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Andrey Averin – Grigory Dudarev

BUSY LINES, HECTIC PROGRAMMING

A Competitive Analysis of the Northwest Russian ICT Cluster

ETLA, The Research Institute of the Finnish Economy
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ABSTRACT: Northwest Russia and particularly St. Petersburg were a globally important development center for information and communication technologies (ICT) during 1850-1950. The region's position of strength deteriorated after this period as a consequence of the choices made about technology and Soviet secrecy. However, the region and its ICT industries still enjoy the benefits of education provision, the research-oriented tradition and inherited human and industrial capital. The transition to the market economy opened up many opportunities but also resulted in the evaporation of uncompetitive producers like giant electronics manufacturers. It also reduced financing and changed the priorities for R&D and education. At the same time, breakthroughs in telecom technologies and the overwhelming success of mobile communications greatly influenced the ICT industries in Russia. Understanding the major changes and trends is crucial for industrial policy and business strategy decision makers. In this study, we identify the Northwest Russian ICT cluster and the key matters related to its competitiveness and growth prospects in the new environment. The study demonstrates that inherited production factors, as well as growing domestic demand, form the background of the growth currently experienced. Russia already has a competitive edge in offshore programming. However, focused industrial policy is urgently needed in order to make the cluster's growth sustainable and create long-term competitive advantages.

KEY WORDS: Northwest Russia, cluster, information and communication technologies ICT, new media, competitive advantage, economic growth, industrial policy.

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TIIVISTELMÄ: Luoteis-Venäjä ja erityisesti Pietari olivat vuosina 1850 – 1950 yksi maailman tieto ja viestintäteknologian (ICT) kehityskeskuksista. Tämä jälkeiset teknologiavalinnat (sotilas- ja avaruusteknologiapainotus) ja salailun aiheuttama eristäytyminen vaurioittivat alaa. Tästä huolimatta ICT-alat hyötyvät koulutuksesta, tutkimustraditiosta, sekä periytyneestä inhimillisestä ja teollisesta pääomasta. Siirtyminen markkinatalouteen avasi monia liiketoimintamahdollisuuksia mutta myös kuihdutti elektroniikan kilpailukyvyttömät jättiyritykset. Myös T&K:n ja koulutuksen rahoitus pieneni ja painotukset muuttuivat. Teletekniikan läpimurrot ja matkapuhelimen ylivoimainen menestys vaikuttivat voimakkaasti ICT-aloihin Venäjällä. On ensiarvoisen tärkeää, että elinkeinopolitiikan ja yritysten päättäjät ymmärtävät näiden muutosten vaikutukset. Tutkimuksessa analysoidaan Luoteis-Venäjän ICT-klusterin kilpailukykytekijät ja kasvumahdollisuudet. Tutkimus osoittaa, että kasvu perustuu perityille tuotannontekijöille ja kasvavalle kotimaan kysynnälle. Ohjelmointiliiketoiminnassa on jo saavutettu kansainvälistä menestystä. Kestävän kehityksen ja pitkän tähtäimen kilpailuetujen saavuttamiseksi tarvitaan tarkasti kohdistettua elinkeinopolitiikkaa.

ASIASANAT: Luoteis-Venäjä, klusterit, tieto- ja viestintäteknologia, uusmedia, kilpailuetu, taloudellinen kasvu, elinkeinopolitiikka.

Preface

Everyone knows the Silicon Valley in California. During the last few decades, Finland and Sweden have become famous as pioneers in mobile telephone technology. Few people know that St. Petersburg was one of the world's leading telecommunications, radio and television technology development centres for as long as one hundred years, from 1850 to 1950. Even after this time period, a huge number of experts continued to conduct research and development, though in secrecy from the rest of the world. The results of their work were harnessed to maintain the military power and ensure the space conquest of the Soviet Union, the world's second super power.

The history of Russian inventors and early introduction of new technology is impressive. It is introduced in greater detail in this book, but here are a few examples. The telegraph, whose development the Czar's army considered highly important, was introduced as early as 1850. The telephone took over St. Petersburg in 1882. The fast growing market attracted industrial entrepreneurs, with approximately twenty communications equipment manufacturers being established in St. Petersburg during 1877–1917. Siemens-Hanske and Ericsson, for example, had their own factories in the city. In 1895 Alexander Popov developed his radio, and in 1915 Professor Bonch-Bruevich invented the electron tube, which revolutionized radio technology. The first television was introduced as early as 1911. The test broadcasts started in 1936, four years after the first television set for consumers was manufactured. The mass production of television sets started in 1949.

History tends to repeat itself. The collapse of the Soviet Union and creation of the new market economy have gotten Russia's information and communications business off on a new, promising start. Mobile and data communications are growing extremely fast. Young consumers and new service suppliers have started to use the newest technologies at once, skipping several generations of technology that are still used in the West. In the programming area, Russia is becoming a phenomenon similar to India or Israel.

The new, solid link to consumers and users is a strong catalyst for business growth. Technology policy measures and risk financing of new technology are almost entirely unused resources in the new Russia. The market will not take care of everything. Russia also has a

long way to go in attracting technology transfer and foreign investment from Western multinational companies. If measures to safeguard investments in Russia are introduced, bureaucracy is diminished and the infrastructure is improved, the old Siemenses and Ericssons as well as new Nokias will return to Russia.

Russia faces plenty of challenges. A good mobile telephone system for a sparsely populated country should be developed. The country's rundown fixed-line telephone network cannot be used as a basis for mobile telephone and data communications, so what should be used instead? What will "eRussia" look like? Over 250 million people speak Russian, and Russia's cultural offerings are versatile. This is a good prerequisite for developing lucrative content products for the Internet and telecom networks. We hope that this book, written by our Russian researchers, will contribute to companies' knowledge of Russia, and in this way reduce barriers to investment and business growth.

Helsinki, January 2003

Pentti Vartia

Author's Preface

This Study is part of a larger project entitled "Analysis of the competitiveness of Northwest Russia," the goal of which is to assess the growth potential of the Northwest of the Russian Federation in the conditions of transition to the open market. The project implies the analysis of the five industries most important to the economy of this region: forest, energy, metallurgy and metalworking, information and telecommunications technologies and food. The research was carried out by a consortium of participants, including: *The Center for Strategic Research* (www.csr.ru), a leading Russian think tank that prepared a current action plan and strategy for the Russian Government; *ETLA* (www.etla.fi) - the Research Institute of the Finnish Economy, a leading Finnish economic research institute; and *Solid Invest* (www.solidinvest.com), a St. Petersburg research-based consulting company. We are happy to express our appreciation of valuable help, understanding and support provided by these organizations in our research.

Within the framework of this study we intended to assess the important issues and trends for the information and telecommunications technologies (hereafter ICT) industries, which are among the most rapidly growing industries in Northwest Russia nowadays. It is envisaged that to make the further growth sustainable new approaches and regulating methods of the state industrial policy are urgently required. The view produced with a help of methods and analysis approaches, used in this study, is quite new in Russia. Therefore this study aimed to assess basic information, introduce new views and facilitate the start of reconsidering the role of industries and governments in ensuring economic growth and prosperity in Northwest Russia. We hope that the results of our research will be interested to the wide range of readers and will be of high value for the purpose of facilitating the further growth of the cluster.

We would like to express herewith our gratitude to the Finnish companies and organizations (SITRA, Elcoteq, Nokia, Sonera, Elisa Communications), which supported the research. Our special thankfulness is expressed to Steering Group members: *Mr Christer Härkönen*, Group Vice President, Terminal Products and Services, *Mr Petri Allekotte*, Account Team Manager, Elcoteq Network Oyj; *Mr Matti Mäki*, Regional Manager NET Russia, Nokia Networks Oy; *Mr Martti Huttunen*, Vice President, *Mr Carl-Frederik Geust*, Director of International Relationship, Russia, Sonera Oyj; *Mr Tauno Heikkilä*, Director, Information Society Development, Elisa Communications Oyj; *Mr Gunnulf Mårtenson*, Managing Di-

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Andrey Averin and Grigory Dudarev

Contents

Figures

Tables

Boxes

Summary

The present paper is devoted to the analysis of the information and telecommunications (ICT) industries of Northwest Russia. The most important lines of business in this cluster are the traditional line telephone services and the fast growing mobile communications, data transmission, Internet services, programming, and manufacture of communications equipment, which still suffers from the collapse of the Soviet market. Northwest Russia is one of the seven federal districts, bordering in the west to the Baltic countries, Finland and Norway. There are 15 million inhabitants in the region. Its administrative center, the City of St. Petersburg is the ICT capital of Russia.

At present, ICT industries are among the fastest growing sectors of the regional economy. A spectacular 35% growth was registered in 2001. The growth of the sector is due to structural changes in demand, transition to the market economy and opening of the economy. The importance of information and telecommunications technologies increases in the overall economic development of the region (in line with the similar global trend). The modern ICT technologies serve both as an instrument of integration into the global networks and as a means of improving productivity and lowering the production costs. This role of the ICT industries is becoming more and more noticeable and, correspondingly, its development draws significant attention of some political leaders and officials in Russia.

The changes in demand caused by the collapse of the Soviet Union have greatly influenced the Russian ICT industries owing to the dynamics and globality of the technological development in the field. When the centralized planning system responsible for the allocation of resources and industrial development collapsed, the advance of many manufacturing and technology development activities stopped as well. New institutions to replace the old ones and facilitate development with indirect means and appropriate industrial policy were not created. A certain vacuum appeared. In such conditions the local manufacturing and R&D companies were forced to fight for survival on their own, using their inherited technologies.

The scale, speed and scope of the change in the Russian industries was such that companies and the government were not able to respond. The government was busy with dismantling the old, Soviet system and building new institutions. The lack of targeted industrial policy weakened the positions of advanced technology and research-intensive industries –

ICT sector in particular. Now that the markets are stabilizing and the new institutions and legal framework started to operate it is time to assess the changes and development prospects.

Among the main goals of the study are the analysis of the structural change in the Northwest Russian ICT cluster, and the creation of an information basis for strategic decision-making, both by regulatory bodies and companies. As a basis for analysis the authors used the 'diamond' model and the industrial cluster concept developed by M. Porter in the well-known paper *The Competitive Advantage of Nations*. Besides, the subsequent theories related and underlying this concept were applied to broaden the views presented in the study.

The cluster approach emphasizes the importance of inherited skills, industrial capital and traditions. Education and research are also considered important, as well the close links between manufacturers and suppliers. In addition to close links, geographical proximity is emphasized. In fact similar ideas underlay the creation of regional scientific-technical complexes in the Soviet Union starting from the 70-ies. In this period the territorial complex of electronics industry was developed in Northwest Russia. The main differences between regional complexes and industrial clusters were allocation of resources and supplies neglecting the markets and customer needs and aspiration for mass employment and standardization instead of competitiveness, lower costs and flexibility. Owing to these differences, the transition to market economy has brought a natural destruction of long-established links in the industrial complex.

Now the region is witnessing the formation of an ICT cluster based on the industries that either survived, e.g. wire communications, or emerged during the transition period, e.g. mobile communications. New networks of market partnerships have replaced most of the links established in the Soviet period. *Chapter 3* introduces the structure of the Northwest Russian ICT cluster – primary goods and services, universities and central research institutes providing the cluster with labor and know-how, other specialty inputs, technology, associated services, companies of related industries and the main consumer groups. Chapter 3 also presents the main interconnections between the companies of the cluster, as well as the value chains in the cluster.

Early concentration of ICT activities in Northwest Russia has made this industrial agglomeration highly important on the national scale. With 12,3% share of the total volume of telecommunication services it is the second largest market in Russia. The largest one is the Central Federal District with 51,6% (Moscow alone accounts for 43%) of the total. The market is heavily concentrated in St. Petersburg – 64% of the total in Northwest Russia.

The mobile business of Russia started in St. Petersburg. North-West GSM was the first GSM operator of Russia, and it quickly acquired the market. Due to this pioneering role, the mobile telephone penetration in Northwest Russia is higher than the Russian average. After the monopoly of North-West GSM was broken, the prices went down and mobile telephones started to become more common.

The geographical location makes Northwest Russia an important branching point of telephone communications. The most important telephone and data transmission lines from Russia go through St. Petersburg and further via Finland to the rest of the world.

Northwest Russia is still among the main telecom equipment production centers in Russia, although the production of the leading companies – Svetlana, Krasnaya Zarya and Positron – has collapsed compared to the Soviet time. New small enterprises producing specialty products emerged within the old companies. Some of the leading western companies, too, such as Lucent and Elcoteq, have started producing telecom equipment. The majority of ICT schools and research institutes is located in St. Petersburg, as described in *Chapter 4*.

At present, the Northwest Russian ICT production is oriented on the domestic market. Its competitiveness on the world market is low, which is reflected in the tiny, 0,03% (118 mln. USD) market share of Russian products in OECD countries. However, the high volumes of telecom equipment imports (over 1 billion USD), as well as the production factors accumulated in the region, suggest the possibility of organizing import-substituting production. Realization of this opportunity depends on whether the authorities manage to create a favorable investment and business climate.

In terms of exports volume the Northwest Russian software industry is substantial but poorly recorded, since the products are immaterial. Russia is becoming the same type of player in the programming as India and Israel. The most important programming centers are Moscow, St. Petersburg and Novosibirsk. Among them St. Petersburg is relatively the most export-oriented one.

Offshore programming needs targeted industrial policy. The example of Finland and many other countries shows that government can do a lot to facilitate development and improve the operating environment of companies. The role of government is important in protecting the intellectual property rights and creating an efficient venture capital market. If these things were taken care of, offshore programming and ICT companies could grow much faster.

Growth of imports in the cluster, to a large extent, results from the growing local demand for telecom services and information technologies, and consequent investments of the operators in the extending and improving their networks. As demonstrated in *Chapter 5*, during the last few years these markets displayed a high rate of growth. In 2000 the growth was 25%, and in 2001 – 35%. Demand for the telecom services and equipment also leads to creation of supplier and service networks, and facilitates development of the domestic manufacturing through import substitution and creation of the solutions meeting better the domestic customer needs.

Development of the software market is based on high concentration of qualified workforce, education and R&D facilities in the region, which enables local companies to participate actively in the world offshore programming market. Compared to Moscow and Novosibirsk, the schools and research institutes in St. Petersburg traditionally have better contacts with the outside world. In addition, the immigration rate of people interested in ICT business is relatively higher in St. Petersburg. These factors contribute to the growth of offshore programming in the region.

Development of the local telecommunications equipment manufacturing has been markedly slower. The industry greatly suffered from the sharp decline in demand and discontinuation of public financing in the early 1990s. A profound structural change is necessary to overcome the technology and quality gap between the domestic hardware producers and the international competitors.

Apart from the key industries, supporting and related industries play an important role in the development of the cluster. Convergence of information, telecommunications and media technologies result in the emergence of cardinally new products and services. New supply creates additional demand, and thus stimulates further growth. There is also some small but positive improvement in the local supplier networks and their possibilities to meet the modern quality and flexibility requirements. Sevcabel and its optic fibre division is a good example of this. A well-developed system of higher education helps to maintain the qualified personnel potential in the region, and to provide the growing ICT sectors with skilled employees.

Among the key competitive advantages of the cluster (see *Chapter 6*) it is possible to distinguish the local factors of production: labor resources, R&D, education and the inherited industrial capital. These factors were the basis of development for a number of successful companies. However, for sustainable growth and development of competitiveness, it is necessary to invest in improvement of these factors. This is possible only

by creating favorable conditions for the investors and business, and removing development barriers. Focusing the government funding on education and R&D would bring better results than uncoordinated support to the remains of the Soviet system. Cooperation between universities and industry, and between domestic and international companies and educational institutions is very important. This could be done through support and cooperation with appropriate industrial associations, funding of the projects targeted at diffusion of knowledge from the universities to industry, supporting international exchange of experts, traveling, etc.

An intense growth in the domestic demand for products and services has a strong positive influence on the development of the cluster. This growth is concentrated in telecommunications and related services. Although the growth is spectacular, it is anticipated to continue for some time, since the hardware and service prices have gone down thanks to the scale effects of a large subscriber basis.

PC penetration in Russia is rather small - 5% of households had a PC in January 2001. As the rate grows development of data transmission, Internet and related services is bound to grow faster than today. This growth is expected to gain gradually more speed and concentrate in large cities owing to poor infrastructure and low density of the population in rural areas. Poor and obsolete infrastructure is one of the major obstacles for development of telecommunications in Northwest Russia. Digital exchanges in the wire telecom network represent less than 32% of the total. This restraints growth in many segments of the ICT market but on the other hand motivates mobile operators to offer competitive wireless solutions. Development of competition stimulates the companies to improve their offerings (lower prices, better services, etc.), which further increases demand.

Other significant obstacles for the development of the ICT cluster are monopolies in traditional areas such as wire communications, access to the backbone infrastructure, and excessive government participation. This leads to the situation where inefficient and inflexible business management is preserved for years and customers pay excessive costs. So far the government preserved important positions in all sectors of the ICT cluster. It is of the outmost importance that this grip is eased and independent and private players are given more freedom. It is also important to focus the industrial policy on lowering the barriers for entry to allow more competition in ICT cluster.

Development of the related and supporting industries in the Northwest Russian ICT cluster is gaining speed. The networks of specialized suppliers form around the leading companies. Nevertheless, due to un-

derdeveloped financial markets as well as lack of venture capital and private equity investors, these networks remain underdeveloped and many opportunities are still unexploited. Dedicated efforts of the regional and federal level government could facilitate the development of the cluster immensely. Making the Russian NIS (National Innovation System) competitive and targeted is among the major challenges of the decision makers.

Traditional media in Russia – newspapers, radio and television – are in difficulties due to deteriorating infrastructure. There are changes in consumer habits, too. For example, the circulation of newspapers has fallen. The deterioration of the infrastructure presents an opportunity for the new media to offer substituting services. An analysis of the audiences of the traditional and new media shows that the gap is already very small. Popularity of the new media continues to increase. Northwest Russia could be among the first areas in the world where the Internet based media outperforms traditional TV, radio and newspapers as a source of information and entertainment.

Most of the competitive advantages of the ICT cluster are potential. They require further development under a comprehensive industrial policy implemented both on the federal, and the regional level. On the basis of the analysis of competitive factors, in the closing part of the study the authors suggest actions of industrial policy, which could help to develop the cluster. These actions could include a number of measures aimed at developing of the existing competitive advantages, improvement of investment and business climate. Stimulation of over-the-border cooperation and integration with the well-developed ICT agglomerations of Finland, Sweden and Germany could also be considered as important measures to develop the local ICT industries.

The main obstacles for the development of sustainable competitiveness of the cluster are an unfavorable investment climate, low efficiency of financial markets, and poorly developed infrastructure. The passive role taken by government bodies hinders the cluster growth. They have been reluctant to solve such crucial for the ICT sector problems as simplification of customs procedures, development of investment and business climate, coordination and focus of development in the spheres of education and R&D. These areas require urgent improvement and better coordination by the regional and federal government.

Yhteenveto

Tutkimuksessa analysoidaan Luoteis-Venäjän tietotekniikka- ja viestintäteknologiaklusteria eli ICT-klusteria. Klusterin tärkeimmät liiketoiminta-alueet ovat perinteinen lankapuhelinliikenne ja nopeasti kasvaneet matkapuhelinliikenne, tiedonsiirto, Internet-palvelut ja ohjelmistoliiketoiminta sekä viestintälaitteiden valmistus, joka vielä kärsii neuvostomarkkinoiden romahduksesta. Luoteis-Venäjä on Venäjän seitsemästä suurpiiristä läntisin rajoittuen Baltian maihin, Suomeen ja Norjaan. Alueella asuu 15 miljoonaa ihmistä. Alueen hallinnollinen keskus Pietari on Venäjän ICT-pääkaupunki.

Nykyään ICT-sektori on Luoteis-Venäjän nopeimmin kasvavia aloja. Vuonna 2001 kasvu oli peräti 35 %. Sektorin kasvu johtuu kysynnän rakennemuutoksesta, markkinatalouteen siirtymisestä, yksityistämisestä ja talouden vapautumisesta. Samalla lisääntyy myös tietotekniikan ja tietoliikenteen merkitys alueen taloudessa, mikä käy yksiin samankaltaisen maailmanlaajuisen kehityksen kanssa. Tietotekniikka ja viestintäteknologia ovat paikallisille yrityksille tehokas integroitumisväline maailmanlaajuisiin verkostoihin sekä keino parantaa tehokkuutta ja optimoida tuotantokustannuksia. ICT-klusterin merkityksen kasvaessa poliitikot ja viranomaiset alkavat kiinnittää suurta huomiota sen kehitykseen.

