in the diffusion of transferred knowledge to the Soviet system, the development of domestic research and development remained lower than expected".[98] She indicated that the main reasons for the failure of implementing transferred technologies rested with the poorly coordinated actions of transfer organs and recipients.[99]

There were other papers, most devoted to the 1950s and 1960s, published as a result of the project. Thus, in his recent article the aforementioned Hanson stressed the role of individuals in technology transfer but showed that the economic system of the Soviet Union slowed down technological progress as it was not successful at adopting imported technologies.[100] Jeremy Smith devoted his chapter to knowledge transfer in the field of wine-making from France to Georgia which resulted in Soviet success in the technology.[101] Riikka Nisonen-Trnka examined transfers of medical lenses from the USA to Czechoslovakia, seeing it as a successful process.[102] This approach, thus, widened the scope of cases and topics, while, however, leaving out the forestry case, the focus of this dissertation.

Many current researchers examine the question of innovation, although there are not many works devoted to the implementation of foreign technologies in the Soviet system. Based on examples from Stalin`s period, historian Sergey Zhuravlev shows that the passivity of local administrators hindered many promising innovations.[103] Other researchers argue that state politics were the main barrier to innovations. Anthony Heywood's book on the engineer Iurii Lomonosov, for instance, asserts that state use of terror was the main reason why some engineers stopped research for years on end.[104] Loren Graham argues that most Russian and Soviet

[97] Autio-Sarasmo, S. (2011). Knowledge through the Iron Curtain: Soviet Scientific-Technical Cooperation with Finland and West Germany. In S. Autio-Sarasmo and K. Miklóssy, eds. *Reassessing Cold War Europe*. London and New York, p. 78.
[98] Autio-Sarasmo, S. (2016). Technological Modernization in the Soviet Union and Post-Soviet Russia: Practices and Continuities. *Europe-Asia Studies*, 68(1), p. 93.
[99] Ibid., p. 85.
[100] Hanson, P. (2011). The Soviet Union`s Acquisition of Western Technology after Stalin: Some thoughts on people and connections. In S. Autio-Sarasmo and K. Miklóssy, eds. *Reassessing Cold War Europe*. London and New York, pp. 16–32.
[101] Smith, J. (2011). Learning from the West: The modernization of Soviet winemaking, 1956 –1961. In S. Autio-Sarasmo and K. Miklóssy, eds. *Reassessing Cold War Europe*. London and New York, pp. 83–99.
[102] Nisonen-Trnka, R. (2011). Soft contacts through the Iron Curtain. In S. Autio-Sarasmo and K. Miklóssy, eds. *Reassessing Cold War Europe*. London and New York, pp. 100 –118.
[103] Zhuravlev, S. (2000). *"Malen`kie liudi" i "bol`shaia istoriia": inostrantsy moskovskogo Elektrozavoda v sovetskom obshcestve.* Moskva. Zhuravlev also discusses Western engineers who worked for Soviet industrialization.
[104] Heywood, A. (2011). *Engineer of Revolutionary Russia.* Farnham. See also Graham, L. (1993). *The Ghost of the Executed Engineer*. Harvard.

innovations were just lonely ideas, which were not implemented because of the existing socio-economic system which did not allow freedom, risk and reliability.[105]

One of the crucial aspects appearing from the examination of East-West technological interactions across the Iron Curtain is non-technological influences. The dilemma of dealing with the Western world and acting within the conditions of Soviet ideology has been investigated in a vast number of works. Primarily, researchers dealt with Soviet scientists and their interactions with the West and Soviet ideology. Thus, Loren Graham and Jean-Michel Kantor concluded that Soviet mathematicians did not work for collective science, as was expected by the leadership, but rather that the best scientific achievements were produced by individual and theoretical researchers.[106] Slava Gerovitch concluded that while choosing a course of action between the 'overtaking and surpassing' and 'criticizing and destroying' strategies, computer scientists tried to make computers distant from ideological debates.[107] In contrast, Alexey Kojevnikov argued that Soviet scientists adapted to the regime and played academic games, reproducing 'public rituals of 'criticism and self-criticism' and taking part in collective formal actions in order to prove their loyalty to the Party.[108]

Some authors stressed the influence of experience in the Weston those Soviet scientists who went abroad. Allen Kassof, who acted as the executive director of the International Research and Exchanges Board, which dealt with academic and scholarly exchanges between the USA and the Soviet Union, said that after Soviet and East European academics and intellectuals participated in exchange with the West, they faced the "basic change" which finally lead to the demise of the communism.[109] Yale Richmond went further into cultural influences on various groups, exploring the changes in people`s minds. Although those who traveled abroad were elite members of Soviet society and had good living conditions, they compared the two sides of the Iron Curtain in terms of material abundance and internal freedom; some of them became very critical towards the Soviet reality. They often admitted the better conditions of American science, more updated scientific equipment and better economic performance.[110] These and other works raise the important issue of the nature of technological transfers and the interplay of technological and socio-cultural aspects. This issue, also considered in this dissertation,

[105] Graham, L. (2013). *Lonely Ideas. Can Russia Compete?* Cambridge. See also Cohen, Y. Op. cit.
[106] Graham, L. and Kantor, J. (2009). *Naming Infinity.* Cambridge, Massachusetts, London, p. 214.
[107] Gerovitch, S. (2001). Mathematical Machines' of the Cold War. *Social Studies of Science*, 31(2), pp. 253–287.
[108] Kojevnikov, A. (1998). Rituals of Stalinist Culture at Work. *The Russian Review*, 57(1), pp. 25–52. See also Adams, M. (2001). Networks in Action. In G. Allen and R. MacLeod, eds., *Science, History and Social Activism*. Dordrecht, pp. 255–276.
[109] Kassof, A. (1995). Scholarly Exchanges and the Collapse of Communism. *The Soviet and Post-Soviet Review*, 22(3), pp. 263–274.
[110] Richmond, Y. (2003). *Cultural Exchange and the Cold War*. Pennsylvania.

resonates with the investigation of technological development as a complicated process which always has social and cultural implications.[111]

Despite the recognition of the importance of the micro level and the cultural consequences of technological transfers, analysis of the macro level still retains its position. A large literature examines transfers within the context of the embargo and inter-state trade as well as the politics of the Cold War. In this vein, Frank Cain discusses not only the effects of trade and transfer restrictions, but also the politics, nuances, and reactions of various governments to embargos, thus, bringing an explicitly political factor into trade relations. He stresses that the embargo expressed the American will to temper economic progress of the Eastern bloc and create a gap in the development of West and East of no less than ten years. However, trade relations, which practically included transfers, were beneficial as many countries received raw materials from the East.[112] He illustrates the tricky nature of dual use technologies, examining such products as pipes and their role in political discussions of capitalist states.

Alan Dobson stresses that in practice, as early as in the late 1950s, the embargo began to weaken and gained rather symbolic meaning. Actually, the Soviet Union managed to increase its war-making capacity and the embargo could not interrupt transfers and actually "might not impede Soviet technological advances and economic growth".[113] Embargo actions were a kind of reaction to different political realities in the relations of the blocs, "an effective means of signaling". Like Cain and other authors, Dobson highlighted the question of double use technologies and the contradictions that arose between countries because of the difficulties balancing embargo and trade.[114]

To sum up, the recent scholarship examines various aspects of technological developments in the Soviet Union and other socialist countries. They discuss interactions of small actors, the nature of the Iron Curtain and cultural implications of technology transfers. Still, mechanisms of transfers and the implementation of Western technologies in the Soviet context require more research.

[111] See Bijker, W., Hughes, T. and Pinch, T., eds., (1987). *The Social Construction of Technological Systems*. Cambridge. As David Nye says, "machines are not autonomous". Nye, D. (1997). *Narratives and Spaces*. New York, p. 2.
[112] Cain, F. Op. cit, p. 93. See also Heywood, A. (1999). *Modernizing Lenin's Russia*. Cambridge.
[113] Dobson, A. (2010). From Instrumental to Expressive, *Journal of Cold War Studies*, 12(1), p. 109.
[114] Dobson, A. (2005). Some Thoughts about Concepts and Explanation Relations" in Eloranta, J. and Ojala, J, eds., *East-West Trade and the Cold War*, vol. 36. Jyväskylä, pp. 21–44.

4.3. Soviet-Finnish cooperation and technology transfer

Finland, one of the key state actors in my dissertation, was a unique player in the complicated scene of East-West relations. In the Cold War literature, many Soviet and Finnish authors stressed the role of this kind of collaboration in proving the possibility of contacts between two systems. This was principally important for the Soviet leadership under Khrushchev, who had promoted the idea of peaceful co-existence and enabled the signing of agreements on collaboration with Western countries. Soviet works, in particular, emphasized political factors in technological relations, on one hand, the peaceful politics of the post-war Finnish leadership, and on the other, the dovish principles of Lenin as realized by the Soviet government. E. Ambatzumov, for example, determined Finnish-Soviet technological cooperation as the practical realization of peaceful co-existence, which was beneficial for both countries. In particular, the USSR supplied Finland with fuel, corn and other materials, which showed that Soviet trade politics "had a friendly character". At the same time, Finland played an important role in providing the Soviet Union with technical goods and technologies.[115] Such notions as friendship, co-existence and mutual benefit would run through the literature of most of the rest of the Soviet period.[116] The volume "Finnish-Soviet Economic Relations", edited by Kari Möttölä, O.N. Bykov and I.S. Korotev is another example. Articles written by politicians, academics and researchers examine various aspects of Finnish-Soviet cooperation in the economy and related fields. Most authors stress the connection between politics and the economy.

One of the authors of the volumes, Erkki Nironen, studies transfer of technologies in its various channels and forms such as trade, scientific-technical cooperation and cultural contacts. He writes that transferred technologies did not make the Soviet Union competitive with Western countries, but opened attractive opportunities on the Soviet market.[117] In this and some other publications, he examined various technological projects of Finnish companies in the Soviet Union.[118]

In the recent scholarship, the emphasis is often put on the role of Finland as a mediator between the blocs and its significance in transmitting Western technologies to the Soviet Union. Vesa Saarikoski even proposed a conception of Finland as a middle Europe (Väli-Eurooppa),

[115] Ambartsumov, E. (1955). Sovetsko-finliandskie otnosheniia – otnosheniia mira i druzhby. *Mezhdunarodnaia zhizn`*, 10, pp. 47–48.
[116] Barten`ev, T., Komissarov, Iu. (1978). *SSSR – Finliandia: orientiry sotrudnichestva*. Moskva.
[117] Nironen, E. (1983). Transfer of Technology between Finland and the Soviet Union. In K. Möttölä, O.N Bykov and I.S. Korolev, eds. *Finnish-Soviet Economic Relations*. London, pp. 161–170. See also his other work Niironen, E. *Neuvostoliitto Läntisen teknologian tuojana*. Lappeenranta, 1991, among others.
[118] Nironen, E. (1992). Itä-Länsi-kauppa, Lappeenranta; Nironen, E. (1991). Neuvostoliitto läntisen teknologian tuojana, Lappeenranta.

which benefited from both West and East.[119] The unique position of Finland in East-West cooperation and in particular Finnish-Western relations is examined in papers of the aforementioned Sari Autio-Sarasmo and Niklas Jensen-Eriksen as they traced attitudes of the Western states towards Finland.[120] Pekka Sutela developed a peculiar focus on Finnish-Soviet trade, its organization and practicalities. In his recent book on "Trading with the Soviet Union" which summarizes his previous research, Sutela treated Finnish-Soviet trade relations on macro and micro levels, arguing that both state and business actors saw trade with the East as highly profitable.[121] In a number of articles, Tatiana Androsova explained the reasons for close Finnish-Soviet relations right after the war. She wrote that Stalin`s leadership considered Finland an important partner which could provide useful cooperation.[122] She also put a strong emphasis on political crises and their influence on economic cooperation between the countries.[123]

The current scholarship, thus, pays attention to a wide range of aspects, including the interplay of politics, economy, technology and culture on different levels. At the same time, the topic still requires deeper examination on the forms of transfers and implementation of technologies on the micro level. For example, we need to learn more about the activities of those who brought Western technologies in different forms (engineers' trips, exhibitions, espionage, among others). The field still requires more cases of separate technologies in order to see the impacts of transfers on Soviet modernization as well as the impacts of various factors on transfers themselves. A crucial observation is that with little exception, the existing literature did not address the implementation of imported technologies, a central focus of this thesis.

[119] Saarikoski, V. (2002). Between East and West. Finland and Hungary during the Cold War. In O. Vehviläinen and A. Pók, eds., *Hungary and Finland in the XX century.* Helsinki, p. 119.
[120] Jensen-Eriksen, N. (2011). CoCom and Neutrality: Western Export Control Policies, Finland and the Cold War, 1949 –1958. In S. Autio-Sarasmo and K. Miklóssy, eds., *Reassessing Cold War Europe*. London and New York, p. 52; Jensen-Eriksen, N. (2005). Just Rhetoric? The United Kingdom and the Question of Western Economic Aid to Finland, 1950–1962. In J. Eloranta and J. Ojala, eds., *East-West Trade and the Cold War*, vol. 36. Jyväskylä, pp. 94–111.
[121] Sutela, P. (2014). *Trading with the Soviet Union*, Helsinki. See also Sutela, P. (2005). Finnish Trade with the USSR. *BOFIT Online*, 7.
[122] Androsova, T.V. (1999). Finliandia v planakh SSSR kontsa 1940-h – serediny 1950-kh gg. Politiko-istoricheski aspect. *Otechestvennaia istoriia*, 6, p. 47.
[123] Androsova, T. (2011). Economic interest in Soviet Post-War Policy in Finland. In S. Autio-Sarasmo and K. Miklóssy, eds., *Reassessing Cold War Europe*, London and New York, p. 134.

5. Theoretical framework

5.1. Levels and actors of technology transfer

This dissertation touches upon several issues which consider the interplay of actors of different levels. The main focus is put on the individual level — engineers and industrial scientists, broadly referred to as Soviet and Finnish specialists. As stated above, they were agents in transferring foreign technologies and the people who were primarily contributing to the modernization of Soviet industry. Another level of research focuses on institutions from both states. Following Douglass North, by institutions I mean "humanly devised constraints that structure political, economic and social interaction", which consist of informal constraints and formal rules.[124] On the Soviet side, they included state research institutions, factories, and logging spots. From the Finnish side, they were mostly represented by companies and separate industrial enterprises. Finally, the macro level of my research is the state, represented by ministries and management organizations as well as inter-state establishments such as the Finnish-Soviet Scientific-Technical Cooperation Commission.

Such a multi-level analysis enables me to see both large-scale and micro-level processes involved in both bringing Western technologies into the USSR and implementing them in the Soviet forestry industry. It examines how the Soviet political and industrial leadership envisioned the aims and content of modernization and how it imagined the role of transferring Western technologies in order to reach a set goal – to update an outdated system.

Firstly, this dissertation analyzes the activities of the Soviet government (primarily through exploring decrees), ministries and large institutions (like *Gostekhnika SSSR,*a special committee with considerable power over science and technology development and succeeding institutions).[125] All-union ministries and research organizations were charged with a responsibility for conducting modernization and defining its aims, while conforming to the general line drawn by the government. Among other activities, these institutions sought resources from inside and outside the Soviet Union. They investigated foreign industrial

[124] North, D. (1991). Institutions. *The Journal of Economic Perspectives*, 5(1), p. 97.
[125] In 1957 Gostekhnika was succeeded by the State Scientific-Technical Committee of the Council of Ministers of the USSR (GKNT), and in 1961 by the State Committee on Coordination of Research of the Council of Ministers of the USSR. All these institutions had similar functions: overseeing domestic research and technology transfer, and studying, transporting and implementing Western technologies.

performance and informed the Soviet engineer community about newer technologies, which could be transferred from other countries and used by Soviet engineers for modernizing industry. They also organized research and development both within research institutions and at factories. Focusing on this level, this dissertation studies the organization of Western-Soviet and Finnish-Soviet scientific-technical cooperation and trade in the forestry industry, i.e. interactions on the levels of the state and large institutions. It explores the possibilities and limitations of these relations and the interests and strategies of the two sides, as well as how they shaped cooperation in the context of the Cold War. The role of institutions (if we look at them as independent entities) was crucial, but not decisive. Although institutions had strong influence in final decision-making outcomes, engineers and industrial scientists had voices and made decisions concerning innovations.

Secondly and most important, the dissertation investigates the level of the individuals and groups who made modernization and technology transfer possible.[126] They were engineers and industrial scientists who worked at enterprises and research institutions. In the terminology of historian Thomas Hughes, they were system builders, those who designed the development of the technological system (the forestry industry). They defined critical problems, explaining their view of the system's drawbacks and what must be improved in its performance. They also were the ones were involved in transferring and implementing Western technologies. As Philip Brey states, "the working of machines does not provide an explanation of technological and social change, but is itself something that must be explained, at least in part by investigating social agents, their interactions, and their beliefs about technology".[127]

These levels explain the interplay between the socialist system, institutions, and personal agency.[128] All the levels were interconnected from the top downward and from the bottom upwards. Institutions gave tasks to the transfer agents and the transfer agents gave responses after trips to foreign factories. At the same time, there was the connection between various actors inside each level. Both axes implied exchanges of knowledge and technologies, but sometimes revealed insurmountable barriers that are crucial in explaining the failures of modernization. The relations between institutions and individuals did not mean only the activities of individuals in particular buildings. Vertically, institutions and individuals interacted while defining critical

[126] This dissertation, thus, looks at a lower-laying group of actors within the command system than Paul Gregory suggests in his work. He defined three tiers of the system such as the dictator, planners (bureaucratic agents) and producers (managers of production). See Gregory, P. (2004). *The Political Economy of Stalinism*. Cambridge, p. 129.