Neuvostoliiton hajoamista seuranneilla kysynnän muutoksilla on ollut suuri vaikutus Venäjän ICT-yritysten kehitykseen alan teknologiakehityksen dynaamisuudesta ja globaaliudesta johtuen. Kun investointivarain jaosta ja teollisuuden kehityksestä vastannut keskitetty suunnitelmatalous romahti, myös monien valmistusmenetelmien ja teknologian kehittäminen pysähtyi. Tilalle ei luotu uutta hallintojärjestelmää, joka epäsuorin keinoin ja pitkän tähtäimen elinkeinopolitiikalla edistäisi kehitystä. Muodostui eräänlainen tyhjiö. Tällaisissa oloissa paikallisten valmistajien ja T&K-yritysten täytyi taistella olemassaolostaan perityllä teknologialla, omin voimin.

Venäjän teollisuuden läpikäymän muutoksen mittakaava ja nopeus olivat niin suuret, että yritykset ja maan hallitus eivät kyenneet vastaamaan niihin. Hallitus keskittyi purkamaan vanhaa neuvostoaikaista järjestelmää ja rakentamaan uusia markkinatalouden instituutioita. Kohdennetun elinkeino- ja teknologiapolitiikan puuttuminen heikensi kehittyneen teknologian ja tieteestä riippuvaisten sektorien – etenkin ICT-sektorin – asemaa. Nyt kun markkinat ovat vakiintumassa ja uu-

det instituutiot ja lainsäädäntö on otettu käyttöön, on aika arvioida muutoksia ja tulevaisuuden kehitysmahdollisuuksia.

Tutkijat määrittelevät tutkimuksen tärkeimmiksi tavoitteiksi Luoteis-Venäjän ICT-klusterin rakennemuutoksen analyysin ja tietopohjan luomisen viranomaisten ja yritysten strategisen päätöksenteon apuvälineeksi. Analyysin perustana on käytetty M. Porterin kehittämää ”timanttimallia” ja kilpailukykyisen klusterin käsitettä, jota kuvataan tunnetussa tutkimuksessa ”Kansakuntien kilpailuetu” (The Competitive Advantage of Nations). Lisäksi tähän käsitteeseen liittyviä ja pohjautuvia myöhempiä teorioita on käytetty syventämään tutkimuksessa esitettyjä näkemyksiä.

Klusteriajattelussa korostetaan perittyjen taitojen, teollisuuspääoman, perinteiden, uutta luovan koulutuksen ja tutkimuksen merkitystä sekä tuottajien kiinteää yhteyttä tavaroiden ja erilaisten palvelujen toimittajiin. Kiinteiden suhteiden lisäksi korostetaan toimijoiden maantieteellistä läheisyyttä. Itse asiassa samankaltaisia ajatuksia oli suunnitelmien perustana Neuvostoliitossa 1970-luvulta lähtien luoduissa alueellisissa tieteellis-teknillisissä komplekseissa. Tällöin Luoteis-Venäjällä kehitettiin alueellinen elektroniikkateollisuuden kompleksi. Suurin ero alueellisten kompleksien ja teollisten klustereiden välillä oli markkinoista ja asiakkaiden tarpeista piittaamaton investointivarojen jakelu sekä pyrkimys massatyöllisyyteen ja standardisointiin kilpailukyvyn, kustannustehokkuuden ja joustavuuden sijaan. Siirtyminen markkinatalouteen on hajottanut alueellisten teollisuuskeskittymien vanhat ja vakiintuneet sidokset yllä mainittujen erojen takia.

Nyt Luoteis-Venäjälle on muotoutumassa ICT-klusteri, joka perustuu muutoksesta selvinneeseen liiketoimintaan, kuten lankapuhelinliikenteeseen, ja uuteen siirtymäkauden aikana syntyneeseen liiketoimintaan, kuten matkapuhelinliikenteeseen ja ohjelmointiliiketoimintaan. Uudet markkinaperustaiset verkostot ovat korvanneet useimmat neuvostoaikaiset sidokset. *Luvussa 3* esitellään Luoteis-Venäjän ICT-klusterin rakenne – primäärituotteet ja palvelut, klusterille työvoimaa kasvattavat yliopistot ja tutkimuslaitokset, muut erikoistuotantopanokset, teknologia, erilaiset liitännäispalvelut sekä klusterin keskeiset yritykset ja tärkeimmät asiakasryhmät. Samalla tarkastellaan klusterin yritysten tärkeimpiä keskinäisiä suhteita ja klusterin arvoketjuja.

ICT-toiminnan varhainen keskittyminen Luoteis-Venäjälle on johtanut siihen, että tästä teollisuuskeskittymästä on tullut kansallisesti merkittävä. Televiestintäpalveluissa Luoteis-Venäjä on Venäjän toiseksi suurin markkina-alue 12,3 % osuudella alan kokonaismarkkinoista. Suurin markkina-alue on Keski-Venäjä 51,6 prosentilla, josta

Moskova yksin kattaa suurimman osan – 43 % Venäjän kokonaismarkkinoista. Luoteis-Venäjälläkin markkinat ovat keskittyneet alueen keskukseen Pietariin. Sen osuus on 64 % Luoteis-Venäjän kokonaismarkkinoista.

Matkapuhelinliikenne Venäjällä alkoi Pietarista. North-West GSM oli Venäjän ensimmäinen gsm-operaattori. Se valtasi nopeasti johtavan markkinaosuuden muilta operaattoreilta. Alan pioneerina Luoteis-Venäjän matkapuhelintiheys on korkeampi kuin Venäjällä keskimäärin. North-West GSM:n monopoliaseman murruttua hinnat ovat kääntyneet laskuun ja matkapuhelimet yleistyvät nopeasti.

Maantieteellinen asema tekee Luoteis-Venäjästä tärkeän puhelinliikenteen solmukohdan. Tärkeimmät puhelin- ja datalinjat Venäjältä kulkevat Pietarin ja edelleen Suomen kautta maailmalle.

Luoteis-Venäjä ja erityisesti Pietari on yhä televiestintälaitteiden tärkeimpiä tuotantokeskuksia Venäjällä, vaikka johtavien yritysten – Svetlanan, Krasnaya Zaran ja Positronin – tuotanto on romahtanut neuvostoajoista. Vanhojen yritysten sisältä on syntynyt uusia pieniä erikoistuotteiden valmistajia. Myös muutamat johtavat länsimaiset yritykset kuten Lucent ja Elcoteq ovat aloittaneet viestintälaitteiden tuotannon. Pietariin ovat keskittyneet myös alan ICT-alojen koulutus- ja tutkimuslaitokset, joista kerrotaan tarkemmin kirjan *4. luvussa.*

Tällä hetkellä Luoteis-Venäjän ICT-klusterin valmistamat viestintälaitteet myydään kotimaanmarkkinoille. Kilpailukyky maailmanmarkkinoilla ei ole hyvä, mitä kuvastaa myös venäläisten tuotteiden olematon 0,03 prosentin (118 milj. USD) markkinaosuus OECD-maissa. Viestintälaitteiden suuri tuonti (yli 1 mrd. USD) ja alueelle kasaantuneet tuotannontekijät viittaavat kuitenkin siihen, että tuontia korvaava tuotanto olisi mahdollista. Tämä mahdollisuus kuitenkin riippuu ratkaisevasti siitä, kykenevätkö viranomaiset luomaan suotuisan liiketoiminta- ja investointi-ilmapiirin.

Luoteis-Venäjän ohjelmistoliiketoiminta on vientimäärältään merkittävää mutta heikosti tilastoitua, koska tuotteet ovat immateriaalisia. Venäjästä on kehittymässä ohjelmoinnissa samanlainen tekijä kuin Intiasta ja Israelista. Alan suurimmat keskukset ovat Moskova, Pietari ja Novosibirsk. Näistä Pietari on suhteellisesti eniten suuntautunut vientimarkkinoille.

Myös ohjelmistoliiketoiminnan tukemiseen tarvitaan oikein kohdennettua elinkeinopolitiikkaa. Suomen ja monien muiden maiden esimerkki osoittaa, että valtio voi tehdä paljon edistääkseen kehitystä ja yritysten toimintaedellytyksiä. Valtion rooli on tärkeä immateriaa-

listen oikeuksien suojelussa ja tehokkaiden riskirahoitusmarkkinoiden luomisessa. Jos nämä asiat olisivat kunnossa, ohjelmistoliiketoiminta ja alan yritykset voisivat kasvaa huomattavasti nopeammin.

Tuonnin kasvu klusterissa johtuu suurelta osin viestintäpalveluiden ja tietoliikenteen kysynnän kasvusta alueella. Kasvun takia operaattorit ovat investoineet verkostojensa parantamiseen ja laajentamiseen tuontiteknologian avulla. Kuten kirjan *5. luvussa* osoitetaan, televiestinnän ja tietoliikenteen markkinat ovat viime vuosina kasvaneet voimakkaasti. Vuonna 2000 kasvu oli 25 % ja vuonna 2001 peräti 35 %. Palveluiden ja laitteiden kysyntä kehittää tavarantoimittajien ja palveluntarjoajien verkostoja sekä paikallista tuotantoa sen korvatessa tuontia ja luodessa uusia venäläisille kuluttajille soveltuvia ratkaisuja.

Ohjelmistomarkkinoiden kehitys perustuu ammattitaitoisen työvoiman ja sitä tuottavien oppilaitosten sekä T&K-instituuttien keskittymiseen alueelle, mikä puolestaan mahdollistaa paikallisten yritysten aktiivisen osallistumisen maailman ohjelmistomarkkinoille. Verrattuna Moskovaan ja Novosibirskiin Pietarin tutkimus- ja koulutuslaitoksilla on perinteisesti paremmat kontaktit ulkomaailmaan. Lisäksi kaupunkiin on suuntautunut suhteellisesti suurempi alasta kiinnostuneiden muuttovirta. Nämä tekijät edistävät ohjelmistoliiketoiminnan kasvua alueella.

Paikallisten televiestintälaitteiden tuottajien kehitys on ollut huomattavasti hitaampaa. Tämä teollisuudenala on kärsinyt suuresti kysynnän jyrkästä laskusta ja julkisen rahoituksen lakkaamisesta 1990-luvun alussa. Tarvitaan perinpohjaista rakennemuutosta, jotta kotimaisten laitevalmistajien tekninen jälkeenjääneisyys ja laatuerot kansainvälisiin kilpailijoihin verrattuna saadaan kurottua umpeen.

Tärkeimpien teollisuudenalojen lisäksi klusterin kehityksessä on tärkeä rooli myös tuki- ja lähitoimialoilla. Tieto-, televiestintä- ja joukkoviestintäteknologian yhtenäistyminen johtaa kokonaan uusien palveluiden ja tuotteiden syntymiseen. Uusi tarjonta luo uutta kysyntää markkinoilla ja siten kiihdyttää klusterin kehitystä. Pientä myönteistä kehitystä on myös nähtävissä paikallisten tavarantoimittajien verkostoissa ja mahdollisuuksissa täyttää nykyaikaiset laatu- ja joustavuusvaatimukset. Tästä on osoituksena esimerkiksi Sevcabelin ja sen optisen kuidun osaston kehitys. Kehittynyt korkeakoulutusjärjestelmä auttaa säilyttämään tasokkaan työvoimapotentiaalin alueella, niin että kasvaville aloille on tarjolla ammattitaitoista henkilöstöä.

Klusterin tärkeimpien kilpailutekijöiden joukosta (ks. *6. luku*) voidaan erottaa paikalliset tuotannontekijät: työvoima, T&K, koulutus ja peritty teollisuuspääoma. Nämä tekijät ovat olleet perusta muutamien

menestyvien yritysten synnylle ja kehitykselle. Klusterin kestävälle kehitykselle ja kilpailukyvylle on kuitenkin välttämätöntä, että suorat investoinnit suunnataan nykyisten tuotannontekijöiden parantamiseen. Tämä on mahdollista vain, jos investoijille ja liiketoiminnalle luodaan suotuisat olosuhteet ja kehitystä vaikeuttavat säädökset poistetaan. Valtion rahoituksen keskittäminen koulutukseen, tutkimukseen ja kehitykseen toisi parempia tuloksia kuin koordinoimaton neuvostojärjestelmän rippeiden tukeminen. Korkeakoulujen ja teollisuuden sekä kotimaisten ja ulkomaisten yritysten yhteistyön edistäminen on hyvin tärkeää. Tämä voitaisiin toteuttaa tukemalla sopivia teollisuusliittoja ja olemalla yhteistyössä niiden kanssa, rahoittamalla projekteja, jotka edistävät tiedon siirtymistä korkeakouluista teollisuuteen, tukemalla kansainvälistä asiantuntijavaihtoa, matkustamista jne.

Tuotteiden ja palveluiden kotimaisen kysynnän jyrkällä kasvulla on myös merkittävä myönteinen vaikutus klusterin kehitykseen. Tämä kasvu keskittyy lähinnä televiestintään ja siihen liittyviin palveluihin. Vaikka kasvu on ollut valtavaa, sen uskotaan vielä jonkin aikaa jatkuvan, sillä laitteiden ja palveluiden hinnat ovat laskeneet skaalavaikutusten ja suuren tilaajakannan ansiosta.

Tietokoneiden levinneisyys Venäjällä on melko alhainen – noin 5 prosentilla kotitalouksista oli tietokone vuoden 2001 alussa. Kun niiden määrä kasvaa, tiedonsiirron, Internetin ja niihin liittyvien palveluiden täytyy myös kasvaa nykyistä nopeammin. Kasvun odotetaan vähitellen nopeutuvan entisestään ja keskittyvän suuriin kaupunkeihin maaseudun huonon infrastruktuurin ja harvan asutuksen takia. Huono ja vanhentunut infrastruktuuri on yksi Luoteis-Venäjän televiestinnän vakavimmista kehitysesteistä. Digitaaliset keskukset kattavat alle 32 % lankapuhelinverkoista. Tämä rajoittaa kasvua monilla ICT-markkinoiden osa-alueilla, mutta toisaalta motivoi matkapuhelinoperaattoreita tarjoamaan kilpailukykyisiä langattomia vaihtoehtoja. Kilpailun koveneminen joillakin ICT-markkinoilla kannustaa myös yrityksiä parantamaan tarjontaansa. Niiden on tarjottava parempia palveluita halvemmilla hinnoilla, mikä edelleen kasvattaa kysyntää.

Muita merkittäviä ICT-klusterin kehitysesteitä ovat monopolit perinteisillä aloilla kuten lankaviestinnässä, estynyt pääsy puhelin- ja dataliikenteen runkoverkkoihin sekä valtion liiallinen sekaantuminen liiketoimintaan. Tämä johtaa tilanteeseen, jossa tehotonta ja jäykkää yritysjohtoa suojellaan vuosikausia ja asiakkaat maksavat liikaa. Toistaiseksi valtio on säilyttänyt merkittävän aseman kaikilla ICT-klusterin osa-alueilla. On erittäin tärkeää, että sen otetta hellitetään ja itsenäisille ja yksityisille toimijoille annetaan enemmän vapautta. Elinkeinopo-

litiikan tulee myös helpottaa liiketoiminnan aloittamista, jotta klusteriin syntyisi enemmän kilpailua.

Luoteis-Venäjän ICT-klusterin ja sen lähi- ja tukitoimialojen kehitys kiihtyy. Johtavien yritysten ympärille on muodostunut erikoistuneiden tavarantoimittajien verkostoja. Kehittymättömistä rahoitusmarkkinoista ja riskirahoittajien ja pääomasijoittajien vähyydestä johtuen nämä verkostot ovat kuitenkin kehittymättömiä ja monet mahdollisuudet ovat vielä käyttämättä. Valtion- ja aluehallinnon ponnisteluilla klusterin kehitystä voitaisiin suuresti helpottaa. Venäjän kansallisen innovaatiojärjestelmän (NIS – National Innovation System) kehittäminen kilpailukykyiseksi ja tavoitteelliseksi on yksi päättäjien suurimmista haasteista.

Perinteinen viestintä – lehdet, radio ja televisio – on Venäjällä vaikeuksissa rappeutuvan infrastruktuurin takia. Myös kulutustottumuksissa on tapahtunut muutoksia. Esimerkiksi lehtien levikit ovat alentuneet. Infrastruktuurin rappeutuminen antaa uusille viestimille mahdollisuuden tarjota korvaavia palveluita. Paikallisten perinteisten ja uusien viestimien käyttäjämäärien vertailu osoittaa, että ero on jo hyvin pieni. Uusien viestimien suosio kasvaa kasvamistaan. Uskomme, että Luoteis-Venäjästä voi tulla yksi maailman ensimmäisistä alueista, joissa Internetiin perustuvat viestimet tiedonlähteenä ja viihteen välityskanavina ylittävät perinteiset television, radion ja lehdet.

Kuten analyysi osoittaa, suurin osa klusterin kilpailueduista on potentiaalisia. Ne vaativat kehittämistä kattavan sekä valtiollisella että alueellisella tasolla noudatettavan elinkeinopolitiikan tuella. Kilpailutekijäanalyysin perusteella tutkimuksen tekijät esittävät raportin lopussa ehdotuksia toimista, joilla elinkeinopolitiikan puitteissa voitaisiin kehittää klusteria. Tällaisia olisivat klusterin nykyisten kilpailuetujen kehittämiseen ja investointi- ja liiketoimintailmapiirin parantamiseen suunnatut toimenpiteet. Rajat ylittävän yhteistyön edistäminen ja integraatio Suomen, Ruotsin ja Saksan kehittyneisiin ICT-agglomeraatioihin olisivat tärkeitä keinoja, joilla valtio voisi vaikuttaa paikallisen ICT-alan kehittymiseen.

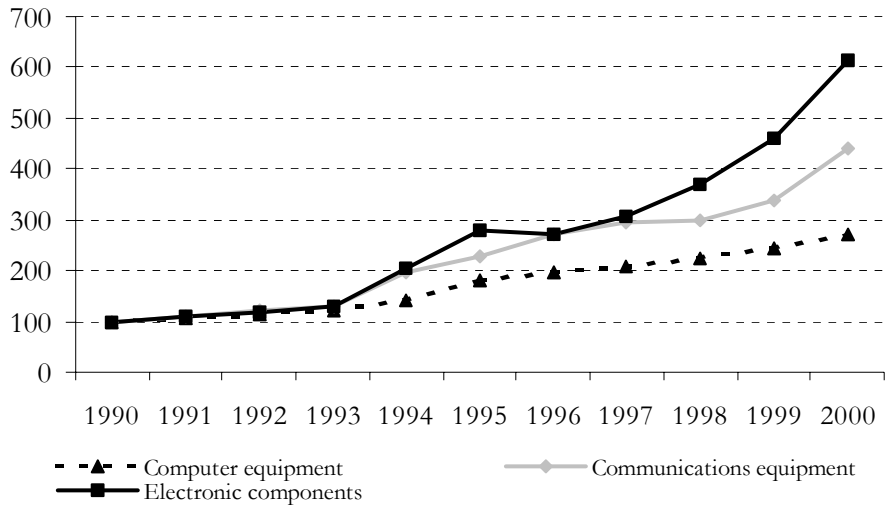
Klusterin kestävän kilpailukyvyn suurimmat kehitysesteet ovat epäsuotuisa investointi-ilmapiiri, rahamarkkinoiden tehottomuus, heikko infrastruktuuri. Klusterin kehitystä hidastavat myös valtionelinten passiivinen asenne ja haluttomuus ratkaista ICT-alalle elintärkeitä ongelmia, joita ovat muun muassa tullikäytännön yksinkertaistaminen, investointi- ja liiketoimintailmapiirin kehittäminen, koulutuksen ja T&K:n kehityksen koordinointi ja keskittäminen. Näillä alueilla alueja valtionhallintoa tulee kiireesti kehittää ja koordinoida paremmin.

1 Introduction

Information and telecommunications technologies are widely accepted vehicles of the global economy today. This development is often called an "information revolution". It is envisaged that telecommunications and information technologies promote integration of countries and regions into global networks, facilitate globalization (e.g. global trade and business) and specialization. They are, therefore the essential tools that enable growth and prosperity of nations. Access to new ICT technologies and facilities is crucial for national and regional economic development.

It is widely accepted that growth of ICT industries could be among the major factors of the overall economic growth of countries and regions. Most developed countries are characterized by increasing investments into ICT products and solutions, as could be seen from the Figure 1.1, thus fuelling economic growth and supporting networking and global integration. Finding its place in the global competition in ICT thus could be important not only as enabling integration, but also as a sustainable source of growth for the domestic economy in Russia. Assessing the ICT industries of Northwest Russia we, as a result, look also at prospects and opportunities for the overall growth of this area.