[127] Brey, P. (2003). Theorizing Modernity and Technology. In T. Misa, P. Brey and A. Feenberg. eds., *Technology and Modernity*. Cambridge, p. 49. See also Law, J. (1992). General Introduction. In W. Bijker and J. Law, eds., *Shaping Technology, Building Society*. Cambridge, pp. 1–15.

[128] See more on the roles of the political system and individual agency in Kivinen, M. and Cox, T. (2016). Russian Modernization – A New Paradigm. *Europe-Asia Studies*, 68(1), pp. 1–19.

problems; moreover, institutions supplied individuals with know-how, techniques, etc. and gained their expertise.[129] This exchange is obviously seen in the process of technology transfer. Institutions provided the transfer agents with information about target countries and industries they visited, while the delegates reported to institutions on what they had learned abroad. These exchanges could have different results, being a form of productive transfer (the transfer agent got a general information about the place of destination) or not bringing a positive effect (usually because the agents did not prepare a substantial report or the report was just archived without consideration). Horizontally, the communication was organized as contact between different institutions and engineers and scientists. Again, quite often such communication revealed strong and sometimes insurmountable barriers between institutions themselves and actors from different organizations. For instance, the analysis of continuous pulp cooking and the activities of Soviet inventor Leonid Zherebov in article III reveals thick barriers between organizations and even an unwillingness to cooperate among them. Zherebov`s project was thus restricted to a small group of specialists, which, in turn, encountered a range of obstacles, especially in communications and the sharing of knowledge across institutions. Monopolization and secrecy created an enigma around the invention. Zherebov`s innovative idea to cook pulp at very high temperatures was not supported by the research institute, even though it was intimately involved in the project together with engineers from the factory. As a result, this complicated the development of domestic innovation and motivated the state to transfer more technologies from foreign technological systems. To a certain extent, communication with foreign engineers and organizations was easier.

My thesis examines these two-level activities and various actors in their efforts to modernize the Soviet forestry industry through the lens proposed by Thomas Hughes.[130] Primarily, my research employs and develops key elements of Hughes`s methodology, emphasizing his analysis of technology transfer and its roles in the evolution of large technological systems. This approach has previously been applied within science and technology studies to explain the development of European electrical systems, aviation development, recycling, and other issues.[131]Applying this methodology to the forestry industry enables me to explain the role of Western technologies in Soviet modernization through interactions of different factors.

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[129] Autio-Sarasmo, S. (2016). Technological Modernization in the Soviet Union and Post-Soviet Russia. *Europe-Asia Studies*, 68(1), pp. 79–96.

[130] Among his programming works are Hughes, T. (1983). *Networks of Power: Electrification in Western Society*, *1880–1930,* Baltimore; Hughes, T. (1989). *American Genesis*. New York; Hughes, T. (1994). The Evolution of Large Technological Systems. In T. Bijker, T. Hughes and T. Pinch, eds., *The Social Construction of Technological Systems*. Cambridge, pp. 51–82.

[131] Heide, L. (2009). *Punched-Card Systems and the Early Information Explosion, 1880-1945*. Baltimore; Jørgensen, F.-A. (2011). *Making a Green Machine*. New Brunswick, among others.

5.2. Large technological systems and Soviet forestry industry

This research proposes to examine the Soviet and Finnish forestry industries as two large technological systems, made up by different artifacts (machinery, technical details, industrial literature, etc.), which were developed by social actors - system builders or engineers, industrial scientists, businessmen and traders who worked for various organizations like industrial companies, research institutions and enterprises. The systems depended on the resources and environment in which they were embedded, as they were influenced by political factors and state institutions. As article I illustrates, this conception helps examine the interplay between social, technological, cultural, and political actors and factors.

The chronological framework of the dissertation covers the period of 1955–1964, which is defined by the years of Khrushchev`s rule. As explained earlier in this introduction, since the modernization project was initiated by the Soviet government (although developed by local system builders), it was limited by the political chronology of Khrushchev's years in power. During this period, Khrushchev aimed for rapid technological modernization, which was comprised of the following tasks: updating techniques and technological processes, launching new technologies, automatization, and mechanization of production. All of these shared the goal of increasing the production of timber as well as of existing and new types of pulp, paper, and other products from the forestry industry. Fulfilling these goals was essential for the development of the forestry system to overcome reverse salients (a set of technical and technological challenges), while technology transfer entered into a distinct period in its evolution, with its own momentum (which explains the point when the system tended to keep the line, although new technologies became available). According to Hughes, a technological system develops through several stages: invention and development, technology transfer, system growth, momentum. Although transfer is put into the sequence, Hughes indicates that transfer might occur at any time of evolution of the system and it might happen several times as well.[132]

In the mid-1950s, the Soviet forestry industry system revealed itself to be in technological crisis. This was recognized by the leadership, which had a key role in decision-making in the centralized system. The Soviet government, recognizing that economic development was hampered by reverse salient, became a formal initiator of modernization.

[132]Hughes, T. (1994). The Evolution of Large Technological Systems. In T. Bijker, T. Hughes and T. Pinch, eds., *The Social Construction of Technological Systems*. Cambridge, p. 66.

Having received the impulse for modernization, engineers and industrial scientists began to define actively the critical problems and to propose possible strategies for improvement by making expert suggestions to their institutions and, as a result, to the Ministries and Gostekhnika. Most of these suggestions meant technology transfer from more developed industry systems, based on what was allowed by Khrushchev`s political discourse. System builders aimed to transfer new and updated technologies which had been rapidly emerging in the United States, Canada, Sweden, West Germany, Finland, and other countries. Many suggestions referred to the Finnish forestry industry system, since Finnish-Soviet scientific and technical cooperation was better developed than the relations with other capitalist countries. The Finnish system was, thus, a donor technical system for the Soviet one, allowing the Soviets to transfer not only domestic Finnish technologies, but also Western technologies through Finland.[133]

The specifics of the Soviet forestry industry system, like the specifics of Soviet modernization in general, lay in that it largely depended on the state, which often took the role of system builder or at least maintained serious control over innovations. As David Reynolds says, "state control of science was not invented by the Bolsheviks, who built on tsarist practice. Their structure of research institutes also drew on elitist German models. What was unique about Stalinist Big Science was the extent of state control and of elite isolation".[134] In later years, state control of innovations via state research and administrative institutions retained its power. In many cases, it prevented the development of initiatives on the local level, as in the case of continuous pulp cooking or wood wastes, discussed in articles III and IV.

The main advantage of the selected approach is that it enables me to consider the system through a contextual approach of the various factors that influenced it, thus avoiding oversimplified explanations for the successes and failures of modernization. The dissertation examines the forestry industry as a large technological system influenced by economic (financial), social, political and cultural factors. Based on selected technologies, it explores how economic interests, political calculations, and cultural factors resulting from the interactions of the systems were incorporated into various cultural and political contexts, how knowledge enhanced or limited the transfer, and what possibilities and restrictions were created. While considering separate technologies (continuous pulp cooking, recycling of wood wastes and one year plants, forest road construction, paper making technologies, among others), this research examines the ways these technologies were brought to enterprises, how specialists implemented

[133] See more on technological development of Finnish forestry industry in Jensen-Eriksen, N. (2007). *Läpimurto. Metsäteollisuus kasvun, integration ja kylmän sodan Euroopassa 1950–1973*. Jyväskylä; Nordberg, T. (1998). *Yhtyneet paperitehtaat osakeyhtiö 1952–1969*. Hämeenlinna; Heikkinen, S. Op. cit.
[134] Reynolds, D. (2010). Science, Technology and the Cold War. In M. Leffler and O.A. Westard, eds., *The Cambridge History of the Cold War*, vol. 3. Cambridge, p. 381.

them, and what factors played a role the in success or failure of their introduction. The social factors are primarily the specialists, their communities and networks, the institutions they worked in, as well as their technical expertise and practices. The dominant technical factor is the equipment and technical details needed for launching technologies. Another factor is the resources involved in production, which include both finances and the raw materials needed for every technology to function. Politics, or the role of the state and the ministries responsible for developing industry, is an additional factor. Studying the interplay of these actors and factors illustrates how specialists worked with techniques and technologies, how they coped with a lack in expertise, technical parts, or equipment, what areas were supplied with resources and funding, how Finnish specialists, techniques and raw materials helped launch technologies, and whether it was successful or not. This enables me to explain how, in the same context and with similar resources, some technologies (like bleaching of pulp) were introduced while others (like using of wood wastes and continuous cooking) failed to be implemented.

The dissertation examines how system builders experienced the system as well as the ways in which they tried to implement foreign technologies. Again, in most cases, the reason for the failure in implanting foreign technologies was the lack of communication between institutions and among individuals and inside the institutions as well as the scarcity of Soviet technological resources and poor infrastructure.

At the same time, this approach enables me to illustrate other meanings of transfers. Thus, while traveling abroad to investigate practices and technologies in a different system, system builders acquired a status of transfer agents. While fulfilling their tasks, the agents encountered non-technological aspects, which influenced them, often implicitly. Any technological system evolves in a certain political, social and cultural context. Technology transfer is always accompanied by non-technological influences. The technological components of a large technological system, thus, cannot be separated from the social and cultural context in which it is embedded, especially when we speak of transfer through the Iron Curtain. In the age of ideological competition with the West, transfer agents, the thin top layer of experts in an industry, were exposed to a vision of the Western world that competed with the official Soviet version, and specialists brought these ideas back to their colleagues and workplaces. They defined technical reverse salients of the forestry system and travelled abroad to learn Western technologies in order to overcome technical problems at home. After returning, they saw other drawbacks of the system, not only technical reverse salients, but also deficiencies of management and casual problems of production. Their trips stimulated them to reevaluate their own experience and compare the Soviet and Finnish systems in terms not only of technological progress, but also of working conditions and cultural development. In Khrushchev`s time, it was

not unusual to discuss wages and labor conditions, and already "in the first year after Stalin`s death several prominent Soviet writers raised new themes in their work. They spoke of sincerity, bureaucratic corruption, and the tensions between generations".[135]This dissertation research shows that discussions were possible among other layers of the society – among specialists who worked in the industrial sector.

[135] Suny, R. (1998). *The Soviet Experiment*. New York, Oxford, p. 405.

6.Sources and methodology

6.1. General remarks

This thesis is based on significant collections of primary and secondary sources. I define my sources as those produced by actors of local, intermediate, and macro levels. These are archival collections which include a large variety of reporting materials, correspondence, personal papers and notes; scientific works published in professional journals, volumes and other periodicals, and publications in newspapers; as well as interviews given by former Soviet and Finnish engineers.

The main feature shared by archival and periodical materials lays in their fragmentary nature and dispersion in different archival funds, collections and printed sources. Thus, in order to trace the moving of technologies and the people who transferred them, roughly speaking, from point A to B (for instance, from a Finnish enterprise to a Soviet one through several institutions), I use sources coming from central and local organizations and actors. This entails looking for materials in a number of archives from two sides and collecting various pieces in order to reconstruct the whole picture. The number of archival sources for this work is, therefore, large, although not always enough to cover some aspects in full. In this reconstruction of transfers, some specific questions are still missing. For instance, in considering modernization and transfer of technology to bleach pulp, I have a lot of evidence showing that foreign equipment was transferred to a Soviet enterprise while the origin of these mechanisms is not always clear. As a result, I have two reconstructed cases of transfer (namely, continuous pulp cooking and the use of wood wastes in the forestry industry), which present the basis of my dissertation. In addition, I gather other significant evidence, though not fully reconstructed stories, which contribute to a general picture of how the Soviets studied, transferred and implemented Finnish technologies.

At the same time, the nature of the materials enables me to examine documents produced by social, economic and political actors. My sources are different documents made by scientific, research, political, economic and other institutions, all of which participated in technology transfer and the modernization of the Soviet forestry industry. These materials, taken from all the levels described, present a complicated picture of communication between establishments of different levels within Soviet industry and between Soviet institutions and Finnish organizations.

This enables me to rebuild interactions of transfer agents within the Soviet Union as well as between the USSR and Finland in terms of inter-state, institutional, and personal contacts.

This chapter describes several collections of sources as well as the methodological aspects of working with these materials.

6.2. Enactment documents

The source base for this dissertation is constituted of unpublished, published, and oral materials. The largest part of sources is documents located in various archive collections from the Soviet and Finnish sides. Among them are decrees and notes issued by different Soviet ministries and institutions responsible for the development of science and technology. These are decrees produced by central bodies and local managing institutions dealing with the sphere for which they were responsible. I treat all management institutions as embodiments of the Soviet state: issuing decrees in their field, they acted within the framework of instructions and discourse set by the center – in particular, directives of the party and separate leaders like Nikita Khrushchev. Usually, such documents made reference to a general task given by the center, for example the need to increase production, spur automation of technological procedures, or study the best foreign experience. Most of the decrees I found are stored in the State Archive of the Russian Federation (GARF) and the Russian State Archive of Economy (RGAE), both located in Moscow.[136] As a rule, these documents consist of two parts: an introduction, which might take up to several pages, and a list of tasks and aims to be fulfilled. The introduction usually contains a detailed description of problems in the development of the industry, probably based on expert conclusions prepared by responsible institutions. In some cases, these explanations summarize previous developments and references to historical processes. Although such introductions do not provide any reference to the sources of their data, they help examine what critical problems were put forth by the state, which actually played an important role in modernization in both stimulating and controlling improvements. In the second part, these documents list concrete tasks and, thus, reveal the intentions and aims of the state.

[136] GARF, funds 409 (State Committee on Science and Technology of the Russian Soviet Federative Socialist Republic), 408 (State Committee on Coordination of Research of the Council of Ministers of the Soviet Union); RGAE, funds 7637 (Ministry of Forestry Industry of the USSR), 8513 (Ministry of Paper and Woodworking Industry of the USSR), 9480 (State Committee on Science and Technology of the Council of Ministers of the Soviet Union).

6.3. Correspondence

Another kind of document is correspondence between Soviet institutions of the all-Union level, usually between the State Committee of New Techniques (Gostekhnika)[137] and various ministries, institutions of the republican level (like Gostekhnika of the Russian Republic), research institutions, as well as separate enterprises and, more rarely, individuals. These bureaucratic documents constitute one of the basic source collections for this dissertation as they reveal the nature of modernization and technology transfer through inter-institutional communication. In this correspondence, I found a variety of problems encountered by different institutions. In general, personal letter exchange between heads of research institutions, officials of ministries, ministerial branches, chiefs and leading engineers of enterprises illustrate a complicated network full of connections, inter-dependencies, and obstacles. Their letters reveal the barriers between research establishments and industrial enterprises. Both hardly assisted each other in matters such as sharing literature, expertise, cooperation on some projects, etc. In addition, I use some correspondence between Finnish, Swedish and other foreign organizations primarily with Gostekhnika/GKNT, which was in charge of seeking out Western technology. These data are scarce and quite fragmentary, although they provide some details on communication between East and West. Among these indications is correspondence on adaptation of foreign techniques, invitations to visit Soviet enterprises, greetings and short reflections of praise after visits, as well as advertisements sent to Soviet enterprises (but finally redirected to Gostekhnika/GKNT) by Western companies.[138]

I also build my analysis on some correspondence between Finnish actors involved in trade with the Soviet Union. These are three letters written by Finnish producers to officials providing their judgments and expectations from cooperation.[139] In particular, they illustrate the issues Finnish companies were concerned with such as prices, the diversity of goods, and the reliability of the Soviet Union, among others.

[137] As mentioned above, in 1955 the State Committee on New Techniques of the Council of Ministers of the USSR (Gostekhnika SSSR) was created as an organ to coordinate the development of science and technology and implement best Soviet and Western technologies. In 1957 it was demolished and the State Committee on Science and Technology (GKNT) was organized with very similar functions. In 1961 it was succeeded by quite similar State Committee on Coordination of Research. These establishments were created on the all-Union level and were duplicated in every republic within the USSR.
[138] GARF, fund 408; RGAE, fund 9480.
[139] Ulkoasiainministeriön arkisto, Signum 58. Ulkomaankauppa ja ulkomaankauppapolitiikka. 58 B1, Neuvostoliitto. Kotelo 112.

6.4. Reports

All the actors examined in the dissertation were involved in producing the most valuable and largest group of documents. First, these are current reports on the yearly development of science and technology or separate fields prepared by Gostekhnika/GKNT and later similar institutions. Since these organizations were responsible for the development of science and technology in general, their specialists prepared reports on technologies concerning different branches of the forestry industry. For example, these include reports made after inspections from Gostekhnika/GKNT visited research institutions and separate enterprises where they examined how new technologies were developed or how Western technologies had been adopted. These reports provide a valuable view on the process of innovation in the Soviet forestry industry, the preferences expressed by the Soviet state in its efforts at modernization, as well as the difficulties and successes of those efforts.

A number of reports on the general conditions of some branches within the industry were prepared by Soviet ministries and organizations of the highest level.[140]If reports by Gostekhnika/GKNT seem to be more comprehensive in terms of providing both positive and negative results of experiments, ministerial reports are full of criticism and tasks to fulfill. They rarely analyzed separate technologies in detail, but mostly emphasized general negative trends of the industry. In many cases, both kinds of reports referred to Western experience as an example of possible development. The aim of ministerial reports was to outline the tasks and points for improvement, and these aims were usually listed in the reports. In this respect, however, it is sometimes difficult to find any data about whether these aims were achieved or not. Both kinds of reports are held not as one collection but disseminated in different funds mostly located in GARF and RGAE. As a result, I have reports covering both the all-Union level and separate republics and prepared in different years, but not illuminating the whole period. Still, these materials provide an opportunity to learn about the development of the industry and related fields as well as the policy of ministries.