Figure 1.1 OECD Trade in ICT Goods, Index: 1990=100



Source: OECD Information Technology Outlook

The Northwest Russian ICT cluster follows the global trends and is one of the most rapidly growing regional industries. The present development is shaped by the structural changes, taking place in the cluster. The ICT industries are transforming from the structure, established in Soviet period under specific government industrial policy to the new system, based on the open market principles. The present study is devoted to the analysis of these development trends and prospects for cluster's future growth.

During the Soviet period, industrial development and distribution of investment resources took place within the framework of territorial-industrial complexes. This approach implied regional concentration of certain industries on the basis of maximum use of local resources, and provided for the required specialization. Such regional complexes were often planned to meet the whole country's demand for specific categories of products.

Northwest Russia has been chosen in this period as the main region for location of electronics industry facilities, including production of telecommunications equipment. This led to the formation of a complex structure aimed to benefit from interaction, within this structure, of specialized manufacturing companies and supporting organizations. However ignorance of the market as a main tool to ensure survival of the fittest, the state planning and centralized allocation of resources lead to low flexibility of enterprises due to their high production volumes (orientation on the mass production of the similar products), decrease in effectiveness due to pursuit of complete national self-sufficiency principle (neglect of core competences – everybody can make everything), excessive staff (due to the policy goal of 100% employment), and absence of competition (substituted by the socialist competition where production targets are set by employees). As a result, market liberalization found the local ICT manufacturers not ready to compete with the international leaders.

The transitional period resulted in significant restructuring of the ICT industries in Northwest Russia. Together with the decrease in production of ICT equipment, there was an emergence and fast growth of industries aimed at the provision of new telecommunications and IT services. Companies and organizations based in Northwest Russia are reconsidering the network of internal connections built within the framework of a territorial-industrial complex.

Regardless of the significance of the current developments in the ICT sector in Northwest Russia, there is almost no research available in this sphere. Most of the existing studies are devoted to particular

industries on the national scale, while regional aspects are only seldom touched upon.

The present paper aims to provide a comprehensive review of the current state and prospects for development of ICT industries in Northwest Russia. This research is based on modern approaches, including the cluster analysis and the "diamond" model of national/ regional competitiveness. This approach is widely used in strategic analysis of industrial sectors in EU countries, but which have almost never been used in Russia to date.

At present, there are several alternative ways of development possible for the ICT cluster of Northwest Russia, depending on the dynamic and directions of development of the primary industries, as well as other factors. A certain influence on increasing the growth and depth of industrial development in ICT cluster in Northwest Russia may also be exerted by a focused government industrial policy, which is now sadly absent. Accordingly, one of the main goals of the present paper is the analysis of prospective directions for development of the cluster, as well as formulation of possible elements of industrial policy in the cluster.

Considering the problems outlined above, this paper aims at achieving the following aims:

- To assess development potential and trends for the Northwest Russian ICT cluster based on the modern industry analysis, e.g. cluster analysis, "diamond" model etc.
- To identify the factors and determinants underlying current growth and advantages, which could serve as a base for possible creation of the competitive cluster, as well as obstacles for the further cluster development
- To create information base and possible ideas for the Russian and regional industrial policy in this sector based on the analysis of its competitiveness and growth potential
- To work out a range of possible of actions to improve investment climate in the sector
- To create ideas and comprehension for focusing corporate business strategy along the most promising lines of the cluster development.

The implementation of the study implied comprehensive analysis of the available industry statistics as well as case studies and analysis of the companies from the different industries of the cluster.

The relevant statistics was collected from wide range of sources including official publications and various industry analytical materials. To look on cluster positions on the international market and also for international comparative analysis we also use databases of international organizations (OECD statistics, International Telecommunication Union database etc). The remaining gaps were filled by our own estimates, based on our industry expertise.

We arranged also a series of structured interviews with top management of the leading companies in order to find out most up-to-day insights and views on the main advantages of the cluster, typical obstacles and possible ways for further development. In the framework of the company's research we carried out totally 15 case studies. The sample of companies was drawn from the list of leading regional companies in the sector by sales and form a representative selection owing to the fact that companies selected were the largest by far in the respective industries.

Below in the text we present our vision on the cluster structure, competitive advantages, and outline the various facets of opportunities, bottlenecks and obstacles to achieving sustainable growth and competitiveness of the ICT cluster in Northwest Russia. We present also possible lines of development and feasible actions for industrial policy, which could lead to sustainable cluster growth and creation of the long-term competitive advantages.

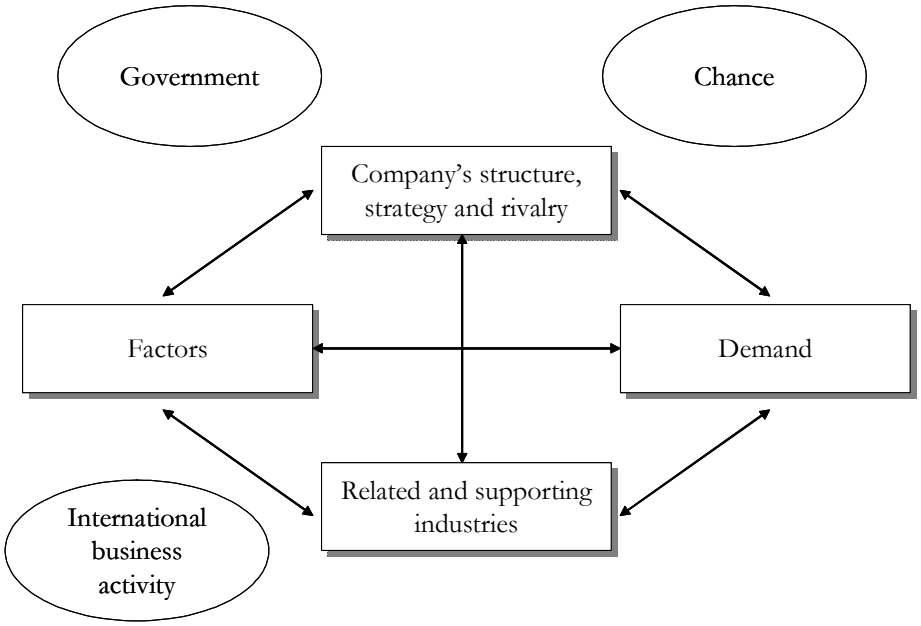
It is worth mentioning, that the study is one of the first attempts to imply to the Russian ICT industries modern research practices and present accumulated statistics and analysis. We see the main role of our research in initiation of the further discussions in the concerned directions and probably in creation of the starting point for the next studies as, despite the large number of questions, raised and analyzed in the study, there is still a place for more focused, in-depth and comprehensive analysis.

2 Theoretical Framework

2.1 Introduction

The present study is inspired by the influential book *The Competitive Advantage of Nations*, published in 1990 by Michael Porter, a professor of Harvard University, and by later research on matters related to regional development and competitive advantages (see box below). In the approach presented in his book, Michael Porter describes how companies find sources of competitive advantages in the specific combinations of skills and networks created in their industries and around it in specific countries and regions. He also studied the competitiveness of nations and regions in terms of their ability to offer companies an environment that provides unique advantages embedded in the networks and industrial structure of those particular regions. The study was grounded in detailed case studies of regions that are known for their persistent ability to provide the world with companies that are able to outperform others, such as Silicon Valley, Detroit, northwest and central Italy, etc.

Figure 2.1 "Diamond" Model



As a main tool in the analysis presented in M. Porter Study the "Diamond" model of national competitiveness was introduced (presented below in Figure 2.1). In this study this model is also used, although slightly adjusted (for more information see box below), as a key tool for assessing and analyzing the competitiveness of Northwest Russia. Although, initially, Michael Porter used this model for studying national competitiveness, it was later tested to fit the studies of regions that are positioned within boundaries of certain countries, or even to regions that comprise neighboring areas of different countries.

The "Diamond" model distinguishes four main sources of competitive advantage. These are

- *Factors*. This category includes production factors such as natural resources and geographical location, as well as created factors inherited from preceding stages. The first group can include natural resources, demographic conditions, geographical location, etc. The second group usually includes production facilities, and positions on various markets, infrastructure, human capital and R&D potential.
- *Demand*. The presence of a sufficient demand for the primary goods is the necessary condition of development and a source of competitive advantage. Here it is important that existing demand allows achieving economies of scale in local production. This demand is formed by local and export constituents. The local demand is a necessary starting source for creating competitive advantages for firms that will cluster in the region, thus reinforcing local advantages. Such specific characteristics of domestic demand as high quality and diversification requirements of consumers, or user-producer cooperation and consequent demand for specific solutions and product/service combinations, which for certain reasons were not possible in the other regions, substantially enforce the sustainability of competitive advantages of domestic producers. In certain industries, the strong and rapidly growing export market and demanding foreign customers played an essential role in formation of competitive domestic producers as well. In this case access to the foreign markets played a key role in formation of the competitive advantage.
- *Related and Supporting Industries*. The existence of developed related and supporting industries could be a source of competitive advantage for regional companies due to the possibility of obtaining advantages from the early access to high quality and reliable supplies of essential and unique or rare components and materials, from the cost advantages gained from the competitive local supplies. This also allows for an increase of production efficiency as a result of specialization. An available developed system of subcontractors and suppliers in a given region

makes it possible to offer more complex products and after-sale service systems. It creates a unique local system of industrial co-operation that exceeds and surpasses similar competitors' systems by their possibilities and degree of development.

- *Company's Structure, Strategy and Rivalry.* The industry structure is an important determinant of the possibility to gaining competitive advantage if the industries are competitive and the competition motivates leading companies to invest in the product and market offering, management and marketing as well as process development. In this case the larger markets for essential supplies and components are created, infrastructure could be better targeted to meet specific requirements of the particular industries, the competitive pressures also motivate higher organizational efficiency and training as well as spin-offs.

Porter offers for consideration two additional areas from which companies are able to draw sources of competitive advantage in his model:

- *Chance.* The role of chance or "luck" reflects rapid changes on world financial markets; changes in currency quotations, an unexpected growth in local/international demand and the event of war. All these sudden and unexpected events create situations on the market when unforeseen opportunities are created. In some cases these opportunities could become a source of competitive advantage.
- *Government.* The influence of government, through its current policy (liberal, deterrent, etc.), is only considered as an attribute in analysis. However, this policy determines the performance of all actors in the regional and/or national economy. A rational governmental policy provides for the growth of potential investor confidence and attracts capital, experience and technology to the economy.

As a result of studies of globalization, another potential source of competitive advantage was later added to Porter's "Diamond" model of national competitiveness: this is international business activity.

International business activity became a source of competitive advantage for companies from particular regions as a result of their internationalization, i.e. their ability to locate production facilities in regions that could offer the best advantages for the particular activity, and thus gain from access to several "diamonds" of the national advantage simultaneously.

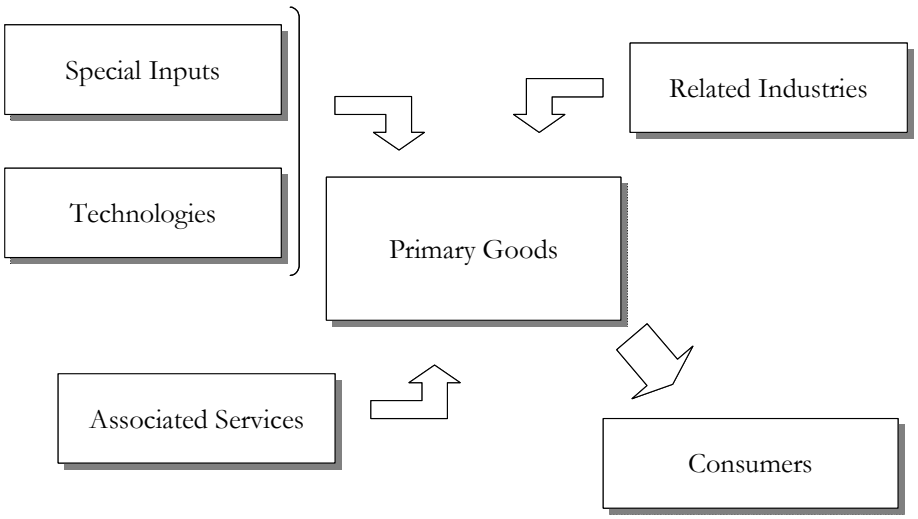
2.2 Concept of the Cluster

As we discussed in earlier in this Chapter the regional competitiveness is based on the ability of the particular location to offer the firms opportunities to gain competitive advantage owing to the specific factor and demand con-

ditions, high demand and quality conscious consumers, and developed networks of competitive companies in related and supporting industries located in this region.

Cluster analysis presumes that no specific industry can be viewed separately from others, but should be analyzed systematically within a cluster of vertically and horizontally linked sectors. It is obvious that the development of a key industry would give a push to the development of supplying and consuming industries, as well as service segments associated with the cluster.

Figure 2.2 Cluster Structure



A cluster structure can be illustrated as a set of separate, but closely interrelating sectors of the regional/national economy, as well as special inputs inherent for the region. There are the following elements in a cluster:

- *Primary goods* – a list of goods or groups of goods, which are competitive on the world market and companies manufacturing these products form the core of the cluster.
- *Specialty inputs* – the main factors of production inherent for the country (region) are the raw materials, transport, infrastructure, labor force, educational system, R&D etc.
- *Technologies* –a description of key technologies, machines and equipment consumed by the core sector of the cluster and its producers, located in the same region.
- *Related and supporting industries* – the different sectors of the economy and particular companies, whose products are directly or indirectly consumed or may be consumed by the core sector.

- *Consumers* – the main consumers of primary goods manufactured by the companies of the cluster.

An analysis and understanding of the cluster and its structure can help companies to create focused development strategies, and authorities to identify the sources of competitiveness in their particular regions, and to create on the basis of this an efficient and active system of general development, of infrastructure and operational environment improvements, including relevant regulatory acts, actions and decrees of the legislative power.

Although there is an extensive body of theory and research behind the matters presented in this chapter we do not dare to bother readers with further explanations and would like to proceed to the analysis presented in the following text. Those who are interested to learn more we ask to refer to the forthcoming book "Advantage Northwest" by Grigory Dudarev and Hannu Hernesniemi where these issues will be addressed in more detail. A short summary of theoretical routes used as knowledge basis for the study is presented below in Box 2.1.

Box 2.1 Theoretical Routes

It was long time a widely accepted fact that national and regional location is central to growth, increased welfare and well-being. Already in the end of the 19th century Alfred Marshall introduced "industrial districts", later Joseph Schumpeter – "innovation clusters", Eric Dahmen – "development blocks", François Perroux – "development and growth poles", economic geographers – industrial and "high-technology" agglomerations. These concepts assessed the geographic concentration of economic activities and innovation from different perspectives. Going here deeper into the intellectual history underlying these approaches and the difficulties of making the above concepts analytically operational is beyond the scope of the present review. Nevertheless we will touch upon their implications that were integrated into the approach used in our study. The reason why these concepts were not successful was not because policy makers did not consider them important: the source of growth and the origins of disparities have remained central to the preoccupations of policy makers and analysts. The unresolved issues that underlie the wide use of the "cluster" concept are related to the following questions: Why do activities cluster? Why is clustering important? How can the clustering process be managed? Is that possible? What are the possible tools and factors that could influence clustering in certain regions? Can, and should, one do something about it?

Michael Porter in his book "The Competitive Advantage of Nations" presented some answers and explanations for many of the above questions. He incorporated implicitly many previous developments, mentioned above in the knowledge base (Rouvinen and Ylä-Anttila, 1999). Although, accord-

ing to these authors, the framework presented by Porter is rewrap of old ideas, they agree that the "diamond" model is internally consistent and in the line with the mainstream competitiveness literature. The ambiguities surrounding the cluster concept (and other related concepts such as industrial districts), proper definitions, and their relationships to regional economic performance are the subject of extensive literature (Asheim and Isaksen, 1997; Feser, 1998a, 1998b; Harrison, 1992; Heinenreich, 1996; Isaksen, 1997; Jacobs and de Man, 1996; Kaufman et al., 1994; Park and Markusen, 1995; Steiner, 1998).

Notwithstanding the fact that this model is obviously a good and comprehensive tool to assess competitiveness and clusters, i.e. represents a certain advance in this area, it has some drawbacks. As Penttinen demonstrated in 1994 they are the following: competitiveness can also be found outside clusters; the diamond model does not properly account for foreign direct investment and multinational enterprise; the model may not be suited to small open economies (as it was suggested by Rouvinen and Ylä-Anttila, 1999 we also used broader cluster definitions); the model may not be applicable to resource-based industries (Rouvinen and Ylä-Anttila, 1999 applied the model to resource-based industries successfully); the role of macroeconomic variables in the Porter's model is unclear; it is unclear whether model is dynamic or static; the studies may not be conducted with sufficient rigour (the loosely defined theory offers possibilities for misuse).

One of the main advantages of the Porter model was that it remarkably departed from traditional analysis and integrated the new, more up-to-date developments in theory such as cluster-based approach. The main differences between traditional and cluster-based approach are that by specifying strict boundaries for industries or sectors (mostly based on statistical data accounting procedures), the traditional sectoral approach fails to take into account the importance of interconnections and knowledge flows within a network of production (Rouvinen and Ylä-Anttila, 1999).

The cluster-based approach also has substantial importance as a tool to study regional development issues. Empirical studies today are far more frequently conducted on the sub-national level (Nelson, 1993, Ohmae, 1995) and often patterned after Porters' model of competitive advantage. There is also a substantial contemporary research in regional development (Russo, Storper and Scott, von Hippel) and sources of competitive advantages (Barney, 1992a, 1992b, Asanuma, 1989, Dyer) that complements Porter's model in a major way adding more understanding and insight into the localization of process of the knowledge creation and diffusion, learning, etc.

In conventional macroeconomics the markets are characterized by anonymous relationships between suppliers and users. Anonymity according to Gibbons and Weijers complicates product innovation because new product development requires effective transfer of specific cost and performance needs knowledge from the potential user to the would-be producer. The challenges of the product innovation process are well captured by Lundvall who stated that reciprocal information flows between producers

and users are essential to successful innovation. Rothwell who introduced the notion there are two main interfaces in user-producer interactions extended this view. These are the interface between the supplier and the producer and the producer and the customer. The above arguments stress importance of geographical proximity, personal knowledge and trust in the development of new products through user-producer co-operation.

John Holmes studying the Californian agglomeration went along theoretical lines of transaction cost theory. He rooted flexibility in the division of labour in production and linked that to agglomeration via analysis of the transaction costs associated with the interfirm linkages, i.e. traded exchange. This analysis is parallel to a major trend in business economics, i.e. that of network forms of production. The transaction cost theory is about the allocation through cost-minimization owing to its concentration on the traded input-output relationships. The evolutionary theory and knowledge based view in the strategic management open the way to understanding "untraded" interdependencies, which does not appear in recorded input-output transactions (Storper, 1997, Storper and Salais, 1992).

Another significant challenge and difficulty in the present study was to assess the transition to the market economy and its impact on clusters and competitiveness. In this respect one shall mention the territorial-industrial complexes by Kolosovsky (1969) approach that included creation of both production facilities and a network of specialized higher educational establishments and R&D organizations in the certain region that was a central national and regional industrial policy and planning tool in the Soviet period. Implementation of this approach resulted in the major distortions in the production allocation decisions and, as a result of the on-going changes, the regional industrial landscape is bound to change substantially in Russia. We believe that material presented in our study could shed some light on the processes of re-allocation in the Russian economy. We used also Porter diamond model to assess the regional competitiveness in Northwest Russia. Brown and Brown (1998) examined empirically the structure-conduct-performance paradigm in Russia and found supporting evidence. Therefore we believe that there is at least some evidence that one of the corner stones of the Porter approach, i.e. industrial organization approach is suitable to assess the period of transition.

3 The Structure of the ICT Cluster

3.1 Description of the Cluster

The sustainable development of such knowledge-intensive industries as telecommunications and IT is only possible among the networks of a large number of specialized companies and organizations. Interaction within these networks stimulates diffusion of technologies and knowledge, which in turn could serve as a basis for the competitive advantages. Thus, the cluster approach is appropriate for analyzing the development of ICT industries. The cluster includes the key companies that produce and deliver primary goods and services, but also all related and supporting organizations that participate in value system for the primary goods.

The concentration of a large number of ICT-related activities in Northwest Russia allows us to view these industries as an ICT cluster. In this chapter, we analyze the structure of this cluster and describe the value system and main interrelations within the cluster.

The primary products of the cluster are, as we see in Figure 3.1, communication services, both wired and cellular, data transmission, Internet-access services, etc. The companies offering the above key products and services form the core of the cluster. Telecommunications equipment manufacturing is another industry that belongs to the central part of the cluster. The development of computer engineering during the last decade added to the current key industries of the cluster information technologies.