Documentation of the Central Research Institute on Paper and Pulp (TsNIIB) located in the Russian State Archive of Scientific-Technical Documentation in Saint-Petersburg is also crucial for reconstructing the process of innovation.[141] It contains reports of industrial scientists responsible for developing various technologies, including continuous pulp cooking, as well as minutes of discussions on technologies. This institution had close connections with a nearby pulp and paper plant in Svetogorsk, often addressed in this dissertation. The materials of the institute

[140] GARF, fund A-510 (Chief Administration of Forestry and Forest Protection); RGAE, funds 7637, 8513.
[141] RGANTD (Saint-Petersburg), fund 303 (the Central Institute of Paper and Pulp).

illustrate the concrete work done on innovations and aspects of cooperation and tensions between engineers and scientists.

Reports and correspondence materials of the Soviet-Finnish Chamber of Trade stored in the National Archive of Finland (Suomen Kansallisarkisto) illustrate the organization of Soviet industrial exhibitions in Finland and Finnish exhibiting activities in the Soviet Union.[142] Letters by officials of the Chamber, reports on exhibitions prepared and held, and notes made by organizers and visitors (ranging from forestry engineers to ordinary members of the public) deal with different aspects of exhibition activities. In addition to displaying some equipment and materials for a certain period, these activities were accompanied by lectures by specialists, negotiations between traders and producers, informal communication, and more. The materials on the exhibitions, thus, enable me to examine different specific modes of cooperation as well as interactions between different actors involved in these activities.

Reports by specialists who visited Finland and some other countries (Sweden, West Germany, and Canada) during their business trips are another cornerstone of my thesis. The largest part of these reports is located in the archive of Gostekhnika/GKNT and collections of ministerial documents or organizations responsible for learning and the implementation of foreign technologies in organizations of smaller scale. The accumulation of the reports in several managing institutions was the result of strict centralization. As a rule, specialists were to submit the reports within one month after coming back to their enterprises or research institutions, which forwarded these documents to managing organizations. While most of these documents were archived, usually not revised carefully by officials, a portion of the reports was checked thoroughly and published in professional journals and special volumes of reports.[143] All these reports had a relatively similar structure. First, they listed all the places the delegates visited, explained the need to visit Finland by describing the better performance of Finnish enterprises, and devoted about forty pages to descriptions of their visit sites. Many reports dealt not only with the assigned topic of travel, but encompassed other professional matters observed by the delegates, with particular emphasis on detailed descriptions of mechanisms and procedures like barking, the work of chipping machines, and a general view of factories. In the conclusion, the delegates gave recommendations for more detailed examination of certain topics, considered new topics, planned to implement learned technologies, and included long lists of machines and

[142] Suomen Kansallisarkisto. Suomalais-venäläinen kauppakamarin arkisto. Hs:5–7.
[143] RGANTD (Samara), funds R-160 (the Central Research Institute on Mechanical Wood Processing), R-216 (the All-Union Planning Institute "Soiuzgiproles"), R-613 (Moscow`s Branch of the Central Research Institute of Paper); Lesnaia promyshlennost`, Informatsionny biulleten` annotatsiy otchetov sovetskikh uchenykh o zarubezhnykh komandirovkakh; Zarubezhnaia tekhnika: Biulleten`. Po materialam otchetov o zarubezhnykh komandirovkakh, and others.

technical items to purchase. In many cases, these reports became sources of information for other delegates who referred to previous trips and recommendations to learn about new topics.

To a large extent, these reports were designed as sources of technical information, aiming to inform readers about the industrial sites and institutions the delegates visited and to detail the "useful" technologies they observed. In this sense, these reports provide valuable data on technologies used in Khrushchev's modernization project. At the same time, in reading these reports, we encounter descriptions that go beyond technical information, such as questions about working culture, the conditions of workers, and life in the "Western world." This indicates exposure to non-technical influences that differed from Soviet practices and challenged delegates` view of Soviet conditions. Such comments, however, do not present the whole picture: they were few in number, and the information put into them was measured since the authors did not want to attract the suspicions of the authorities.

I could not find any reports or other reflections of Finnish specialists on their communication with arriving Soviet delegates, and it is likely that they were not prepared, as one of my interviewers – a representative of a Finnish company – explained.[144] However, in the Finnish Business Archive (Elinkeinoelämän Keskusarkisto, ELKA) I found seven reports made by Finnish engineers of the company Ahlström after their visits to foreign enterprises, in particular to the USA, Canada, and Sweden.[145] These are relatively detailed descriptions of visits, technologies, and communication with foreign specialists. Although it is complicated to follow the movement of the same technologies from North American to Finnish and then to Soviet enterprises, these documents help reconstruct a general picture of multiple transfers. To a large extent, close Finnish-Soviet scientific-technical contacts provided the Soviets with an opportunity to learn about not only Finnish technologies, but technologies of other capitalist countries. In Soviet archival materials, in particular in some observations of specialists who travelled to Finnish enterprises, I saw some indications that Finns could help break the technological Iron Curtain created by CoCom restrictions and the Cold War.

In addition to these reports, ELKA`s collections contain reports on Finnish trips, probably made within the program of scientific-technical cooperation and trade, to Soviet enterprises,.[146] In most cases, these trips aimed not only to investigate the level of Soviet forestry, but to a large extent to set contacts with local producers and administrators in order to open new prospects for trade and other forms of cooperation. They covered a wide geography,

[144] Interview with Kari Ketola, taken 27.11.2013 in Helsinki.
[145] ELKA, Ahlström A. OY, Varkauden tehtaat. Insinööri Hans Schneckin kokoamat historia-ainestot, 1952–1966. Matkakertomukset.
[146] ELKA, Suomen puunjalostusteollisuuden keskusliitto. Neuvostoliiton kauppa. Kansiot 1765–1767; Metsäteollisuus ry, kansainvälinen yhteistyö, Suomi-Neuvostoliitto. Kansio 1446.

described key features and important questions of the enterprises visited, and discussed various aspects of Finnish-Soviet trade and scientific-technical cooperation. For instance, they related, among other things, how Soviet engineers dealt with Finnish equipment in Soviet enterprises and what benefits might be drawn from contacts with the USSR. These reports illustrate the intentions of local actors from the Finnish side as well as the nature of Finnish-Soviet interactions. Also, comparing Soviet and Finnish reports helps reconstruct different visions of "the other" and other technologies in the Cold War. Although the descriptions in both sets of reports are similar in terms of structure, these documents reveal different aims and expectations.

6.5. Materials of the Svetogorsk pulp and paper plant

The last group of materials is presented by local documents of the Svetogorsky pulp and paper plant (former Enso) located in the Leningrad Regional State Archive in Vyborg (LOGAV).[147]The dissertation is mainly based on the example of this plant for a number of reasons. First, it was among the largest producers of pulp and paper in the Soviet Union. Second, in the 1950s and 1960s, this former Finnish plant was representative of Soviet enterprise in facing typical problems of management, communication, supplies of techniques and raw materials, work culture, etc. Third, it was a playground for developing the technique of continuous pulp and paper cooking, which is the focus of article III. The fund of this enterprise contains reports of receiving new techniques, deliveries, experiments on separate technologies and notes on fulfilling plans made by engineers. In particular, reports on implementing such technologies as continuous pulp cooking, bleaching pulp, wood supplies and other issues present the character of modernization in one enterprise. The fund`s collection is manifold, although some materials shown in inventories are missing. Though they may have been lost or destroyed, they were probably moved to Moscow`s archives as the result of centralization.

In addition, the picture of modernization and the use of foreign experience on the local level is illustrated by another sort of materials, namely the collection of minutes of discussions in Svetogorsk`s local party organization. These discussions were arranged frequently and involved employees who were party members or candidates. The Central Archive of historical-political documents in Saint-Petersburg (TsGAIPD) holds detailed minutes of this organization's open and closed meetings.[148] They are quite a specific source brimming with party vocabulary, which, however, provides some discussions on basic technological problems in the plant. Being

[147] LOGAV, fund R-180 (Svetogorsky Pulp and Paper Plant).
[148] TsGAIPD, fund O-1542 (Party organization of production enterprise Svetogorsk).

primarily involved in industrial production and living in an industrial town, the local party members discussed professional issues along with everyday and cultural topics. As a rule, these minutes were revised carefully, but they discussed only negative moments and were full of criticism. While in many cases materials of the plant`s engineers present a positive picture of changes and the fulfillment of annual and monthly plans, minutes of party discussions mostly talk about negative aspects of the plant's activities. The most 'popular' strategy was blaming managers of separate factories and departments of the plant for various mistakes and shortcomings. Actually, each technical problem, like the discrepancy in outcomes compared to targets set by the annual plans, was presented as a result of insufficient organization and an irresponsible attitude towards the matter. This criticism was said to stimulate the activities of the plant`s workers. At the same time, unlike the official reports of the plant, the minutes of party discussions were not exposed to a wider audience and allowed more criticism. These materials are valuable in terms of showing "live discussions" of workers, particularly in comparison with other sources to produce a critical view of the plant's modernization.

The collection of local sources is complemented by materials of a newspaper published in Svetogorsk and titled "Svetogorski rabochii" ("Stakhanovets" until 1956).[149] This periodical was published twice a week and contained articles by the party organization and the plant. The newspaper was printed with a circulation of a thousand copies and was distributed among the plant's workers as well as the nearby town's other inhabitants. While there were many publications on political news, some engineers and workers published short articles on current problems of the plant, local events, plans, and announcements. In this respect, this category of materials is a valuable source for my thesis as they provide the views of those who were involved in the activities of the plant in the 1950s-1960s. However, both the newspaper articles and minutes of meetings of the party organization are quite ideological: both contain a lot of references to speeches and presentations given by party leaders and slogans. In some instances, they served as propaganda materials to appeal to the need for modernization and, as a consequence, they might misrepresent the reservations or criticism of some individuals. In addition, as in many other Soviet sources, a large number of speeches in the minutes and newspaper articles were anonymous. In most cases it is extremely difficult to identify the authors.

[149] Svetogorski rabochii, 1953–1964.

6.6. Statistical data

Specific materials are presented by statistics, in particular in the volumes on foreign trade issued yearly by the publishing organization Vneshtorgizdat.[150]These volumes contain numbers on the import and export of different goods from and to Finland and other countries. These figures do not provide detailed information on specific items, but discuss categories like pulp making equipment, etc. In this sense, I use these data to illustrate a general picture of transfers from Finland to the Soviet Union. Other statistical data I encountered in different Soviet archival sources is quite fragmentary and difficult to check for reliability. In fact, unreliability and the common falsification of Soviet statistical materials is the crucial reason for why I do not refer much to statistics.[151] Other statistical data is given in the draft and year treaties as well as in the minutes of negotiations between the Soviet foreign trade organization and Finnish companies archived in the Finnish Archive of Foreign Affairs (Ulkoasiainministeriön arkisto). I use these sources to trace the imports of some specific techniques and technical parts as well as the general dynamics of technological trade between the countries.[152]

6.7. Interviews

Finally, my thesis is based on several interviews of former Finnish and Soviet specialists who took part in the modernization of Soviet forestry industry. First, I use five interviews by engineers of Finnish companies Enso-Gutzeit and Rauma-Repola.[153] Because my research is several decades far away from the period in focus, the interviews deal with the 1970s–1990s. The interviews were organized as a free conversation with some basic questions. They concerned professional experience, ways of cooperating with Soviet specialists, issues related to the organization of scientific-technical cooperation and trade as well as professional communication. No less important are conclusions and opinions expressed in the interviews on Soviet modernization, its failures, successes and peculiarities. These materials enable me to specify some aspects not presented in other materials and to compare the archival sources with

[150] Vneshniaia torgovliia SSSR, M., 1957-1964.
[151] For example, as historian of Stalinism Yves Cohen shows, Stalin`s officials often distorted statistics intentionally or occasionally. Cohen, Y. Op. cit., p. 44. Joseph Berliner mentions this in the relation of 1950s and 1960s. See Berliner, J. Op. cit.
[152] Ulkoasiainministeriön arkisto, Signum 58. Ulkomaankauppa ja ulkomaankauppapolitiikka. 58 B1, Neuvostoliitto. Kotelot 116-19, 126, 129.
[153] Taken in November–December, 2012 and between August and December, 2013. Kari Ketola, three interviews taken in August and November, 2013; Ilkka Kallio, November, 2012; Raimo Mäkelä, December, 2012; Voitto Pölkki, December, 2012; anonymous interview, November, 2012.

the experience of engineers themselves. I also conducted one interview with a former Soviet engineer whose professional activities were not directly connected with the subject of my thesis, but who was engaged in a later project "Ladenso," a mutual Finnish-Soviet enterprise in Soviet Karelia.[154] The questions in this interview were similar to the others and concerned the technological side of cooperation (such as comparison of techniques in Finland and the Soviet Union, technology transfer, effects of modernization), and cultural aspects (language problems, ways of informal communication), among others.

In general, all the key materials outlined in this chapter present the basis for my research. Together, they help reconstruct technology transfer and its effects for Soviet modernization in the forestry industry. Except for the interviews, these are mostly mass sources which provide a solid grounding for the project, though they are not complete in every aspect.

[154] Interview with Yuri Kuznetsov, February, 2013.

7.Results

The main question of this dissertation is the role of Western, and in particular, Finnish technology, in the Soviet modernization of the forestry industry in 1955–1964. This question concerns three sets of questions related to Soviet modernization and the forestry industry, Soviet technology transfer and innovations as outlined in chapter 2. The results for each part are considered in separate sub-chapters.

7.1. Soviet modernization in the forestry industry

This thesis examines the use of forest resources in the Soviet Union as well as industrial operations for making pulp and pulp-based products. It emphasizes state politics and the activities of engineers and industrial scientists as well as their visions of technological modernization.

7.1.1. Development of the forestry industry in the 1950s and 1960s

This research approaches the Soviet forestry industry as a large technological system with a number of deficiencies that had already been officially recognized several times during the Khrushchev era. The critical problems of the system derived from backward technologies in wood harvesting, pulp and pulp-based products making. Thus, as **article IV** shows, while the volume of cuts was high, the amount of waste left in the forests was enormous and led to a rapid devastation of forest resources. Also, as **articles I and III** show, the quality of pulp and other products was often low and the Soviet forestry industry lagged behind other countries in making pulp, paper, machinery and other goods. Soviet leaders and engineers believed that backward technologies, which prevented the required development, explained this lag. The chain "raw materials-production/innovation-goods" was not working smoothly. In different stages, producers faced difficulties such as the inadequate and poorly organized supply of raw materials and techniques, the absence of proper technology and trained engineers and workers. Soviet specialists understood it well. **All the articles** support the argument that the Soviet industry was

facing shortages, and they illustrate that this was a crucial feature for the development of the forestry industry in the 1950s and 1960s.[155]

7.1.2. Modernization of the forestry industry as seen by Soviet specialists

Modernization involved many activities of engineers working in various branches and with various technologies. **Articles I, III** and **IV** show that when modernization was declared, Soviet engineers, encouraged by the leadership, defined critical problems, which should have increased the quality of products. In general, Soviet engineers showed that they were able to define the critical problems well and see what was required for successful development, while they often could not solve these problems using only internal resources. Their suggestions were related to a large number of fields, ranging from the reduction of cuts in the forests to making viscose pulp. In these suggestions, as **article IV** puts it, we see the intention to reduce wasteful cuts and introduce the more rational use of resources. This intention served economic purposes: using resources rationally, improving technology and techniques would save resources for future industrial production. Nonetheless, there was a group of scientists who thought about cutting less in order to save the forests for the future.

All the articles argue that, as in previous and later periods, both leaders and engineers relied on the transfer of Western experience and technologies in order to modernize the Soviet forestry industry. Borrowed technologies were to fill the gaps in the Soviet forestry technological system in order to provide a quicker modernization of technological processes and equipment, but in practice modernization saw different outcomes. While some technologies were successfully implemented, others failed or succeeded only partially. The Soviet institutions did not recognize the problems of resource shortages as something to be solved through innovation. As a result, Soviet innovations remained dependent on Western technologies.

7.2. East-West cooperation and technology transfer

This thesis provides a number of examples of the permeability of the Iron Curtain, illustrating different channels of communication between Soviet and Western engineers and

[155] Kornai, J. (1980). *Economics of Shortage*. Amsterdam; Berliner, J. Op. cit; Schattenberg, S. Op. cit.; Osokina, E. (2001). *Our Daily Bread*. Armonk, New York and London, among others.

industrial scientists. The two chosen channels – trade and industrial exhibitions of Finnish companies in the USSR and visits by Soviet specialists to Finnish enterprises—analyzed in this dissertation in detail, demonstrate encounters between actors from two technological systems. Analysis of these encounters leads to two conclusions.

7.2.1. Importance of encounters on the micro level

Articles I and **II** contribute to a discussion of Soviet-Finnish trade and Cold War interactions between the socialist and capitalist blocs. As **article I** argues, the Soviet state was the main instigator for technology transfer, aiming to use the resources of advanced technological systems in Soviet modernization. In doing so, the Khrushchev leadership signed agreements on trade and scientific-technical cooperation with a number of capitalist countries, which intensified communication through exhibitions and visits of specialists. **Article I** shows that visits of Soviet engineers and industrial scientists to foreign enterprises were an important means of communication and learning more about another technological system. As **article II** states, exhibitions entailed various activities, such as presentations, lectures, intensive advertising, and personal meetings of Finnish and Soviet traders, managers and specialists. They contributed to an increase in knowledge about what was happening behind the Iron Curtain and opened up a channel for technology transfer to Soviet industry. Through these encounters, Finnish traders could illustrate the possibilities of the Finnish forestry system and goods that might be delivered to the USSR. They advertised and promoted production as they established economic ties with potential consumers. Soviet specialists and officials could choose technologies to transfer and see the material product with their own eyes before buying it. They made recommendations on the purchase and implementation of Finnish experience in domestic production.