Telecommunications and information technologies are among the most rapidly growing industries in the Northwest. The growth of these industries today, is induced by an increase in demand. However, the background of current development lies in specialized production factors inherited from the Soviet period, e.g. industrial and human capital, and R&D potential. These factors were concentrated in the Northwest (mainly in St. Petersburg) in the 1960-80s as a part of the government program for the development of regional electronics production[1], and these factors still fuel the development of the ICT industries.

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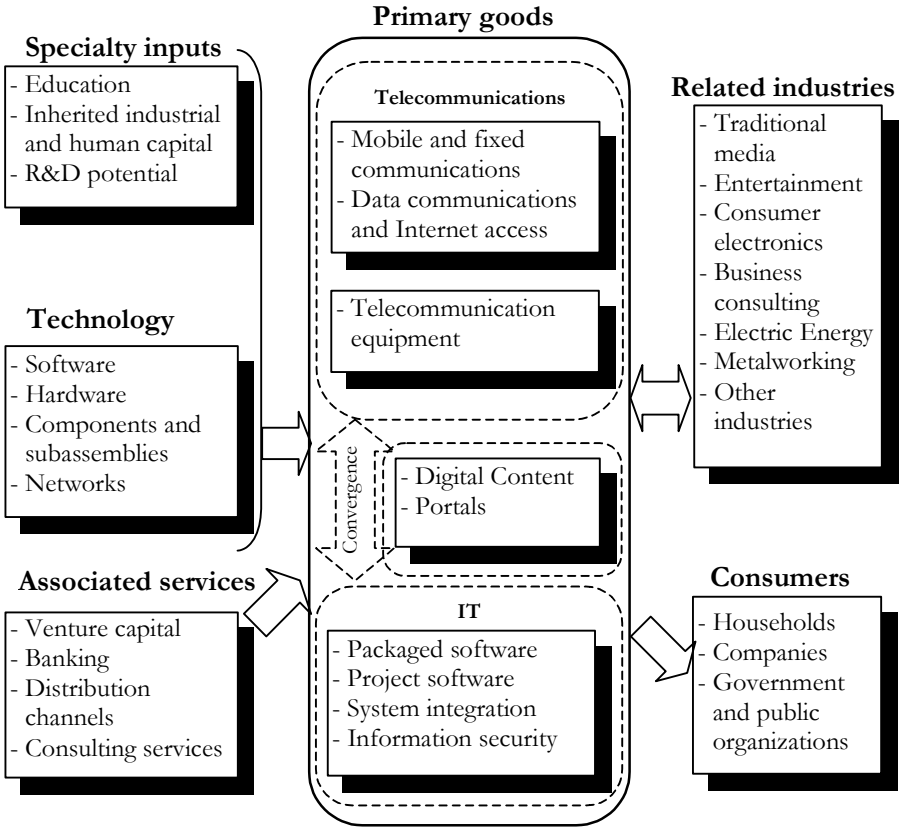
[1] The development of the territorial industrial complexes included the creation of both production facilities and a network of specialized higher educational establishments and R&D organizations in specific regions. (Kolosovsky N.N. The theory of economic regions, Moscow, 1969)

Figure 3.1 The Northwest Russian ICT cluster

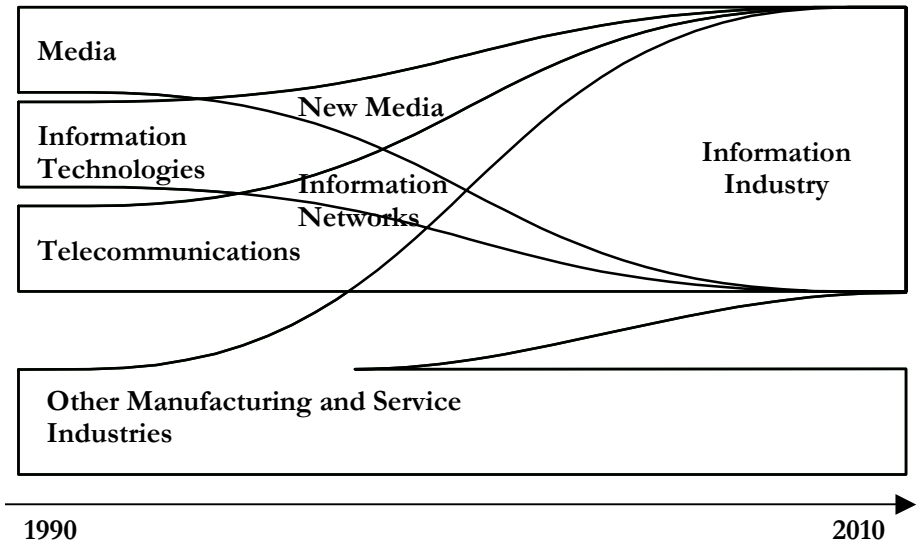


Supporting industries, which provide the domestic technology inflow into the cluster, are represented mainly by software and hardware developers. Both local companies, and a few subsidiaries of international companies, are in evidence here. The ongoing process of specialization of the existing domestic supporting companies, as well as introduction of new technologies and solutions by international companies, has been improving the local supply sector. At the moment, however, it does not fully satisfy the demands of the cluster, as we will show in the value system analysis below.

The venture capital investors (one of the most important associated services of the cluster) provided seed money to a number of new projects in the cluster. However, these venture resources have always been very scarce, and at the moment there is an urgent need for effective venture capital, private equity and stock market to back up sustainable growth of the cluster.

The related sector of the cluster consists of two main parts. The first part includes companies that provide value added services to the basic telecommunications and IT infrastructure. The focus here is directed at new services that appear in the process of the ongoing convergence of information and communication technologies and media. The second part is represented by industries that are actively implementing ICT solutions and are thus converging with the ICT. This process is illustrated in Figure 3.2.

Figure 3.2 The Convergence of Information and Telecommunications Technologies



Source: Paija, Laura, The Finnish ICT Cluster in the Digital Economy, Helsinki, 2001

It is envisaged that the tendency of convergence of information and communication technologies and media will have dramatic importance in shaping the future of Russian ICT industries due to specific features of this region, i.e. long distances between cities, deterioration of the traditional media infrastructure, etc. The new services that are created by this process, generate an additional demand and thus stimulate the long-term development of the cluster.

Despite the existence of participants in all parts of the cluster, its effective structure is undergoing a continual process of transformation. The cluster system is restructuring itself out of the system established during the Soviet period, into new networks, in which relations are based solely on market principles. In the following chapter, we will emphasize the current value system of the cluster, and the processes that influence its formation.

3.2 Value System

The foundation of the cluster under consideration was formed during the Soviet period. The Soviet government and planning organizations subscribed to a policy of full economic self-sufficiency during that time. This meant that all stages in the development and manufacturing of products were to be located within the territory of the country. The local industrial complex for electronic (including telecommunications) equipment manufacturing had been created in Northwest Russia during the 1960-1980s. Accordingly, production facilities for both supplying and primary industries were designated for the region. Specialized R&D institutions and universities that supplied the industries with a qualified labor force and fundamental and applied research were also concentrated here.

Thus, the prototype of the ICT cluster, with a well-defined value system, was formed in Northwest Russia as part of the development of the local industrial complex. The main difference between this complex and the ICT clusters that had been formed at the same time in Europe (Finland, Sweden) and the USA, was the non-market interrelations between its participants.

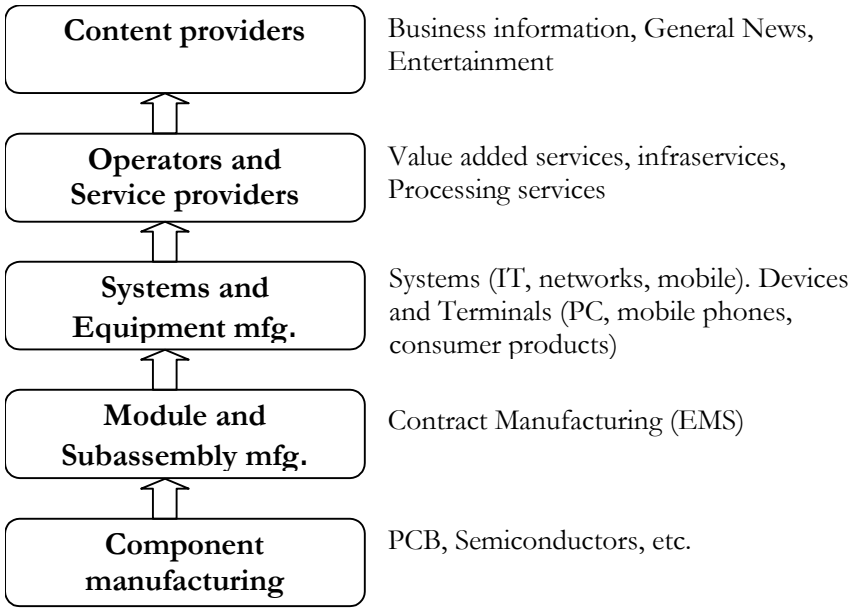
In addition, an important distinguishing feature of Soviet industry was its focus on the development and manufacturing of military solutions. Most capital and labor resources were oriented towards the military sector. As a result, civil technologies often were copied directly from western products to economize on R&D and other resources. Another factor that distinguished Soviet industry from its foreign counterpart was the application of different planning criteria (e.g. output maximization, full employment, etc.), which often compromised economic effectiveness.

The aforementioned factors resulted in a lag in technological development in electronics and telecommunications between Russia and developed countries by the end of the 1980s. Consequently, a large number of local enterprises became uncompetitive with introduction of market reforms and the shift to open markets. This led to a dramatic decline in industrial output.

One of the unfavorable changes was the disappearance of a large number of manufacturers that were an essential part of the ICT value system (Figure 3.3). At the moment, there are no effectively functioning local manufacturers of components, modules and subassembly, and the necessary articles are imported. However, there is still substantial industrial and human capital inherited from the Soviet period that

could potentially substitute imports of certain products, and become a basis for unique competitive advantages on global markets. There is also room and the need for global integration and access to the up-to-date technologies and solutions of world leaders. Successful alliances, partnerships and networking could prove to be the essential tool for jump-starting the development of the ICT in Northwest Russia, considering the existing industrial capital and production factors mentioned above.

Figure 3.3 The ICT Value System



Abbreviations: EMS – Electronic Manufacturing Services, PCB – Printed Circuit Board.

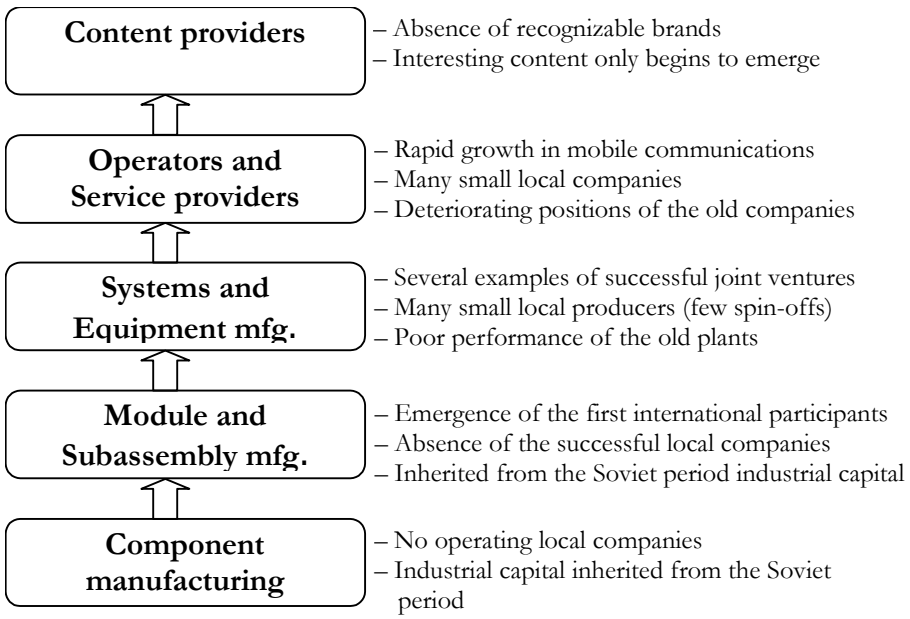
Nowadays a new structure of the Northwest Russian ICT cluster has been formed. As we see from Figure 3.4, a large number of new manufacturers have appeared in the telecommunications equipment production sector. These are mainly spin-offs from old stagnating plants and R&D institutions.

In addition to local manufacturers, international companies, such as Lucent Technologies and NEC, have established joint ventures in telecommunications equipment production. The Finnish company Elcoteq, has launched its EMS subsidiary in St. Petersburg. Furthermore, the Northwest is one of the main centers for software development in

Russia, and a number of specialized software developers originated and are currently operating here.

There are also many new companies that offer a wide range of telecommunications services. However, the markets are quite oligopolic and have monopolized access to certain facilities. In mobile communications, competition is only in its beginning stages with a second GSM operator recently (in the end of 2001) launching active operations in this area.[2] In wire communications, the new operators offer high-quality digital services, but they focus mainly on corporate clients, while individual users still do not have a wide range of choices and are forced to use traditional providers that offer poor services.

Figure 3.4 Key Features of the Value System of the Northwest Russian ICT Cluster



The development of content is a new business in Northwest Russia and, at the moment, there are no recognizable local brands in this area. There are a few companies that operate in this sector; however, the scale of their business is quite small at the moment. Another problem

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[2] Until 2001, the only operator in the GSM-standard in the Northwest was the Northwest GSM. On December 11, 2001, a second GSM operator (MTS) appeared on the Northwest Russian market.

here is of a global nature - the content that is really attractive for consumers is only now appearing on the market.

Thus, we can see that the Northwest Russian ICT cluster is in a process of transition from the inherited value system to a new one. This process is characterized both by reconstruction of the inherited institutional and personal interconnections on the market principles, and by the emergence of a new network of relationships with local and foreign partners. In the next chapter, we will examine the current interconnections between key industries of the Northwest Russian ICT cluster.

3.3 Interconnections within the ICT Cluster

The abovementioned convergence of information and telecommunications technologies has led to a variety of complex interconnections between the companies of the cluster. Companies producing primary goods and supplying them to final consumers often serve as suppliers for the other cluster industries.

For example, among the main suppliers of technology for telecommunications operators are software developers. Software companies provide the telecommunications sector with tailor-made and packaged software. A number of companies in St. Petersburg provide software for both telecommunications equipment and communication networks.[3] This links the IT sector with telecommunications equipment manufacturing and the telecommunications sector. At present, telecommunications companies are among the largest consumers of software in Russia.

The relations between R&D and educational organizations and the companies of the cluster play an important role in its development. Although these relations are often based on personal relations, they help a number of companies to gain access to the technologies and a qualified labor force. In chapter 6, we will prove that human capital and R&D potential are among the main competitive advantages of the cluster, and that their role in the current development of the cluster is very strong.

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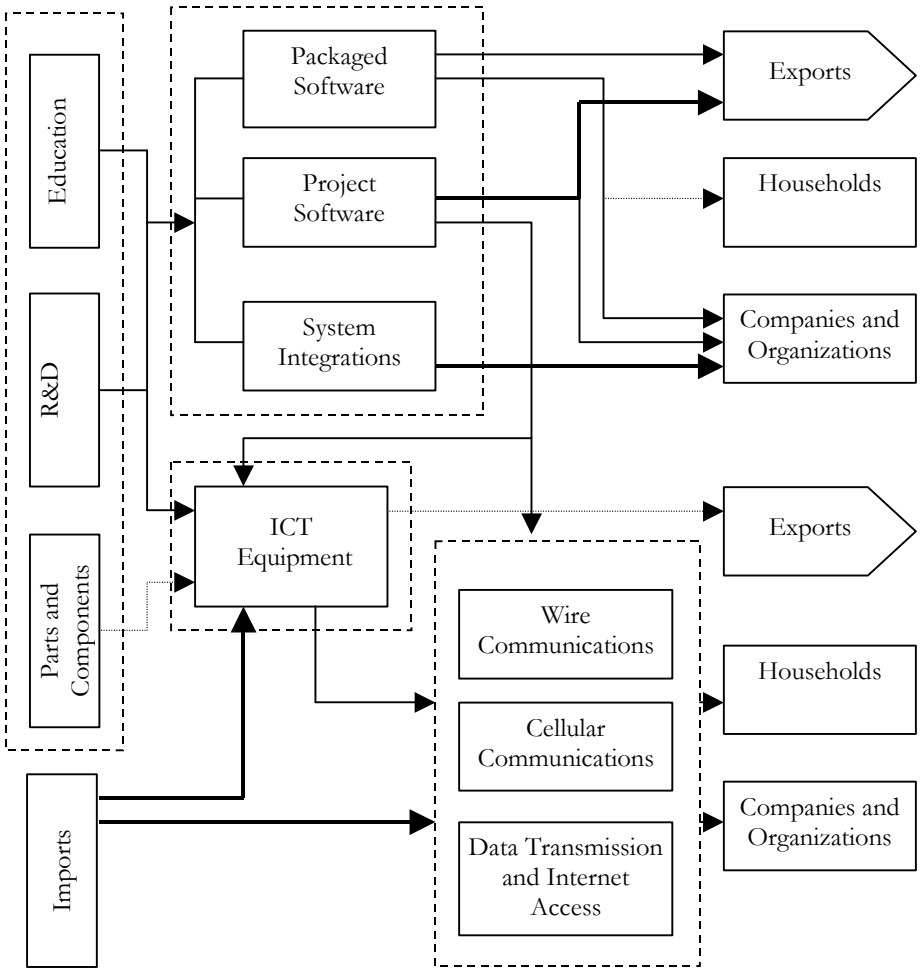
[3] For example, billing systems, software for intellectual services in ICT networks, etc.

Nevertheless, as seen in Figure 3.5, telecommunications equipment manufacturers and operators rely mainly on imported subassembly and equipment. The lack of financial resources and the limited size of the domestic market make it difficult for local manufacturers to reach economies of scale and compete with multinational corporations. It will be shown below that local supplies occupy a certain place on local markets, although their share is very small compared to that of foreign companies.

Figure 3.5 Interconnections of the ICT Industries of North-west Russia



Note: The thickness of the lines reflects the comparative strength of the relations

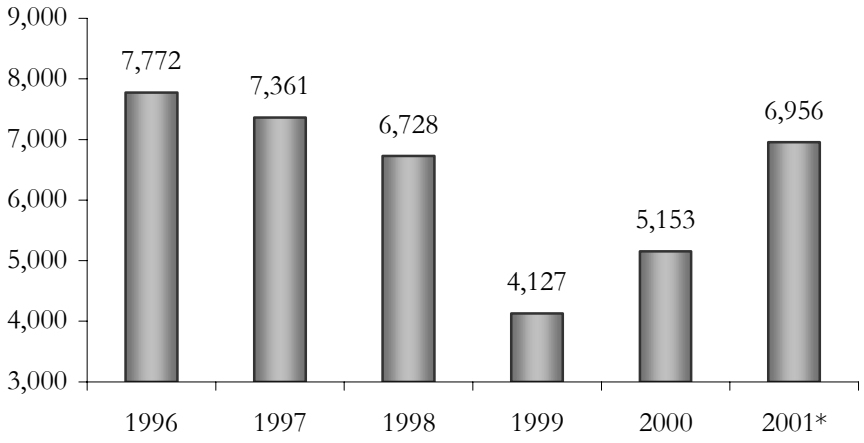
Nowadays, however, we can see that with the breakthrough of local companies into international markets, new and effective interrelations between them and their partners are beginning to emerge. With the development of export-oriented industries, this process will continue, leading to further clustering of the ICT industries. In the last chapters, we will examine in more detail the obstacles to realizing these opportunities, and we will outline possible solutions that can serve as driving forces for further cluster growth.

4 ICT Cluster Mapping

4.1 Domestic Market

The telecommunications market in Russia suffered a dramatic drop after the financial crisis and devaluation of the domestic currency in 1998. In 1999, it reached only 56% of the volume recorded in 1997. In 2000, however, telecommunications services began to recover and showed an impressive 25% growth. In 2001, according to preliminary assessments, the market grew a spectacular 35% and reached pre-crisis levels. According to the estimates of experts, the market is continuing to grow, and will sustain such impressive growth in the near future.

Figure 4.1 The Russian Telecommunications Market, USD million



Note: preliminary data
Source: Russian Ministry for Telecommunications and Informatization, http://www.minsvyaz.ru/

The Northwest is the second largest telecommunications market in Russia after the Central district, where the largest agglomeration, Moscow, alone occupies a substantial share of the total Russian market size, at 43%.

Table 4.1 The Telecommunications Market by Federal Districts in 2000

	Million USD	*Share in Russia*
Russia	**5,153**	**100%**
Central Federal District	2,661	51.6%
Northwest Federal District	635	12.3%
Privolzhski Federal District	589	11.4%
Siberian Federal District	390	7.6%
Southern Federal District	341	6.6%
Urals Federal District	311	6.0%
Far Eastern Federal District	224	4.4%

Source: Russian Ministry for Telecommunications and Informatization, http://www.minsvyaz.ru/

Table 4.2 Telecommunications Market in Northwest Russia in 2000

	Million USD	*Share in the Northwest market*
Northwest Federal District	**635**	**100%**
St. Petersburg	407	64.0%
Murmansk Region	34.9	5.5%
Kaliningrad Region	31.9	5.0%
Arkhangelsk Region	31.6	5.0%
Republic of Komi	29.5	4.6%
Leningrad Region	28.6	4.5%
Vologda Region	24.0	3.8%
Republic of Karelia	17.8	2.8%
Novgorod Region	16.3	2.6%
Pskov Region	13.7	2.1%

Source: Russian Ministry for Telecommunications and Informatization, http://www.minsvyaz.ru/

As we see in Table 4.2, the Northwest Russian telecommunications services market is heavily concentrated in St. Petersburg. The share of communication services in the local GRP is 5%, which is close to the average in developed countries, whereas in Russia overall, the average

is substantially lower, at 2% of the total[4]. This fact demonstrates the relatively high level of penetration and market concentration of telecommunications services in the city.

In the following chapter, we will show that the Northwest is not only an important Russian telecommunications market, but also one of the key agglomerations of activities related to information and telecommunications technologies.

4.2 The Role of Northwest Russia in the Russian ICT Sector

The Northwest has always played an important role in the telecommunications industry in Russia. The development in the 1960-1980s of the local industrial complex for telecommunications equipment production in the Northwest had its own logic and was preconditioned by the availability of industrial and human capital here. The modern communication-equipment manufacturing industry in Russia dates back to the mid 19th century. It started in Russia in the city of St. Petersburg, and the first telecommunications networks were also built here. It formed the foundation of the future development of the manufacturing, educational and R&D infrastructure for the electronics industry, and telecommunications in particular.

Its geographical proximity to Europe, as well as the available scientific and research potential made St. Petersburg virtually the center of innovation in the telecommunications and IT in the 1990s. It was here that the first Russian cellular communication network appeared[5], as well as the first optical fiber networks for data transmission. At present, the Northwest is an important location and hub in Russia in data transmission, a kind of "digital window on Europe," since here the main optical fiber channels connect the Russian communication and data transmission networks with Finland, and, via this country's networks, to Europe and the rest of the world (see Figure 4.2).

In the IT, the Northwest plays an even more important role in Russia. The educational institutions of St. Petersburg have shown impressive achievements in offering high-quality training in a wide range of areas of IT development. St. Petersburg has consequently become one of the leading centers for software development in Russia (the other two being

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4 Source: Russian Ministry for Telecommunications and Informatization, http://www.minsvyaz.ru/.

5 Delta Telecom, 1991.

Moscow and Novosibirsk), and is the main concentration of offshore programming activity, due to its strong ties with the international IT community.

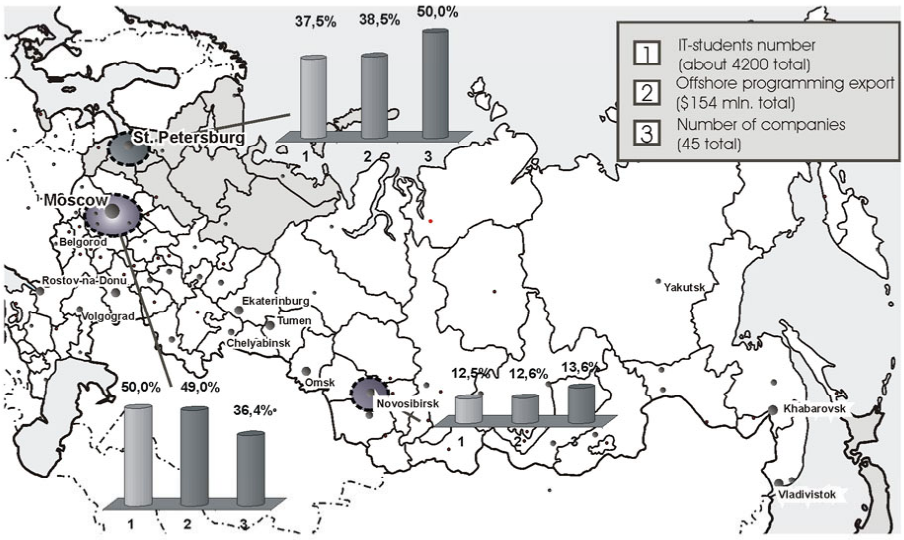
Figure 4.2 Main Data Transmission Lines in Russia

Note: The width of lines is proportional to transmitting capacity
Source: Data of main transmitting companies

As we see in Figure 4.3, its proximity to Finland and Sweden, Europe's leading information technology agglomerations and its high level of specialized education, favor its further development as the most important agglomeration nationally, and to a certain degree, even globally.

Due to high scale business activity, Moscow has occupied a greater share in offshore programming exports than St. Petersburg. However, nearly 50% of the total number of Russian offshore programming companies is located in St. Petersburg. Moscow will most probably remain the main location for companies aimed at serving domestic consumers because of the opportunities and advantages offered by this location in terms of market concentration and size (the largest consumers in Russia, private and business, are concentrated in Moscow). Market participants have pointed out that the IT market in St. Petersburg is currently much more competitive, as there are fewer lobbying opportunities and companies are engaged in open competition. Thus, the Northwest has better prerequisites for developing into the main Russian offshore programming center.

Figure 4.3 Main Offshore Programming Centers



Source: Market-Visio/EDC, 2002

Figure 4.4 Main University Centers and University IT Networks

Note: The size of the city signs is proportional to the number of students
Source: Goscomstat (2001)

St. Petersburg has an advanced educational infrastructure, occupying the second place in numbers of students after Moscow. The first

IT training centers in Russia were established here due to its geographical proximity to Europe and its well-developed telecommunications infrastructure. At present, most Russian universities are connected with one another through Moscow, and with the rest of the world though St. Petersburg, as shown in Figure 4.4. This is yet more evidence of the key role of the Northwest in the Russian ICT sector.

4.3 Foreign Trade

Telecommunications and software markets are today among the fastest growing and most globalized markets. For this reason, it is important to pay special attention to the global competitiveness of domestic products when we analyze regional markets[6].

Trade data analysis helps to distinguish specific product groups that are currently or potentially competitive on a global scale. Thus, it becomes possible to focus on the development of the most promising sub sectors, thus promoting the growth of the whole cluster.

Unfortunately, detailed statistics on international trade for the Northwest are not available – trade data for Russia and OECD countries is used instead. This data can be applied for an analysis of the Northwest because the region plays the key role in telecommunications equipment manufacturing in Russia. In addition, St. Petersburg is one of the main import trade hubs through which imported goods are delivered to Russia. The detailed description of the methodology of the foreign trade analysis is presented in the box in the end of the chapter.

Table 4.3 Russian Foreign Trade with OECD Countries in ICT Products

Index	1998	1999
Total Exports, USD million	126.1	118.8
Share in total imports of OECD countries	0.03%	0.03%
Total Imports, USD million	1,904	1,006
Share in total exports of OECD countries	0,47%	0,24%
Trade balance, USD million	-1,778	-887

Source: OECD, International Trade by Commodities Statistics ITCS

[6] The competitiveness of domestic products is evaluated within the framework of international trade data analysis for the country (or region).

Russia is an import-oriented country in telecommunications, since during the transition period local manufacturers lost the technology race and failed to compete with international companies on their traditional markets, thus losing their positions on the domestic market.

Imports of the ICT equipment decreased considerably in 1999, as a result of devaluation of the domestic currency[7] and decrease in investments by the domestic operators. However, there has been accelerating growth in demand for telecommunications, and especially for cellular services, taking place since 2000, which has led to substantial investments and related increase in imports of equipment. According to experts' evaluations, already in 2001 imports of the telecommunications products were above the levels of 1998.

A dramatic decline in the telecommunications equipment manufacturing industry led to the disappearance of competitive domestic products. The share of Russian exports of telecommunications commodities in OECD imports amounts only to 0.03%[8]. Nevertheless, there are some competitive products, and they are presented in Table 4.4. However, exports of these products are very small in volume.

Table 4.4 Russian Competitive Products in OECD Market in 1999

HS #	Article	Russian share in OECD imports	Total OECD imports, USD million	OECD imports from Russia, USD million	Russian trade balance, USD million
854081	Receiver or amplifier valves and tubes	5.50 %	51	2.8	2.7
854049	Microwave tubes	1.31 %	132	1.4	1.58

Source: OECD, International Trade by Commodities Statistics ITCS

As we see in Table 4.4, Russia has a very small share on major telecommunications equipment markets. However, the country (and especially Northwest Russia) has both the necessary qualified labor force and industrial capital inherited from the Soviet period, thus creating a potential for the growth of manufacturing in this sector.

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7 The financial crisis of 1998 resulted in the devaluation of the ruble. The ruble/US dollar exchange rate grew four times, and in 1999 equaled on average 24.53 rubles (whereas at the beginning of August 1998, the exchange rate was 6.2 rubles to the dollar).

8 Source: OECD, International Trade by Commodities Statistics ITCS.

Table 4.5 Major Telecommunications Equipment Markets, 1999

HS #	Article	Total OECD imports, USD million	Russian share in OECD imports	OECD imports from Russia, USD million	Russian trade balance, USD million
8542	Electronic integrated circuits and micro assemblies	125,961	0.03%	32.8	-7.3
8517	Electric appliances for line telephony/line telegraphy, including current line system	54,190	0.02%	9.4	-297
8525	Transmission appliances for radio-telephony, radio-broadcasting; television camera	43,449	0.02%	7.0	-232

Source: OECD, International Trade by Commodities Statistics ITCS, 2001

Russia has a negative trade balance with the OECD countries in telecommunications equipment (Table 4.5). Taking into consideration the fact that the Northwest has substantial human and physical capital, already established traditions, and a well-developed educational infrastructure, it is reasonable to assume that there is a real potential for import substitution in the sector. Another significant factor in an analysis of this potential lies in the fact that imported goods are primarily delivered to Russia via St. Petersburg, which would also facilitate the concentration of import substituting manufacturing in St. Petersburg. Here the growing domestic demand has already begun to promote the development of local manufacturing companies. Import

Table 4.6 Main Telecommunications Products, Imported to Russia in 1999

HS #	Article	OECD Exports to Russia, million USD	Russia's share in OECD Exports	Total OECD Exports, million USD	Russian Trade Balance, million USD
8517	Electric appliances for line telephony/line telegraphy, including current line system	306	0.54%	56,701	-297
8525	Transmission appliances for radio-telephony, radio-broadcasting; television camera	239	0.7%	51,239	-232

Source: OECD, International Trade by Commodities Statistics ITCS, 2001

structure analysis helps to determine the product groups with the highest potential for import substitution, and thus orient decision-making in the industry.

According to Table 4.7, different kinds of equipment for wired and cellular network have the most significant import volumes in the Russian ICT sector.

For a more detailed analysis of import substitution potential, trade data by 6-digit product groups was used.

Table 4.7 Potential for Import Substituting in Russian ICT Sector, 1999, Results of the Statistical Cluster Analysis

Product category	Product Groups (HS)	Average Russian imports, USD million	Average share of Russian imports in OECD exports	Interpretation
1	852520	220	0.54%	Substantial potential for import substituting domestic production
2	851790 852810 851730 852990 854011	78	0.66%	Good potential for import substituting domestic production
3	Other groups of ICT equipment	3	0.18%	Limited potential for import substituting domestic production

Source: Author's calculations

Commodity groups of the first two product categories have significant potential for creating import-substituting production in Russia. The possibility of achieving economies of scale on the domestic market could also make exports of these products probable in the medium term. These product groups are presented in Table 4.8.

The current volume of imports is considerable. The six commodity groups listed in Table 4.8 represent almost $612 million of imports in 1999. It is worth noting that in 1998 these commodity groups accounted for about $1 billion of imports. In 2000-2001, the volume of imports grew, due to the accelerating development of telecommunications service providers and related investments in infrastructure, and consumer spending on user terminals, and in 2001 imports were above the levels achieved in 1998, according to estimations of experts. The rapid growth

of telecommunications services in 2001 is evidence that there is a significant potential demand for equipment, and consequently that domestic production has good prospects for growth in the near future.

Table 4.8 Product Groups with Substantial and Good Import Substituting Potential, 1999

HS #	Article	OECD Exports to Russia, million USD	Russia's share in OECD Exports	Total OECD Exports, million USD	Russian Trade Balance, million USD
852520	Transmission apparatus, for radio-telephony incorporating reception apparatus	220	0.54%	41,023	-215
851790	Parts of electrical apparatus for line telephone or line telegraphy	122	0.56%	21,868	-119
852810	Television receivers including video monitors & video projectors, color	93.3	0.57%	16,440	-92
851730	Telephonic or telegraphic switching apparatus	73.7	1.05%	6,989	-68
852990	Parts suitable for use solely/mainly with the appliances of headings 85.25 to 85.28	54.2	0.25%	21,917	-50
854011	Cathode-ray television picture tubes, including video monitor tubes, color	49.2	0.87%	5,670	-49

Source: OECD, International Trade by Commodities Statistics ITCS, 2001

As we will be show below, among the advantages of Northwest Russia is the availability of a production infrastructure, as well as skilled personnel for the development of modern equipment manufacturing for the ICT sector. Thus, the existing possibilities for import substitution in Russia carry with them the potential for establishing new manufacturing facilities in the Northwest.

At present, there are examples of telecommunications equipment manufacturers in the Northwest that have taken advantage of the above facts. The company NEC, together with the Telecominvest holdings, established the NEC Neva Communication Systems that manufacture digital exchanges. Lucent Technologies has set up a factory to manufacture switching equipment. The Finnish company Elcoteq created facilities for manufacturing accessories for telecommunications equipment. The rapid increase in the final demand for telecommunications services and the consequent growth in demand for equipment will obviously promote further development of import-substituting production in the near future.

Local manufacturers have the possibility to improve significantly their competitive strengths on international markets if they reach economies of scale. Russia possesses certain characteristics (such as large territories, low density of population, etc.) that are specific to it and could facilitate the development of new products and solutions and achieving economies of scale for certain types of products. If certain products are new also globally, cost competitive and successful in the domestic market, they can be exported to other countries with similar characteristics. The development of such new products and technologies will not be, however, possible unless greater commitment and effort is made by industrial policy-makers and the government, in order to create or upgrade the necessary infrastructure and dismantle barriers for trade and development.

Another potentially important export article of the Russian ICT cluster is software. Russia has significant export volumes in this field due to the advanced development of the offshore programming.

At present, the volume of Russian offshore programming accounts for about 0.2% of the world market; but according to expert forecasts, this sector could grow 50% annually in the near future and increase a global importance substantially.

The real volume of Russian offshore programming is estimated to be considerably higher than shown in Figure 4.5. In the first place, centers for software development of western companies located in Russia[9] were not taken into consideration in the figures above. Second, there are many small groups of programmers on the market that are not incorporated, and operate solely on a cash basis, making it virtually impossible to assess the volumes of their production.

Russia has a very small share on international markets of offshore programming despite the significant potential of its IT sector based on the availability of highly qualified labor resources and advanced IT training facilities. Government support is necessary in order to implement special programs for the development of the IT sector and to realize its potential. This could result in exponential growth of software exports, as witnessed in India in the 1990s. The beginning of the federal program "Electronic Russia"[10] is an important first step in this process, and it

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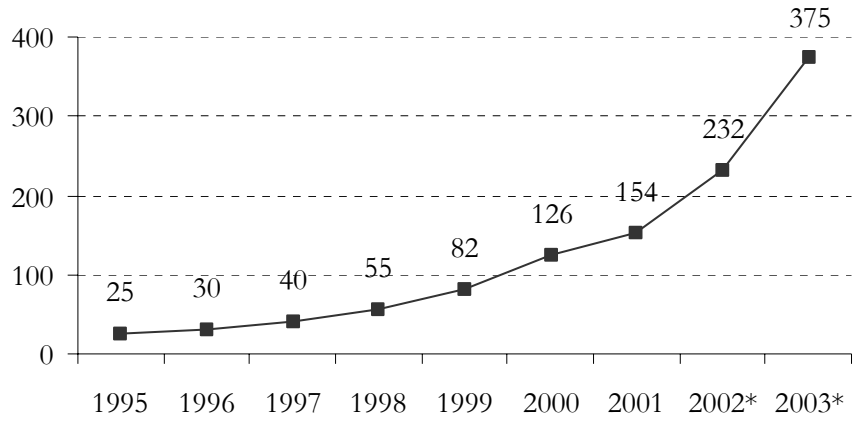
[9] For example, Motorola has a large center for software development in St. Petersburg employing more than 200 programmers. Intel has a center for software development in Nizhniy Novgorod.

[10] The purpose of the program "Electronic Russia" is to assist the development of the Russian IT sector through upgrading the IT infrastructure of government institutions (making it available via the Internet) and support of the educational infrastructure and IT training programs.

gives grounds for hope in further government efforts to support the development of high-tech export-oriented sectors, one of which is the IT industry.

Figure 4.5 The Russian Offshore Programming Market, USD million



Source: Market-Visio/EDC, 2002. Note: forecast

Box 4.1 XJ Technologies – Successful Offshore Programming Company

XJ Technologies was founded by specialists of the Distributed Computing and Networks department (School of Technical Cybernetics) of St. Petersburg Technical University. The company utilized the large R&D potential accumulated in the department and offered services for complex simulation of various processes in electronics, telecommunications and other industries to its clients.

In addition to analytical and R&D work in simulation, the company develops software tools for simulating complex, nonlinear and discrete systems.

Its unique experience and accumulated advanced knowledge allow the company to sell its services with high value added - the price for company's man-hour is nearly two times higher than average on the St. Petersburg offshore programming market. The high price derives from the level of services - the company offers not only implementation of the technical aspect of project, but also carries out research activity based on its own unique knowledge and practical experience.

The company's success story is reflected in its partnership with such well-known international companies as Hewlett-Packard Labs, IBM CAS, LG, etc.

St. Petersburg is one of the major centers of offshore programming in Russia, as we have seen above in Figure 4.5. In comparison to Moscow, its market volumes are smaller, but it leads in the number of companies operating in this field. Below we will analyze the competitive advantages of the IT industry in Northwest Russia, which could facilitate the sustainable and long-term growth of the IT in the region if proper developed. Thus, software is an important competitive product of the ICT cluster of Northwest Russia, with a significant potential for export growth.

Box 4.2 Methodology for the Foreign Trade Analysis

For analysis of the clusters' positions on the foreign markets we use statistics of international trade of the countries, belonging to the Organization for Economic Cooperation and Development (OECD), with Russia. This approach is characterized by a number of advantages. First, OECD includes the most developed countries of the world, and thus its statistics allows analyzing positions of the Russian products on the most competitive and large segment of the global market. Moreover, detailed data of the ITCS (International Trade by Commodities Statistics) is available for the OECD countries, including more than 6 000 product groups (classified by HS – Harmonized System), which make possible detailed and comprehensive trade analysis.

We divide the analysis of the Russian foreign trade into two main parts:

- Study of competitive positions of the Russian products on the OECD markets (Russian exports analysis)
- Assessment of the import-substituting potential in Russia (Russian imports analysis)

1. Competitive positions of the Russian products

To assess the competitive edge of the Russian commodities on the OECD markets we estimate average share of the Russian exports in total OECD imports. It is considered that Russia has got competitive edge in those products where its exports share in OECD imports is over the Russian average share and trade balance is positive (separated by cut-off dotted lines in the tables below).

The analysis starts from the brief look on the shares of the Russian products on OECD markets by the most aggregated two digit groups. Here the main sectors where Russia got competitive edge are outlined.

№ HS	*Product Group*	*Russia's share in OECD imports*
Russian average		1,09%
05	Pr. Group 1	3,14%
84	Pr. Group 2	2,10%
34	Pr. Group 3	0,60%
67	Pr. Group 4	0,51%

On the next step we go deeper into classification of the product groups, sketching out competitive positions on the four-digit level.

№ HS	*Product Group*	*Russia's share in OECD imports*
Russian average		1,09%
0504	Pr. Group 1	5,56%
8416	Pr. Group 2	4,78%
5710	Pr. Group 3	1,56%
1905	Pr. Group 4	0,78%

On this level of classification we look also on the largest OECD markets and share of Russian products on them. This is aimed on assessing not only relative indicators of competitiveness, but also absolute figures of Russian exports.