Article II shows that encounters at exhibitions were not penetrated by ideology, but rather focused on business activities and a way of demonstrating the possibilities of Finnish imports to Soviet managers and specialists. For Finnish traders, it was also a way of competing for Soviet consumers. For Soviet visitors, it was a channel to examine Finnish production and decide what techniques and technologies could be transferred.

7.2.2. Technology transfer and non-technological impacts

Still, even without ideological implications, encounters entailed non-technological impacts. **Article I** discusses travels of Soviet engineers and industrial scientists to Finland to bring advanced technological know-how. The Soviet leadership did not intend Soviet specialists to bring anything except the technologies necessary for modernization. However, given that any technological system evolves in a certain political, social and cultural context, technology transfer is always accompanied by non-technological influences. Due to organizational aspects of Soviet travels to Finland, as examined in **article I**, transfer agents acquired a new role as social and cultural transfer agents. Thus, due to general impressions, the need to visit as many enterprises as possible, the lack of finances, and the excessive centralization of communication between Western and Soviet specialists, there was an unexpected transfer by forestry industry specialists. The technological components of a large technological system, thus, cannot be separated from the social and cultural context in which they are embedded, especially when we speak of transfer through the Iron Curtain. Trips stimulated Soviet transfer agents to reevaluate their own experience and compare the Soviet and Finnish systems in terms not only of technological progress, but also of working conditions and cultural development. While Soviet transfer agents were aware of the better technological performance of Finnish forestry industry, their trips abroad deepened their impressions and stimulated further debates from the perspective of positive capitalist experience. Specialists discussed wages, labor culture, and conditions in Finland at meetings which were supposed to discuss technologies and foreign industry. The thesis, thus, contributes to debates about Khrushchev`s "thaw" as it played out in engineering and scientific communities. This period allowed more space for personal opinions, and these opinions were shaped by the foreign experience of delegates. As **article I** shows, such debates took place among engineers who worked in the forestry industry.

7.3. Soviet innovations and implementation of Western technologies

Visits by Soviet specialists to Finland and encounters between Finnish and Soviet actors at trade and industrial exhibitions allowed the transfer of Finnish and Western technologies to the Soviet forestry industry. This dissertation accepts that transfer, as a complete procedure, means a two-stage process – transportation and implementation of technologies. The second phase was the most fraught and did not automatically lead to the better performance of the Soviet forestry industry system. In most cases, the efforts to develop a competitive industry failed and made the Soviet system dependent on the foreign system. In other words, the transfer of the

1950s and 1960s meant bringing technologies from the donor (Finnish) to the recipient (Soviet) system and afterwards this schema remained as such. **Articles III** and **IV** contribute to the discussion of Soviet innovation and the role in it of technology transfer. The following results explain the reasons for this as they discuss Soviet implementation of Western technologies.

7.3.1. Deficiencies of the Soviet forestry system and their impacts on innovations

Articles III and **IV** illustrate that the problem of turning inventions into innovations as well as further developing technologies that had been transferred layin the deficiencies of the technological system as a whole. The system resembled an organism made up of various components. The articles illustrate that the technological system did not change as a whole; it continued to suffer from shortages of techniques, technical details and knowledge in the Khrushchev period. Bringing new technologies did not imply a radical shift in production and required a lot of time and resources. The problem of implementation of imported technologies could only be solved by solving the problems of the system itself, such as the supply and training of workers. The main reason for failures in implementation was the Soviet mindset that assumed technology could be introduced into the system quickly. On the contrary, innovation required large amounts of time and investment. For these reasons, the Soviets were interested in purchasing whole enterprises and mechanisms, although it was not always possible in practice. Successful transfers were those brought as a whole, as **article III** illustrates. And as **article IV** shows, due to these reasons, after purchasing some mechanisms like debarking machines or chippers, Soviet engineers put a lot of effort into repairing them. In some cases, these new techniques remained dependent on foreign repair parts and caused either sophisticated inventions or delays in production.

With varying successes, the transfer of foreign technologies helped fill the gaps in the technological system. As **article III** shows, Kamyr apparatuses purchased from abroad allowed manufacturing pulp continuously. **Article IV** illustrates that even though there was communication with Finnish engineers about experimenting with using alternative resources in pulp making and even though technical equipment was purchased, the deficiencies of the Soviet technological system made successful implementation impossible.

7.3.2. Barriers between institutions and Soviet innovation

Article III shows institutional and personal barriers that hindered the implementation of imported technologies. The socialist regime saw some technologies of the forestry industry as strategically important. As a result, the state prevented the diffusion of information even within the industry. In many cases, scientists and engineers worked in isolation and had no access to literature, technical details and other artifacts (in Hughes`s terms) available at other Soviet factories and research institutions. As Joseph Berliner said in 1973, "a fundamental feature of modern science and technology is its international character"[156] and it was indeed a crucial feature of the post-war scientific and technological development. Within the Soviet forestry industry, dysfunctional contacts among various actors hindered development because of competition between institutions, the need for each to fulfill the plan, and simple technical inability to cooperate. **Article IV** shows that conflicts between timber mills and pulp makers hid a technical problem. Neither was capable of either preparing chips or transporting them while both accused the other of an indifferent attitude towards the use of wood wastes. There were often barriers between suppliers of raw materials or timber mills, supplies of techniques and technical details, research institutions, and producers of pulp, paper, cardboard and other products. This led to interruptions in production and the development of innovations.

Article III examines continuous pulp cooking dating back to the 1940s. During the Stalin era, state support sustained the project. After Khrushchev`s liberalizing reforms, the conflict between participating institutions led to the end of the project. These institutional barriers between research and industry were also a product of excessive centralization of industry, the key feature of the Soviet regime. In the forestry industry, it prevented the making of a collective invention, in the terminology of Robert Allen, which requires a free flow of information about new techniques and technologies among firms.[157]The strategic importance of bleaching pulp, making high-quality cord pulp and other materials, prevented a larger discussion of reverse salients. After liberalization and the reorganization of the invention system, the degree of secrecy decreased and the system stopped working on some technologies and, rather, using ready-made innovations transferred from the West.

7.3.3. Partiality of transfers and the problem of modernizing the whole technological system

Articles I, III and **IV** prove that Soviet specialists paid much attention to details and aimed to transfer separate technologies. Often, Soviet modernization efforts in the forestry

[156] Berliner, J. Op. cit., p. 212.
[157] Allen, R. (1983). Collective Invention. *Journal of Economic Behavior and Organization*, 4(1), pp. 1–24.

industry were pursued on a small scale, with no real attempt modernizing the whole system as was indeed required. As a result, Soviet specialists were not able to change the infrastructure or the technological system. To illustrate this conclusion, **article IV** argues that when a critical problem was revealed in making better and cheaper wood, this required a change in the wood supply system. Most successful were those innovations which were brought as a whole such as the Kamyr apparatus (examined in **article III**) but not those which were transferred partially, such as the technologies and techniques for using alternative resources examined in **article IV**. Transferring details implied the need to improve the whole technological system, i.e. infrastructure and the system of supply, but this need was not articulated in Khrushchev's time.

8.Concluding remarks

Russia is a paradigmatic example of a country continuously trying to modernize. Almost every political period saw an attempt to modernize industry and take the lead in technology and production. Modernization was always accompanied by comparisons with the West, most vividly in the Soviet epoch.[158] But, as Kristine Bruland and Dave Mowery state, it was "a noncapitalist catch up failure".[159]It is hard to measure success and failure, but an array of examples of failed technologies, low quality of production, and poor general performance of the forestry industry are convincing proof.

This dissertation has conceptualized several historical and methodological aspects of Soviet technological modernization in the forestry industry in a dialogue with modern scholarship. This research has examined an attempt to catch up to more advanced technological systems in the technological modernization of the 1950s and 1960s, emphasizing technology transfer and its multiple impacts on the Soviet forestry industry and professional communities. Technology transfer served as a means of filling the gaps made by deficiencies of the system. In other words, it would help, as the Soviet leadership and specialists expected, import missing parts of the technological system.[160] In the future, it was hoped that it would lead Soviet forestry to a more advanced level, even to be competitive with the West. However, due to ideological factors and insufficient infrastructure, a number of state-regulated transfers were not sufficient and proved unable to improve the system as a whole.

The period under consideration witnessed a number of promising inventions in the Soviet forestry industry such as continuous pulp cooking and using wood wastes and annual plants in production. Specialists aimed to solve such critical problems as outdated techniques, insufficient production of pulp, wasting forests and overcutting. Overall, these would help produce more high quality pulp as well as save forest resources, i.e. make an important change in the wasteful Soviet practices of wood harvesting and production. In practice, not all inventions were translated into innovations successfully. In some cases, foreign technology, if transferred as a whole, bolstered domestic production while in others, when only separate parts were transferred, it was not introduced successfully. Using borrowed experience in order to create the Soviet Union's own innovations was inconsistent and required the accumulation of various resources.