№ HS	*Product Group*	*OECD market, million USD*	*Russia's share in OECD imports*
5603	Pr. Group 1	20 000	0,06%
1209	Pr. Group 2	15 000	0,15%
0504	Pr. Group 3	4 000x	0,56%
3402	Pr. Group 4	2 500	0,43%

Finally the most detailed (six-digit) product groups, possessing larger than Russian average share on the OECD markets, are revealed. Analysis on this stage makes it possible to bring study on the level of certain products and corresponding companies, and thus to sketch not only competitive commodities, but also outline competitive manufacturers.

№ HS	*Product Group*	*Russia's share in OECD imports*
Russian average		1,09%
841610	Pr. Group 1	9,86%
500420	Pr. Group 2	5,13%
341790	Pr. Group 3	2,84%
232178	Pr. Group 4	0,89%

2. Import-substituting potential

The analysis of import-substituting potential starts from sketching out commodity groups with highest share of Russian imports in OECD exports. Those products, which have more than Russian average share, are considered as possessing relative import-substituting potential (separated by cut-off dotted lines in the table below).

№ HS	*Product Group*	*Russia's share in OECD exports*
Russian average		0,83%
45	Pr. Group 1	2,45%
08	Pr. Group 2	1,07%
24	Pr. Group 3	0,59%
1208	Pr. Group 1	6,87%
4503	Pr. Group 2	2,45%
0813	Pr. Group 3	0,26%

On the next step we focus on the volumes of Russian imports. The statistical cluster analysis is used for singling out commodity groups with import-substituting potential. All the 6-digit commodity groups are divided into three product categories by volume of imports into Russia. The first product category is interpreted as product groups possessing substantial possibilities for creating import-substituting production in Russia. The second product category includes product groups with a good potential for import substitution. The third product category is interpreted as product groups with very small possibilities for creating import-substitution production in Russia.

Product groups	*Average Russian imports, million USD*	*Average share in OECD exports*	*Domestic production potential*
4419, 5902 2413	524	3,34%	Substantial
3414, 4218 2911, 4811	256	2,57%	Good
Other	45	0,32%	Insignificant

Product groups with substantial and good potential for creation of import-substituting manufacturing are of interest for the further analysis.

№ HS	*Product Group*	*Russian imports, million USD*	*Russia's share in OECD exports*
Russian average			
4419	Pr. Group 1	712	2,20%
5902	Pr. Group 2	456	2,56%
2413	Pr. Group 3	404	5,50%
3414	Pr. Group 1	305	3,56%
4218	Pr. Group 2	287	2,45%
2911	Pr. Group 3	224	1,05%
4811	Pr. Group 4	208	3,22%

Finally, similar statistical cluster analysis is applied to the most detailed six-digit product groups. This, as in competitive edge study, helps to bring analysis on the level of certain products.

№ HS	*Product Group*	*Russian imports, million USD*	*Russia's share in OECD exports*
Russian average			
441912	Pr. Group 1	457	5,67%
590201	Pr. Group 2	325	4,07%
421835	Pr. Group 1	156	3,56%
341404	Pr. Group 2	123	2,45%
481102	Pr. Group 3	98	3,22%

5 The Cluster System

In this chapter we will consider in greater detail the following sub-sectors of the Northwest Russian ICT cluster:

- Wire communications
- Data transmission and Internet access services
- Cellular communications
- Production of telecommunications equipment
- Information technologies
- Science and education
- Media and New media

While most of these sub-sectors are new and have appeared only in the last decade, the history of the telecommunications in Northwest Russia is quite long and began already in the 19th century.

5.1 History

The history of telecommunications dates back to the mid-19th century when the first German-made telegraph line from St. Petersburg to the military base in Kronstadt was laid.

The history of electrical engineering in the Northwest Russia began with the creation of the Chief Telegraph Workshop by Siemens and Halske, which opened in the summer of 1853 in St. Petersburg. A rapid increase in domestic demand led to the development of the industry in Russia. By the early 20th century, there were a total of nineteen electric engineering plants in St. Petersburg alone.

Dating from this period, Northwest Russia has been among global leaders in the development of telecommunications technology up to the 50-70´s. The first telephone network was also introduced into Russia in St. Petersburg, in 1879. It was in St. Petersburg that Popov invented the radio in 1895. The first TV set in the world was also built here in 1911, as well as the first color TV in Russia, in the late 1950s. One of the key reasons for such leadership was the accumulated skills and commitment of the government, as well as traditions deriving from the concentration of activities in one location, i.e. St. Petersburg.

Table 5.1 Milestones in the History of ICT Development in Northwest Russia

Year	*Event*
Telegraph and Telephony	
1850	The construction of the first telegraph line in Russia (connecting St. Petersburg and the Navy base in Kronstadt) began
1853	The appearance of the first manufacture of communications equipment (Main Telegraph Workshop of the Siemens and Halske Trade House)
1879	First telephone call in Russia
1882	The construction of the St. Petersburg telephone network began
1914	The St. Petersburg telephone network in reached a capacity of 50,000 lines
1877-1917	During this period more than 19 telecommunications equipment manufacturers began operation in St. Petersburg
1933	First automatic exchanges were introduced by the "Krasnaya Zaria" plant
1941	The St. Petersburg telephone network reached a capacity of 100,000 lines
1947	Introduction of decade two-motion selector exchanges into local networks
1962	Upgrade of telegraph networks to an automatic system
1972	The implementation of coordinate exchange equipment in local networks began
1980	The implementation of digital exchange equipment in local networks began
1991	Appearance of the first cellular operator in Russia (Delta Telecom, NMT 450 standard)
1995	Operations of the first GSM operator in the Northwest of Russia (the Northwest GSM company) began
Radio and TV	
1895	Invention of the radio by Alexander Popov (first in the world)
1911	First demonstration of a TV picture in the world
1915	Invention of the electron tube by Bonch-Bruevich, which created a new era in radio technology
1925	Beginning of radio broadcasting and mass production of consumer radio receivers
1932	Development of the first consumer TV sets
1936	Beginning of trial TV broadcasting
1949	The mass production of the consumer TV sets began

Source: Russian Virtual Computer Museum, (2002), http://www.computer-museum.ru

In the period from 1950 to 1960, a considerable diffusion of radio engineering and electronics took place in Northwest Russia. In Novgorod several radio plants were created, all of them were closely related to St. Petersburg-based enterprises and specializing in manufacturing TV sets, electronics and network equipment. In Pskov, the production of equipment for long distance telephony was created in this period.

Within the framework of the state planning policy, large investments were made in telecommunications equipment manufacturing in Northwest Russia in the 1970–1980s. A scientific and industrial complex was developed on the basis of existing and new production facilities and specialized scientific research institutes. In the late 1980s, more than 50 industrial enterprises and scientific research organizations were operating in the sphere of microelectronics alone in St. Petersburg.

During the 1990s, radical changes took place in the sector. The collapse of the Soviet Union led to the demise of user-producer relations, which connected organizations from the Northwest with partners all over the Soviet Union and Eastern Europe. The local manufacturers were exposed to open market competition and lost markets in many product groups. This led to a decline in the development of manufacture and technology. The timing of these changes was crucial, since during the same period the leading nations of the world were committing ever-increasing investments into rapid technological breakthroughs in this sector. The technology gap between domestic and international companies increased dramatically in this period.

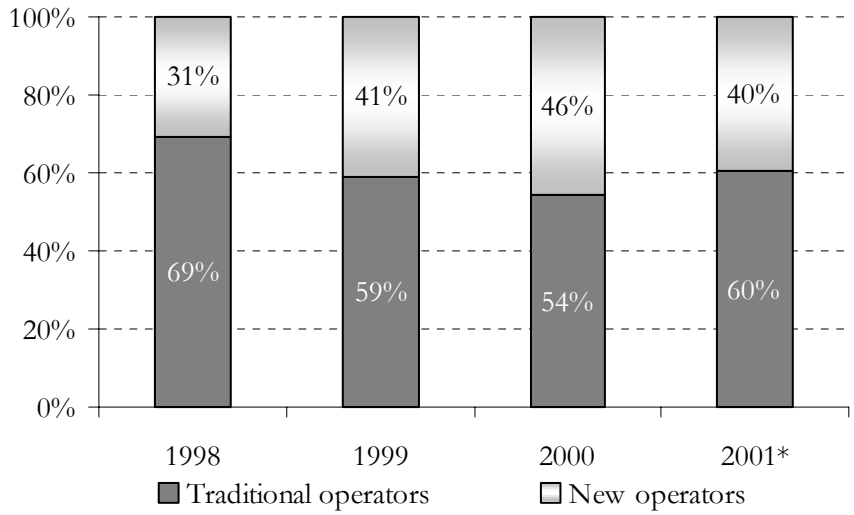
5.2 Wire Communications

The history of telephone communications dates back to 1879, when the first telephone call in Russia was made between St. Petersburg and the residence of the Tsar. The St. Petersburg telephone network was founded in 1882, and the network was handed over for private management to the Bell Company for twenty years. However, during this period the development of the network proceeded very slowly, and in 1902 the network was reverted to government ownership. Since that time, the development of wire communications in Northwest Russia was under government control, both before and after the October revolution.

Thus, throughout almost its entire history, telecommunications in Northwest Russia have been under government ownership and developed in centralized and bureaucratic decision-making conditions. Only in the 1990s, with the transition to the open market, did the emergence of new private telephone operators in the industry become possible.

Today wire operators in Northwest Russia can be grouped into two substantially different categories, traditional and new operators, created after 1990. The traditional operators are former state communication companies owned by the state-controlled holding company Svyazinvest. Other companies created after the beginning of reforms are private, and focus mainly on new and higher value added services, such as digital telephony for business customers and data transmission.

Figure 5.1 The Share of New and Traditional Operators on the Russian Telecommunications Market



Note: * preliminary data
Source: Russian Ministry for Telecommunications and Informatization, http://www.minsvyaz.ru

The traditional sector is characterized by its low quality of services and low effectiveness of operations. The existing telecommunications networks of traditional operators were designed and built in the Soviet period. Therefore, the already installed equipment is largely worn-out and outdated in these companies. Low revenues per client and sales have resulted in only minor upgrading in recent years.

Moreover, traditional companies became natural monopolies for the household sector in the new economic environment. Unlike corporate clients, households have no real alternative to traditional operators as the infrastructure of new companies is not sufficiently developed to offer its services to all inhabitants, and the regulations for new operators switch-

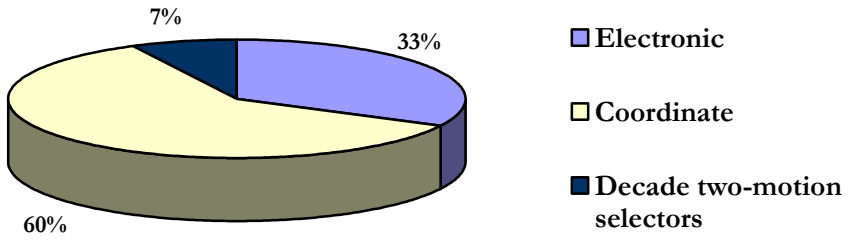
ing to networks of the traditional companies are not clearly defined by the industry legislation. The monopoly position of traditional operators, which was acquired when they inherited the networks accessible to almost all private users, never motivated them to increase efficiency and improve their competitiveness.

The final and probably most significant factor hindering the development of the traditional sector is government regulation of charges[11], which forced traditional companies to sell their services for even less than their costs.

Box 5.1 Northwest Telecom – Monopoly on the St. Petersburg Wire Communications Market

Northwest Telecom (former PTS) operates nearly 1.8 million telephone lines in St. Petersburg, and the total length of its network exceeds 32 thousand km. The company has sole access to almost all private clients in the city, which gives it a monopoly position in this segment of the market. The network of the company needs considerable modernization – the level of digitalization did not exceed 33% at the beginning of 2002.

Figure 5.2 The Structure of Exchange Equipment of Northwest Telecom, 2001



Source: Company's data

The monopoly position of the company adversely affects the quality and price of the company's services. For example, when a person buys an apartment that has already been equipped with a telephone line, a new owner must pay for the installation of the line. Worn-out exchanges in the company's network make it impossible for the clients of the company to use such modern services as telephone cards (requires tone dial, which is not supported by the old exchanges), high-speed dial-up access to the Internet, etc.

[11] Russian authorities limit charges for telephone services as a part of their social policy.

In the mid-90s, large investments were made by the company into development of high-speed communication networks within the city. This allowed the establishment of the fiber-optic transportation network, more than 1,300 km in length. However, the company was not able to pay back the loans it had made, and the equipment and the company's debts were transferred to a specially established company, Petersburg Transit Telecom, which started its own business. This means that planned renovation of the company's basic network was not accomplished, and further network upgrading is moving very slowly.

On the other hand, newly established companies invested into a new modern infrastructure and focus on high value added and high-quality services for business clients. They are not subject to government regulations of charges, and their profitability is, therefore, not affected. Only a few of them try to work with households, as mostly they don't have any last mile networks.

Table 5.2 Capitalization Comparison of Telephone Companies

Companies	*Total Capitalization (as of August 31,2001), USD million*
MTS (the biggest Russian cellular operator)	2,600
All Russian traditional wire operators (including long-distance operators)	2,310

Source: www.expert.ru, Expert Top 200 rating

Table 5.3 The Wire Phone Penetration Rate, Northwest Russia, 2000

Region	*Total, %*	*Urban population, %*	*Rural population, %*
Northwest Federal District	**30.6**	**34.3**	**13.9**
St. Petersburg	42.7	42.7	
Murmansk Region	30.1	31.5	14.3
Arkhangelsk Region	26.5	30.3	15.3
Republic of Komi	26.3	29.3	17.6
Republic of Karelia	25.4	29.0	14.9
Leningrad Region	24.1	28.7	15.1
Novgorod Region	23.6	28.2	12.5
Pskov Region	23.6	29.0	12.6
Vologda Region	23.5	28.4	12.7
Kaliningrad Region	19.8	23.5	7.2
Russia	*22.8*	*27.4*	*10.1*

Source: Russian Ministry for Telecommunications and Informatization, http://www.minsvyaz.ru

All of this has resulted in an enormous gap between the capitalization of traditional and new (alternative) companies. As we can see in Table 5.2 the capitalization of all traditional wire operators in Russia is lower than the capitalization level of one successful mobile operator.

The main obstacle for the development of wire communications is, therefore, the low investment attractiveness of the traditional sector. It requires huge investments into network upgrading and development. The number of fixed phones grows very slowly, and many small towns actually have no available communication facilities. Even in St. Petersburg, the number of people waiting for wire telephone installation was 53,000 at the beginning of 2001, while just 20,000 lines were installed during 2000.

As a positive tendency, one could point to the planned introduction of time-based charges instead of fixed monthly payments. In addition to this Svyazinvest holding, which includes all the regional wire operators, introduced plans to reorganize the holding structure in order to increase its management effectiveness and make the company more attractive for investments. Within the framework of this program, all regional traditional operators (listed in Table 5.4) in the Northwest merge with Northwest Telecom. Below, in Chapter 6, we will also focus on these issues.

Table 5.4 Traditional Operators in Northwest Russia, 3Q 2001

Company	*Staff*	*Installed lines, thousand*	*Turnover (1-3Q2001), USD million*	*Capitalization, as of September 1, 2001*
Northwest Telecom, St. Petersburg	9,185	1,789	100.3	163.9
Lensviaz, Leningrad Region	4,661	374	20.6	22.9
Murmanelectrosviaz, Murmansk Region	3,488	232	22.1	21.7
Artelecom, Arkhangelsk Region	4,350	264	20.0	9.2
Sviaz, Republic of Komi	3,826	252	21.8	7.7
Electrosviaz, Republic of Karelia	2,915	175	11.7	7.4
Pskovelectrosviaz, Pskov Region	2,286	127	8.3	7.3
Novgorodtelecom, Novgorod Region	2,310	147	8.8	7.2
Electrosviaz, Vologda Region	2,947	168	10.4	5.3
Electrosviaz, Kaliningrad Region	2,708	149	14.2	4.3
Cherepovetselectrosviaz, Vologda Region	1,036	94	6.2	4.3
Total	**39,712**	**3,772**	**244**	**261**

Source: www.scrin.ru

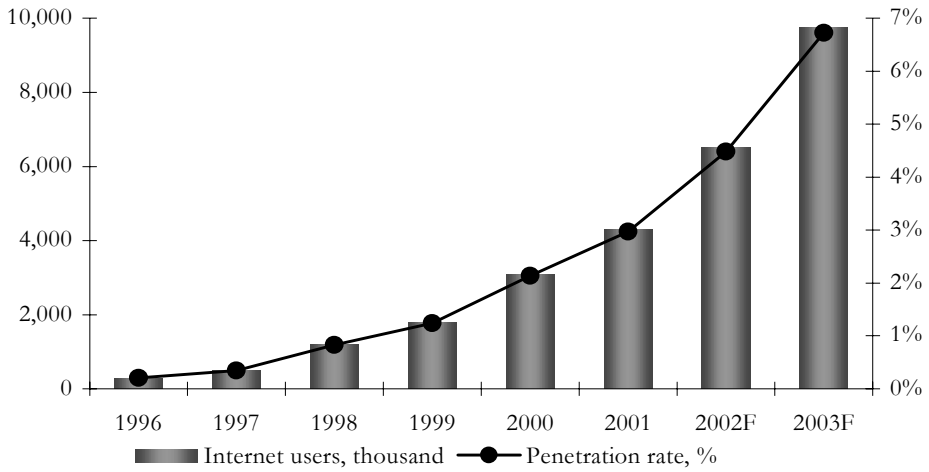
The planned modernization could also create substantial demand for locally produced equipment, which is important as a factor motivating the upgrading, investment in product development, startups and manufacturing subsidiaries of the multinationals.

On the other hand the rapid growth and increase in coverage area by mobile communications providers poses a great challenge as substitute for wire solutions. In many cases the gap is so great that the certain areas are bound to have more mobile then fixed connections also in the future.

5.3 Data Transmission and Internet Access

One of the fastest developing sectors in the ICT is data transmission and provision of Internet access. The Internet is actively developing in Russia due to a rapid spread of information technologies and PCs, as we see in Figure 5.3.

Figure 5.3 Number of Internet Users and its Penetration Rate in Russia[12]



Source: Russian Ministry for Telecommunications and Informatization, http://www.minsvyaz.ru. Author's calculations.

One of the distinctive features of Russia is that computer ownership per capita varies greatly between large cities and regions. Most computer owners are concentrated in Moscow and St. Petersburg. These cities generate nearly 85% of all Internet traffic in Russia.

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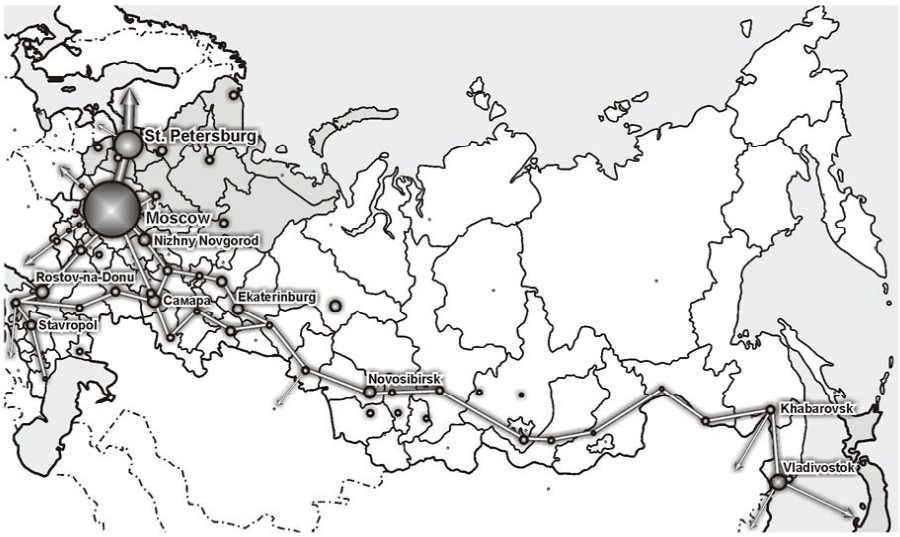
[12] The number of regular Internet users is shown here. The number of occasional users is much higher.

Figure 5.4 Geographical Distribution of Russian Internet Users



Note: The size of the circle is proportional to the number of Internet users
Source: SpyLOG, Rostelecom

However, if we consider the number of Internet users, it appears that they are more evenly distributed in the territory of Russia. The Internet is actively developing in cities with a population from 300,000 to 1,000,000 people. The high concentration of traffic in Moscow and St. Petersburg can be explained by the large number of regular Internet users in these cities, whereas in other regions occasional users predominate. In addition, Moscow and St. Petersburg are the major business centers of Russia, and this also contributes to the larger volumes of Internet traffic generated in these locations.

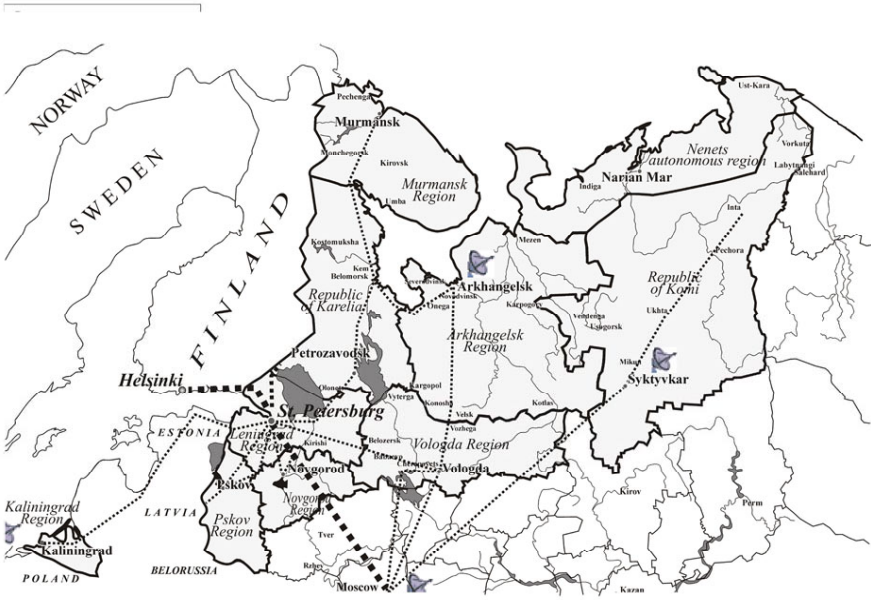
The Northwest region is second in Russia in terms of number and penetration of Internet users. One of the main reasons for this is that the Northwest has a well-developed data transmission infrastructure in comparison with other Russian regions. There are several long-haul optical fiber channels that run through St. Petersburg. Because of these channels St. Petersburg is one of the largest hubs connecting Moscow (the largest market and concentrator of domestic traffic) to the state-of-the-art communication networks of Finland, and hence to global networks. As we have shown above, St. Petersburg is an important hub not only in national data networks, but also in university IT networks. Thus, the Internet has undergone continual and rapid development in Northwest Russia.

Table 5.5 Internet Penetration by Federal Districts in 2001[13]

	Internet penetration rate	*Population, thousand*	*Share of total number of Internet users*	*Number of Internet users*
Russia	3.0%	144,819	100%	4,345
Central Federal District	3.4%	36,738	29%	1,249
Northwest Federal District	4.2%	14,371	14%	604
Privolzhski Federal District	1.6%	31,840	12%	509
Siberian Federal District	2.3%	20,675	11%	476
Southern Federal District	2.2%	21,523	11%	474
Urals Federal District	3.4%	12,565	10%	427
Far Eastern Federal District	7.9%	7,107	13%	561

Source: Russian Ministry for Telecommunications and Informatization, http://www.minsvyaz.ru/. Goscomstat, Author's calculations

Figure 5.5 Data Transmission Networks in Northwest Russia



Note: Fiber optic lines
Source: Companies' data

[13] The number of regular Internet users is taken into consideration in calculating the penetration rate.

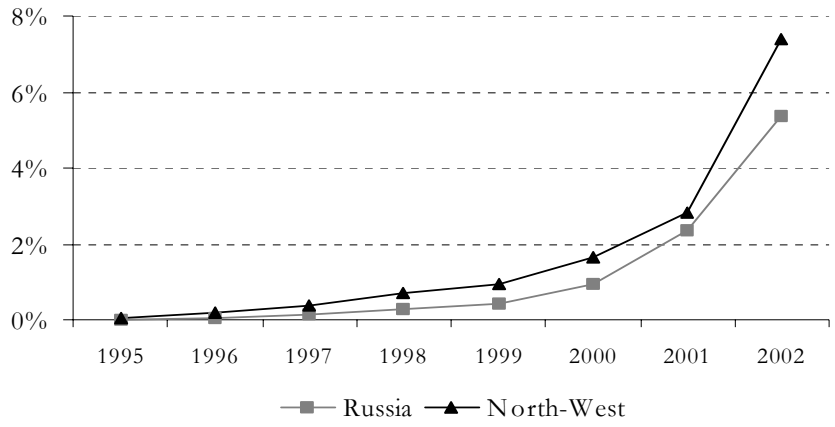
St. Petersburg also has a well-developed local optical fiber network. This creates good conditions for the active development of broadband Internet access in this location. Available services on the market (ADSL[14] access, dedicated channels of medium and high traffic capacity) make quality access to the Internet possible for both corporate and private users in St. Petersburg.

Unfortunately, there are some fundamental obstacles to further development of these services. The primary obstacle is that the infrastructure does not meet quality and efficiency requirements, i.e. Russia is still a land of analog exchanges[15] and older generation technologies. We will consider this and other problems in Chapter 6.

5.4 Cellular Communications

Northwest Russia took the lead in mobile telecommunications development when Delta Telecom started the first mobile network in Russia in 1991. The service quickly became popular and soon after, two other

Figure 5.6 The Dynamics of Cellular Services Penetration



Source: Sotovik.ru, Goskomstat

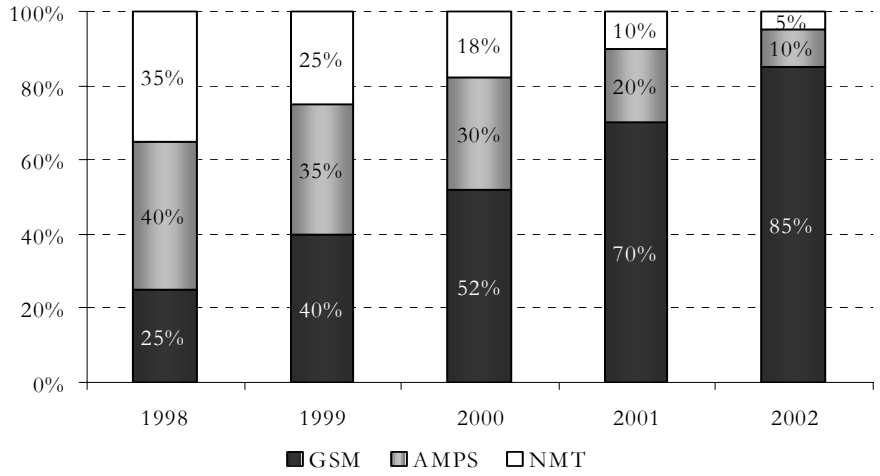
[14] DSL (Digital Subscriber Line) a technology that exploits unused frequencies on copper telephone lines to transmit traffic typically at multi-megabit speeds. ADSL (full rate Asymmetrical DSL) is a variation of DSL technology, which offers differing upload and download speeds and can be configured to deliver up to six megabits of data per second from the network to the customer.

[15] According to the Ministry for Communication and Informatization the digitalization level of telephone networks is only 26%.

companies, St. Petersburg Telecom and Northwest GSM, began their operations in St. Petersburg.

The recent popularity of wireless communications has been stimulated by the rapid development and spread of the GSM standard worldwide. Intensive competition between leading international equipment manufactures has led to a substantial reduction in prices of equipment and eased investment. Russia followed worldwide tendencies, and as we can see from Figure 5.7, the GSM standard soon become the leader on the market.

Figure 5.7 Relative Portions of Different Standards on the Russian Cellular Market



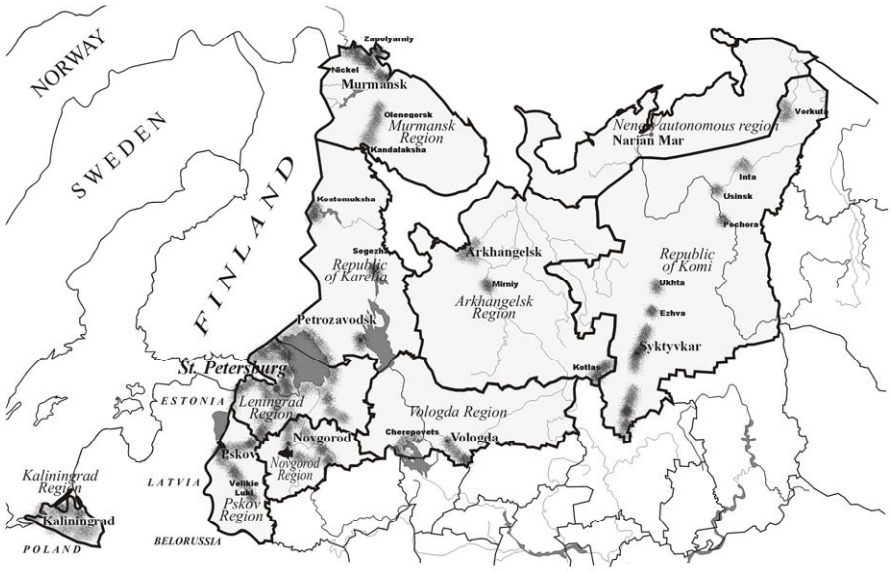
Source: Sotovik.ru, Goskomstat (figures correspond to the beginning of the year)
Abbreviations: Cellular standards: GSM – Global System for Mobile Communications; AMPS – Advanced Mobile Phone Services; NMT - Nordic Mobile Telephone.

Cellular communications began in the Northwest much earlier than in other regions of Russia. This is one of the reasons for the much higher penetration rates today. However, the Northwest has lagged behind in the rate of growth, in comparison with the Russian average, due to the lack of local competition until 2001 (contrary to Moscow, for example). Only at the end of 2001, did the second GSM operator (MTS, Moscow) begin its operation in St. Petersburg. The same company, MTS, announced that later the service would also be offered over the entire territory of the Northwest. This obviously intensified competition, and has already resulted in booming sales[16].

[16] During the first two months of operation of MTS in St. Petersburg, the number of cellular subscribers in St. Petersburg increased by 52%.

Already by the beginning of 2002, 7.4% of the total population in Northwest Russia used cellular telephones. This is a very small number if compared to developed countries. GSM coverage in Northwest Russia is also far from satisfactory, which can be verified by looking at the map in Figure 5.8. There are still densely populated areas that are not sufficiently covered. Notwithstanding the existing potential, it is difficult to expect better GSM coverage in Northwest Russia, due to the substantial investments required to extend coverage further to areas with very low sales potential because of the low density of population and purchasing power in these areas. Therefore, it is possible to imagine that there could be a place for the development and implementation of new technologies compatible with GSM or other modern standards and suitable for covering large rural areas with substantially lower initial financial outlays[17]. Northwest Russia could be a test field for this new standard, which

Figure 5.8 GSM Coverage in Northwest Russia



Source: Companies' data

[17] The lower frequency standards, GSM 400 or CDMA 450, could be considered here. A study made for the World Bank/International Finance Corporation in 1999 forecasted a world-wide GSM400 total subscriber number of some 25 million five years after launch. This corresponds to five-year cumulative market of about US$10 billion, which should be sufficient for a small equipment manufacturer to be interested in.

potentially could have markets all over Russia, and also in many other areas of the world with low population density.

The development of this kind of means of communication could be strategically important for Russia and the Northwest region, in particular due to an obvious need to develop forest and mineral resources in large, sparsely populated areas in the near future. The inability to provide this kind of infrastructural support could leave large areas underdeveloped.

The Megafon[18] project, launched by Telecominvest, could be important for future ICT development in Northwest Russia. It could also be a necessary facilitator for local business, as Telecominvest is planning to utilize local technologies and know-how in this project. For example, the billing systems are supplied by the St. Petersburg based Peterservice. Participation of the local suppliers in a Russia-wide project could facilitate user-producer relations and lead to sophisticated advantages for both suppliers and telecommunications companies in the region.

5.5 Production of Telecommunications Equipment

In the Soviet period Northwest Russia, and St. Petersburg in particular, became the center for the development and manufacture of industrial and consumer electronics. Substantial investments were made in electronic and telecommunications engineering. One of the areas in which significant efforts were concentrated was the manufacture of military applications. Large scientific and manufacturing organizations were established, with headquarters located in St. Petersburg, such as Krasnaya Zarya (telecommunications equipment), Svetlana (microelectronics and vacuum tubes), Kozitskogo plant (TV sets) and Pozitron (components and TV equipment).

According to the policy of regional industrial development implemented by the Soviet planning system, specialized educational and scientific research organizations were integrated into manufacturing organizations. As a result, Northwest Russia had a high concentration of specialized R&D and higher educational facilities. The main R&D organizations were NII[19] Radio, which provided research and development in the field of radio communications, NII Sviazy (also known as LONIIS), which

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[18] Megafon is an all-Russia GSM project with main shareholders Sonera, Telia, Telecominvest and CT-Mobile. At the beginning of 2002, Megafon acquired GSM licenses for 100% of the Russian territory. Telecominvest holding includes 32 telecommunications firms.

[19] NII is a widely used Russian acronym for *Scientific Research Institute.*

conducted research and development in telephone communications, and Gyprosvyaz, which designed almost a half of the communication networks in Russia. The advanced educational institutions of St. Petersburg, such as the St. Petersburg University of Telecommunications, named after Bonch-Bruevich, the Military Academy of Communications, the St. Petersburg State Polytechnic University (Leningrad Polytechnics at that period), and the St. Petersburg Electro Technical University provided specialists to the enterprises and scientific research institutes of this industry.

These sophisticated scientific and manufacturing organizations suffered greatly during the period of perestroika and the break-up of the Soviet Union. They lost their subdivisions in those parts of the Soviet Union which became independent and introduced trade barriers, and they also lost the majority of their clients and suppliers due to changes in product allocation from state planning to the market-based as a result of reforms. For example, of the large scientific and manufacturing association Krasnaya Zarya, which supplied almost the whole Soviet Union and some former Soviet republics with exchange equipment, only the head company in St. Petersburg remained.

Box 5.2 The Development of Krasnaya Zarya – Mirror of the ICT Industries in Russia

The history of the Krasnaya Zarya industrial complex dates back to 1897, when a telephone factory was built by Ericsson in St. Petersburg. The enterprise specialized in the manufacture of exchanges and devices for telephone networks. The name Krasnaya Zarya was given to the plant in 1922 after the October revolution and nationalization. During the Soviet period, it became the leading manufacturer of exchange equipment, with a large number of affiliated organizations all over the USSR. By the end of the 1980s, the company produced up to 800,000 ports annually.

After the collapse of the Soviet Union, the company lost a major part of its markets and a number of production subdivisions located in the Soviet republics that became independent. As a result, the enterprise's output decreased rapidly, and in 2000 accounted for just 83,000 ports.

In order survive the crisis the company initiated a number of projects for the joint production of digital equipment. For instance, one of the projects involved the joint production of digital exchanges with global leader Nokia. However, gaps in Russian legislation and problems with the business environment made it more profitable to sell exchanges manufactured abroad. Accordingly, the products made in Russia were exported to Finland and then re-imported to Russia. The major product of the company today is the domestically developed digital exchange Kvazar, which however looses in comparison to similar products by foreign competitors.

Moreover, these companies were suddenly forced to compete on the open market, and to offer internationally competitive solutions and services, which were beyond their abilities and existing skills. The technology race that increased its pace at the same time in the global market made their efforts and facilities very quickly obsolete, as they were not able to invest heavily, nor was there sufficient market and government support available. Today, however, the growing concentration of ICT industries in Northwest Russia creates an option for their further development in the region on the new grounds, i.e. as niche players or as assembly and parts producers.

The world's booming information and telecommunications technologies markets in the late 90s spread into Russia, as well. The mobile communications, data transmission, Internet access and other modern services took off here. Local manufacturers were completely overwhelmed by international competitors that offered breakthrough solutions with ever-increasing speed. Under these circumstances, local producers concentrated on smaller niche markets of specialized equipment and software. New startups and spin-offs from the old, Soviet companies had no problem hiring professionals, who were leaving older R&D organizations and plants in great numbers. On the other hand assembly operations never developed notwithstanding existing basis owing to inefficient customs and bureaucracy as well as prohibitive taxation.

At present, there are three main types of telecommunications equipment manufacturers in Northwest Russia:

- Companies, which have inherited the assets of the scientific and manufacturing associations from the Soviet period. As these companies were burdened by large assets in their possession (maintenance costs, asset taxes etc), they turned out to be unable to invest in upgrading and development of new products. At present, they are normally not able to offer competitive products and solutions. A typical example of such companies is Krasnaya Zarya. Though it was once a leader in telecom-

Table 5.6 Old Manufacturers of Telecommunications Equipment in Northwest Russia

Company	*Products*
Krasnaya Zarya	Exchange equipment
Inteltex	Office exchange equipment, switching equipment, military solutions

Source: NWMG Co (Northwest Media Group), "St. Petersburg Telecom. Telecommunications Encyclopedia", 2001

munications manufacture in the past, today it fails to offer competitive equipment to its customers.

- Companies founded by specialists who left various R&D organizations and science-and-production associations. These are spin-offs, which managed to organize the production of certain types of modern equipment on the basis of their founders' skills and knowledge, and the use of advanced technologies (including imported technologies). As they normally concentrated their efforts on the use of new technologies, the companies in this group managed to occupy their niches in the domestic market, and are successfully functioning today.

Table 5.7 New Manufactures (Spin-offs)

Company	*Products*
SuperTel	Equipment for data transmission lines
Perspektivnye Tekhnologii	Components for fiber-optic networks
Opten	Fiber-optic cables
Bercut	Soft/hardware systems for telecommunications networks

Source: NWMG Co (Northwest Media Group), "St. Petersburg Telecom. Telecommunications Encyclopedia", 2001

- Joint ventures or subsidiaries of western telecommunications companies.

Table 5.8 Joint Ventures and Foreign Subsidiaries

Company	*Products*
Lucent Technologies, St. Petersburg plant	5ESS Digital exchanges
Elcoteq	Electronic Manufacturing Services
NEC Neva Commutatsionnye Sistemy	NEAX 61 Digital Exchanges

Source: NWMG Co (Northwest Media Group), "St. Petersburg Telecom. Telecommunications Encyclopedia", 2001

In addition to these, there are companies that produce specialized software for telecommunications equipment and communication networks.

The growth in the final demand for telecommunications services and primarily for mobile communications, led to substantial investments and corresponding growth in demand for telecommunications equipment. Such an increase in demand, together with the remaining educational and research infrastructure and the inherited industrial capital, creates preconditions for gradual recovery in ICT equipment manufacture in Northwest Russia, provided that the other essential industrial policy issues are duly handled, i.e. facilitated integration into global networks and associated infrastructure development, improvements in the investment climate, training and education, support of basic research, etc.

5.6 Information Technologies

The history of information technologies development in Russia was very unusual. Cybernetics was declared a pseudo-science by the Soviet government in the 1930s as a result of political intrigues. This led to a cutting back in resources targeted for the development of the IT and even prosecution of leading scientists and professionals, and predetermined Russia's lag in development in information technologies.

Only in the 1960s, did leading Soviet mathematicians succeed in restoring the favorable attitude of the government leaders towards the field of cybernetics. This was also facilitated by the fact that the development of information technologies was necessary for the military industry, which had the highest priority in scientific and industrial development of the Soviet Union. However, the decades of disfavor negatively impacted the IT industry in Russia, and in many sectors, e.g. personal computers, the country was not able to catch up in the technology race. Only the software development industry, backed by the traditionally strong Russian school of mathematics, succeeded in reaching the technological levels of the world leaders.

The availability of qualified personnel and know-how in information technologies resulted in the appearance of a large number of software developers in the early 1990s. Many of them were able to introduce competitive products not only on the local, but also on the international market.

Today software development is one of the most productive and rapidly growing sectors of the Russian economy. In 2000, labor productivity showed as much as 38% of the productivity level in the USA, whereas the average level in Russia was 18%, and in project programming was as

high as 72% of the same index in the USA[20]. The size of the offshore programming market in Russia reached $154 million in 2001 and is forecasted to grow 50% annually in coming years.

It was shown above (Figure 4.3) that the main centers for software development in Russia are the cities of St. Petersburg, Moscow and Novosibirsk. St. Petersburg is considered to have the most favorable conditions for the development of the IT sector due to:

- Availability of qualified personnel;
- Lower cost of living, and consequently, lower average salary level, than in Moscow.

The main factor underlying the success of St. Petersburg in information technologies is its educational system. Specialists for the IT industry are trained in many institutions of higher learning in St. Petersburg. The following five are the leading Universities:

- The State University,
- The State Polytechnic University
- The Electro Technical University
- The State University for Aerospace Instrumentation.
- The State Institute of Fine Mechanics and Optics

The high educational level of St. Petersburg universities is regularly confirmed in international competitions. At the prestigious International Programming Contest (March, 2001, Vancouver, Canada) the teams from St. Petersburg State University and St. Petersburg State Institute of Fine Mechanics and Optics won the first and the third places, respectively.