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[158] Schattenberg, S. (2002). *Stalins Ingenieure*. Bd. 11, München.
[159] Bruland, K. and D. Mowery. Op. cit., p. 119.
[160] James Cortada says about information ecosystem which formed after the WWII and made possible the movement of information, being part of coming globalization. See Cortada, J. (2014). When Knowledge Transfer Goes Global. *Enterprise & Society*, 15(1), pp. 68–102.

Overall, three features of the technological system –formulated in this thesis as speed, barriers, and partiality – were crucial in the process of modernizing the forestry industry. Again, modernization was multi-faceted and did not include only failures, but in general it failed; it did not lead the forestry industry to the fore as was expected by the Soviet leadership in the beginning of the modernization project. Bringing new technologies required changing infrastructure, but the new technologies met the same deficiencies that already hindered production. As Thomas Hughes shows, the development of the system, including transfers, depends on the interaction of its components. In the Soviet context, this interaction was complicated by supplies, ideology and secrecy, poor infrastructure, and restricted communication among institutions.

As this thesis illustrated, Soviet transfer agents – institutions and specialists – used various channels for transfer, which meant encounters with Western, in particular, Finnish actors. Transfer opened up the possibility of discovering more information about the world behind the Iron Curtain and produced non-technological impacts on Soviet actors. For the Soviets, it helped equip some plants and instigate research in Soviet enterprises and research institutions. It was also beneficial for Finnish producers in terms of economic profit. In sum, various contacts across the Iron Curtain demonstrate its permeability and prove that on the micro level, the Cold War was not just a confrontation.

On the basis of examined research works, we might conclude that the modernization attempt in the forestry industry followed the general path of a wider modernization process. It revealed that the main barriers to development were the endemic shortages in the planned economy and the social organization of industry. Modernization of the forestry industry also illustrated visions of resource use and industrial innovations for making a wide range of products.

This research contributed to the history of technology transfers from West to East during the Cold War and their role in Soviet technological modernization. It also contributed to the history of Soviet post-war use of forests and the forestry industry, Cold War studies, and Finnish-Soviet relations in the 20th century. It has proved that it is important to analyze many factors in their interaction, such as society, technology, management, and environment as they are embedded in the same technological system. In the Soviet Union, some components of the system remained unchanged and prevented the development of the system. Poor infrastructure, the barriers between suppliers, producers, and researchers, and wasteful forest management illustrated path dependence in the forestry industry. These problems existed before and during the modernization of 1955–1964 and remained afterwards. For modernizers in the modern age,

they should be avoided. This might be done by decentralizing political control over technological systems and fundamental change in state control over innovations.

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Appendixes

Appendix 1

The number of workers in industries in the USSR and the Russian republic of the USSR (RSFSR), 1950 and 1960

	USSR		RSFSR	
Branch of industry, number of employees, million people, %	1950	1960	1950	1960
Total number of workers	13.2	19.7	9.4	13.3
Electrical energy	1.4	1.4	1.3	1.6
Fuel	7.7	6.9	5.9	5.2
Chemical	2.7	3.1	3.0	3.8
Construction	4.9	7.1	4.1	6.4
Wood harvesting, wood processing and paper	17.1	12.2	17.8	14.3
Metallurgic	6.1	7.0	6.4	6.5
Machinery making and metal-based manufacturing	30.3	30.5	32.4	33.4
Polygraph	0.9	…	0.8	…
Consumer goods	15.9	18.2	16.5	17.3
Food	10.0	9.4	8.5	7.6
Others	3.0	4.2	3.3	3.9
Total	100			

Source: Treivish, A. (2002). Promyshlennost` v Rossii za 100 let. In N. Marfenin, red., *Rossiia v okruzhaiuchshem mire. Analiticheskii ezhegodnik*. Moskva, p. 22.

Appendix 2

Wood harvesting in the Soviet Union in 1949–1961 compared to Europe and the USA.

	Roundwood, million cubic meters		Sawnwood, million cubic meters		Woodpulp, million cubic meters		Paper and Paperboard, million cubic meters	
Years	1949 – 1951	1959 – 1961	1949 – 1951	1959 – 1961	1949 – 1951	1959 – 1961	1949 – 1951	1959 – 1961
Europe	293.9	305.8	61.1	70.1	11.6	15.3	11.7	22.2
USSR	227.2	372.8	49.4	104.6	1.5	3.2	1.4	3.3
USA	280.3	305.5	101.6	99.0	7.1	15.0	26.5	37.6

Source: Richards, E., ed. (1987).*Forestry and the Forest Industries: Past and Future*. Dordrecht, pp. 11–13.

Appendix 3

Share of Finland in Soviet imports of equipment for forestry industry, 1955–1964

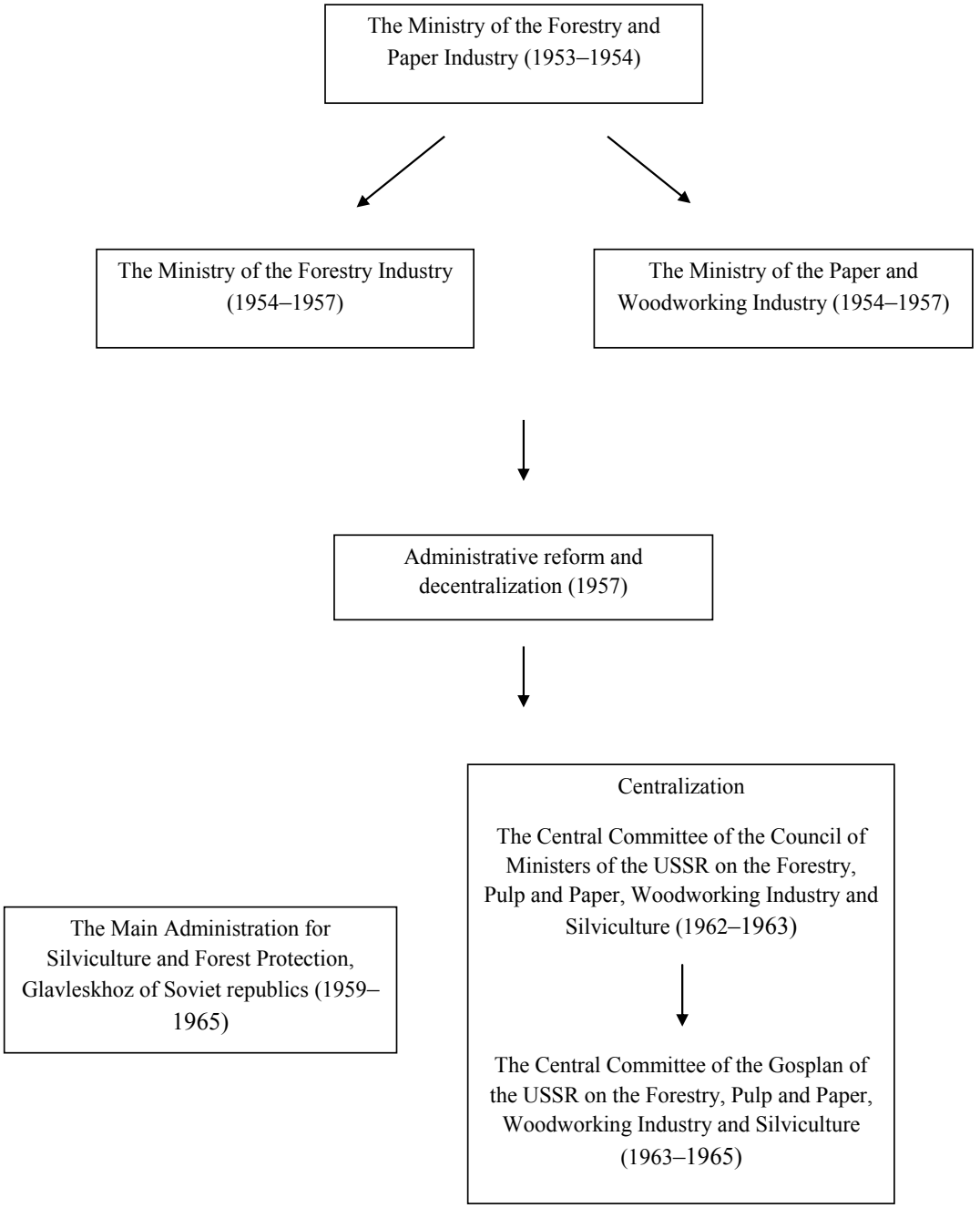
Years	1955	1960	1961	1964
From Finland (thousand rubles)	3'818	9’002	14’814	8’474
TotalfromSweden, Austria, Britain, Italy, Poland, France, Czechoslovakia, Finland, Japan (thousand rubles)	7'991	30’304	39’915	54’621*

*This year 29’366 was imported from Japan.

Source: *Vneshniaia torgovlia Soiuza SSR za 1961 g*. (1962). Moskva, p. 62; *Vneshniaia torgovlia Soiuza SSR za 1964 g*. (1965). Moskva, p. 83.

Appendix 4

The structures of Soviet forestry industry and silviculture administration, 1953–1965



Appendix 5

A layout of the thesis