Taking advantage of this, many IT companies were founded on the basis of university departments. It gives them opportunities both to employ highly qualified University staff, and to prepare young personnel, implementing special education programs and choosing the best students. Many leading software developers in Northwest Russia implement such strategies. Among them are Lanit Tercom (the leading software developer in St. Petersburg, founded at the St. Petersburg State University), Astrosoft and XJ Technologies (founded at the St. Petersburg State Polytechnic University), etc.

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[20] McKinsey Global Institute, "Unlocking Economic Growth in Russia", 2000.

Box 5.3 Lanit Tercom – One of the Leading IT Companies in Northwest Russia

The company grew out of the System Programming Department (Mathematics and Mechanics Faculty) of the St. Petersburg State University, headed by the chief of department, professor Andrey Terehov.

The utilization of the resources of the Mathematics and Mechanical Department gave the company an opportunity to use the knowledge and scientific background accumulated in the department during the decades of the Faculty's history. Moreover, the company has acquired a virtual monopoly over the highly qualified and talented staff - the teaching and research staff, as well as the best graduates of the department.

At the moment, there is no clear boundary between the educational organization and the private company. Almost all teaching staff of the System Programming Department work for the company. The most talented students of the department are engaged in the company's projects within the framework of practical research (included in the curriculum) starting from 2nd –3rd years of education. Such symbiosis is gainful both for the company and the department. The latter receives financial support and the opportunity to place its students in a job. Lanit Tercom is able, in turn, to prepare qualified personnel and to use the renowned name of the department in its marketing policy.

Taking advantage of the qualified and readily available labor force, a number of well-known international companies have opened software development centers in St. Petersburg. In 1997, Motorola opened its development center in St. Petersburg. The R&D department of Lucent Technologies has been successfully operating in St. Petersburg for some time already. The list also includes Scala, LG, Siemens, Alcatel, etc.

However, these are only the well-known software centers in St. Petersburg. In fact, there is no full information on the activity of foreign participants in establishing software development centers in the city. Estimates show that there are about 20 such companies. These include both software developers and technology companies that need in-house software development. The growing scale and number of such operations is evidence of the high efficacy of software production based in St Petersburg.

Below we will analyze both competitive advantages, which fuel the development of IT industry in the Northwest (human capital, R&D and educational infrastructure, etc.), and the primary obstacles that hinder the further growth of local software producers and their integration into global networks. Among the main obstacles here we could mention the

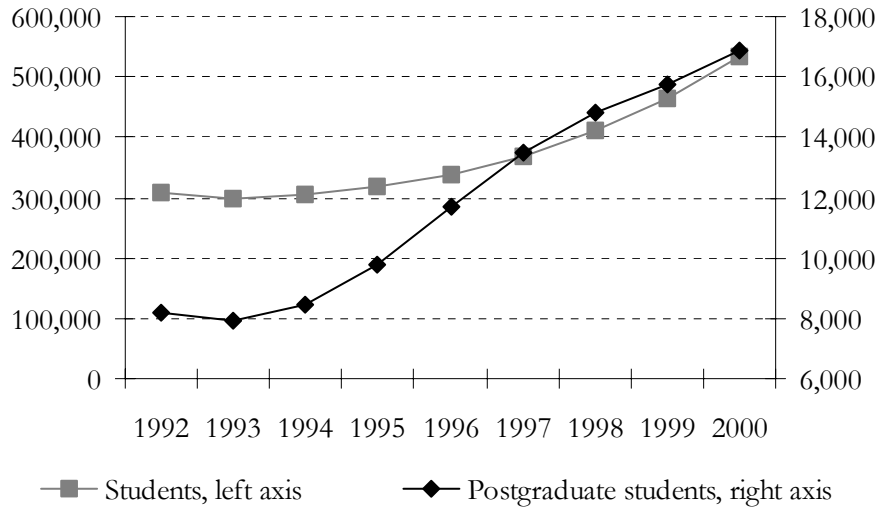
absence of a targeted policy for the software development industry, and offshore programming in particular. This negatively influences the investment climate in the industry and the integration process.

5.7 Education and R&D

Northwest Russia historically has had a strong educational system. It was in St. Petersburg that the first Russian university was founded, in 1724. A number of technical universities were founded here in the late 19th and early 20th centuries. These educational institutions created a foundation for the development of an infrastructure of higher technical training, which was carried out within the framework of the creation of an electronics manufacturing complex in Northwest Russia. Significant investments into the educational sector provided industries with an increasing inflow of qualified personnel.

The educational system in Northwest Russia suffered less dramatically than manufacturing industries during the transition period. Many institutions of higher learning in the region were able to adjust their educational programs to the demands of the market and now provide an increasing number of students (graduate and postgraduate) with internationally competitive training. We can see from Figure 5.9 that the overall

Figure 5.9 The Number of Students and Postgraduate Students in Northwest Russia



Source: Goscomstat, 2002

number of students and postgraduate students is growing continually in Northwest Russia.

Nevertheless, many talented graduates leave Russia to work in international companies abroad. This may be associated with fact that salaries and working conditions that the domestic job-market offers to these young professionals fall far short of those which developed countries are able to offer them. A positive aspect of this phenomenon is the fact that efficient networks and links are created between international companies that employ Russian immigrants and Russian students and professionals who decide to stay in Russia. It is anticipated that this process could be a major facilitator of the development of local ICT industries in the future.

The development of IT industries in the region creates a considerable demand for specialized qualified personnel. At present, the technical universities and high schools of the Northwest Russia train up to 2,000 computer programmers annually, of which about 1,000 receive a prestigious and internationally recognized education at the most renowned schools. The inflow of professionals from these schools, and a growing economic infrastructure has made St. Petersburg the leading Russian center of offshore programming. A detailed examination of the structure of ICT-related higher education will follow in the special study "Growth of Human Resources".

Institutions of higher learning that specialize in telecommunications have also revised their educational curriculum and offer students a program that meets the requirements of the rapidly developing domestic companies. The availability of well-trained personnel, and the concentration of the market in St. Petersburg (the merger of the regional Northwest wire operators, the Megafon project, etc.), leads to further specialization and agglomeration of knowledge and skill-based activities in the region[21].

St. Petersburg has also inherited a highly developed research and science infrastructure. It is now one of the key Russian R&D centers. This infrastructure grew up throughout the 20th century simultaneously with the growth of technology-based industries. As a result, up to 600 organizations were operating in the sphere of R&D in different industries in Northwest Russia in 1992, with 233,000 employees.

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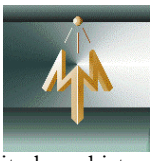
[21] These are mobile telecommunications, digital telephony, data transmission, etc.

Box 5.4 The Department of Mathematics and Mechanics of St. Petersburg State University – the Highest Quality IT Educational Program in Russia



The Department of Mathematics and Mechanics of St. Petersburg State University is the oldest educational institution for mathematical sciences in Russia. Such distinguished scientists as L. Eiler, N. Bernoulli, P. Chebishev, A. Markov, L. Kantorovich, and others, have been part of the faculty during its long history. The professors of the department received numerous rewards, and L. Kantorovich won the Nobel Prize in economics for his contribution to the theory of optimal allocation of resources.

With the advent of computer sciences, the department began to excel in this area, as well. As a result, the department has won various prizes in international competitions for several years, and in 2000 and 2001 took first place in the International Collegiate Programming Competition.

The department selects the most gifted and talented high-school mathematics students. It maintains close relations with the leading specialized schools in physics and mathematics, and is therefore able to attract the most promising of them before they graduate. In addition, a highly competitive entrance examination guarantees the admittance of only the brightest students of mathematical sciences. Thus, the department is able to implement a very difficult curriculum and ensure the highest standards of education.

Research and development activity in ICT was forced to restructure substantially during the period of transition, when demand and resource allocation shifted to open market mechanisms. The number of personnel involved in research and development dropped dramatically between 1992 and 1999, and some research organizations even closed down.

The R&D for ICT industries declined, as did the rest of the economy during the transition period. However, the decline here was not as dramatic as it was in R&D for other industries, for example in the forest and base metal industries, in which R&D activity came virtually to a halt. The key ICT R&D organizations, such as NII Radio, LONIIS, and Giprosvyaz, survived and continue to operate in their respective spheres of specialization although the volume of their R&D activity has substantially decreased. There are also spin-off companies specializing in R&D activity, which are rapidly developing, due to better flexibility and entrepreneurship.

Box 5.5 LONIIS – the Leading R&D Institute in the Sphere of Telecommunications in Northwest of Russia

The history of LONIIS dates back to 1909, when a research laboratory was founded at the St. Petersburg Telegraph Company. Later, the institute became the leading research organization for telecommunications in Russia. The areas of research at the institute included the design of exchange equipment and the development of long-distance telephony equipment. The institute designed the first Russian decade and coordinate exchanges. Subsequently, the institute extended its sphere of research to cable, user terminals, and telephone acoustics.

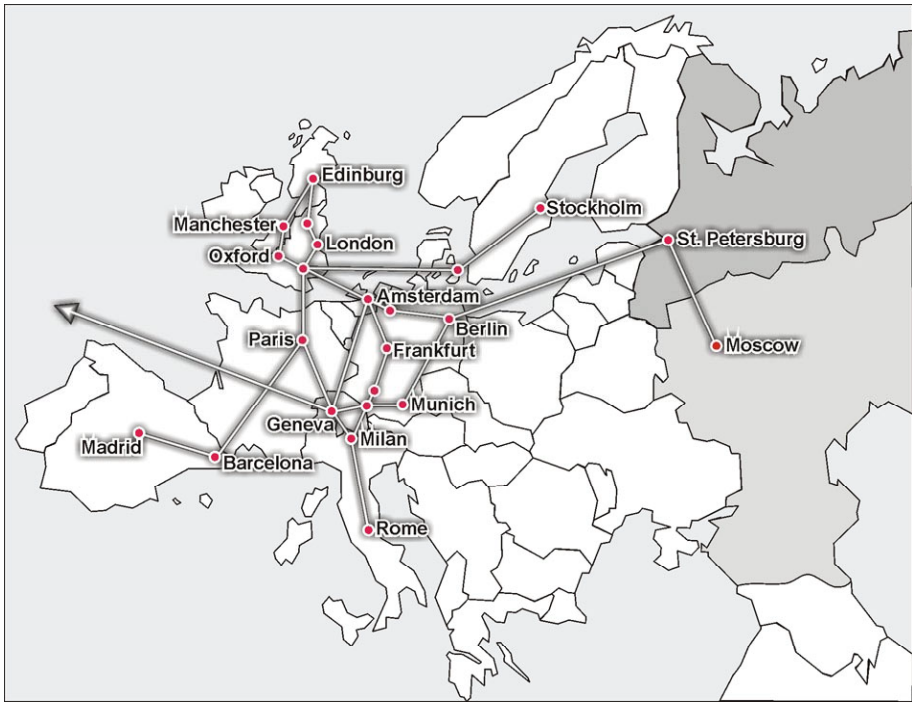
In the early 90s, the institute faced financial difficulties, as a result of a sharp drop in government financing during the period of transition. Like in many other R&D organizations, professional employees began leaving LONIIS, and many promising projects were closed due to the lack of financial backing.

In the new economic environment, the institute began to initiate involvement with international manufacturers. One of the main roles of the institute today is the licensing and adaptation of foreign equipment to Russian networks. However, the institute's own research and design work has not altogether ceased. Recently, the institute has initiated a number of individual and cooperative developments, such as the ATSC-90 digital exchange, exchange equipment for rural areas, etc. However, the level of R&D activity is much lower than during the Soviet period, since large investments are required to maintain an intensive research process.

St. Petersburg is more than just one of the key Russian educational and R&D centers: the city was founded as Russia's "window to Europe" and in the fields of science and research inherited this historical role. As we see from Figure 5.10, the city is now the primary link between Russia and the rest of the world in scientific endeavors, which is evident from numerous cooperative projects and co-authorship relations.

It is anticipated, that the further development of ICT markets outlined in the previous sections would facilitate further focusing of education and R&D on the most important areas for improving competitiveness of ICT cluster in Northwest Russia. It is also clear that easing the evolution of education and product development shall be one of the primary goals of industrial policy makers regionally, as well as on the federal level, if the historical and the existing potential of the Northwest is to be preserved and developed.

Figure 5.10 Co-authorship Relations



Note: The map represents the strongest connections between main academic centers in terms of co-authorship

Source: "Gateways to the Global Economy" (eds) Ake E. Andersson and David E. Andersson, Phasis, Moscow

5.8 Media and New Media

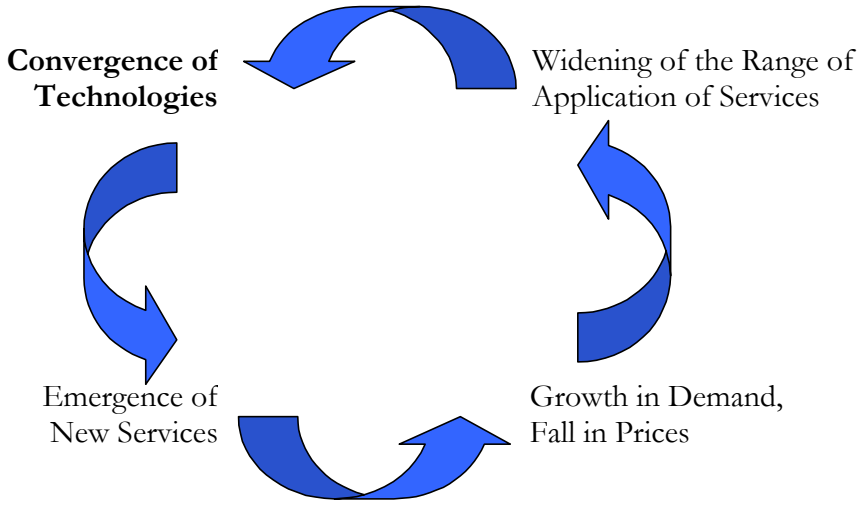
The convergence of information, communication technologies, and the media is one of the main tendencies in the further development of ICT industries. This process leads to the emergence of the new products and services, which in turn create additional demand, and thus stimulates the growth of the cluster.

In this chapter, we examine the media industry, as it is one of the most important related sectors. The history of the media in the region and the main processes of convergence are described.

The history of Russian media began in St. Petersburg. The city has always been a scientific and cultural center of Russia, as it was here that the leading Russian scientists worked and the first Russian university was founded. This explains why all major discoveries and the implementation

of new technologies before the revolution of 1917 took place in St. Petersburg.

Figure 5.11 Cycle of New Media Technologies



On May 7, 1895, professor Alexander Popov of Petersburg University demonstrated the world's first radio. Subsequently, Popov's research led to the invention of radiolocation and the development of applied radio technologies. The first mass-production of radios began in St. Petersburg in 1907. M. Bonch-Bruevich constructed the first electron tube in Russia in 1915, which initiated a new era in electronic technologies. Television is considered to have its beginning when B. Rosing demonstrated the first TV-picture of acceptable quality, and this event also took place in St. Petersburg. Even the term "television" first appeared here, instead of the term "longvision" that was prevalent in other countries.

In the mid 1920s, the first experimental radio broadcasting began in several large Russian cities, including St. Petersburg. Soon after, mass-market radios appeared on the market, and radio became a popular phenomenon. Regular radio broadcasting began in 1925.

At the same time, several research institutions began experimenting with TV broadcasting. In the beginning of the 1930s, the St. Petersburg Kozitsky plant began production of disk TV-receivers and this stimulated the spread of TV-broadcasting services. In 1936 regular TV broadcasting began in St. Petersburg.

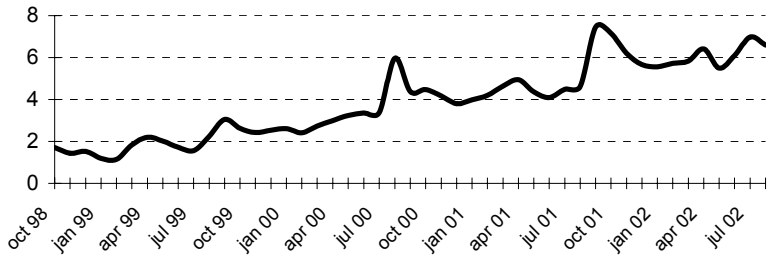
Box 5.6 News Portal www.rbc.ru

www.rbc.ru, the leading news portal in Russia, was established in 1994. It was the first to provide news line, i.e. on-the-fly updated main page describing almost every event in Russia and in the world as soon as it became known.

Information was provided by «RosBusinessConsulting» agency (RBC). It also provided financial and economic data. The site visitors received access not only to news but also to various analytical reports and studies. It significantly added to differentiation of this portal. Owing to the higher speed of information update, accessibility and analytical materials, the site gained popularity among the Russian Internet users.

The Russian Internet audience growth in the end of 1990s was accompanied by increase in the site visits (hits). At that time the RBC company added to the portal specialized information resources devoted to various subjects (sport, education, IT etc.) thus widening available content.

Figure 5.12 The www.rbc.ru Users Activity Dynamics (million hits)



The vivid example proving the news portals advantages is the explosion of visits in the period of intense interest in news (the tragedy of the Russian atomic-powered vessel Kursk in August, 2000, the US terrorist attack of September 11, 2001, etc). The Internet sources gave the opportunity to receive the topical information about events in a quick manner while the traditional media provided the information with a significant time lag.

From the late 1940s to 1960s, however, the further spread of TV and radio broadcasting was impeded by a sizable deficit of TVs and radios. World War II reoriented Russian industries towards military needs, and as a result, TV made very little headway in the 1950-1960s.

In the 1970s, the manufacture of new types of televisions and radios based on semiconductors began. This led to a boom in TV and radio at the beginning of the 1980s. Every large city or region had its own channel for local news and events. However, the development of mass media was limited by 100% state ownership and the strict content regulation and censorship.

After the collapse of the Soviet Union, the censorship was abolished, and new, liberal mass media laws were passed. Such changes made possible the privatization of state-owned TV channels and radio stations, launching new independent TV and radio companies and a large number of newspapers and magazines. At the moment, however, the development of this so-called traditional media, is to a large degree limited by the deterioration of the related infrastructure. Media companies have scarce investment resources and have not been able to upgrade. The state still runs a countrywide broadcasting network that is old and out-dated as well as newspaper printing (it is also subsidized by government that keeps printing costs low) that is also not competitive.

At the same time, the development and spread of information and communication technologies in the mid-1990s, led to the emergence of the new media, the first of these being Internet news portals – virtual newspapers. We believe that the new media in Russia will develop at a greater pace than in western countries, due to a number of advantages that is has if compared to traditional media.

The major advantages of the new media over traditional media are:

- Easy and convenient access;
- Regular information updating;
- Mixed content (text, audio and video, graphics);
- More flexible set of services (including interactive features).

Today, the leading Russian portals have about the same turnover as large regional traditional newspapers and successfully compete even with TV news programs. In chapter six, we will analyze the advantages and possible future role of the new media in Russia in more detail.

It also deserves mentioning that Russian legislation does not include any regulatory acts for controlling or restricting the new media. It was only in 2002 that frequently updated Internet sites were required to become licensed as traditional newspapers. The lack of regulation might be considered as an additional advantage, because it renders new media more independent of government influence, lowers entry barriers, thus allowing more room for competition and bright ideas. On the other hand entry barriers for the traditional media are still very high and limit greatly the opportunities for outsiders.

The active convergence of information, telecommunications technologies and the media has resulted in the emergence of new services on the market. Cable TV companies are beginning to provide high-speed Internet access; TV and radio stations broadcast through the web, etc.

This process is in its beginning phase, and such services are not yet very popular. For example, out of fourteen TV channels available in the Northwest region, only three have interactive features and web pages. However, a number of new services (such as digital interactive television, video-on-demand, etc.) are expected to appear on the market soon.

Box 5.7 Telemedium – the First Russian Digital Television Provider

Telemedium company was established in 1998 in order to accomplish the project on digital TV broadcasting organization in St. Petersburg. The first experimental broadcasting started in 2000. In June 2002 the company was the first to start commercial broadcasting in digital format in Russia covering the territory of Saint-Petersburg and the near suburbs. Broadcasting is organized in the DVB-T format while the reception is based on the regular aerial and special converter.

The major advantages of digital TV are the high image and sound quality, significant saving of air frequency resources for other uses and extended capabilities (interactive TV, data transfer, access to the Internet, etc). It distinguishes this offering from the competitive technologies (cable TV, satellite broadcasting) where the same options are possible but more expensive and with lower quality.

By the end of September, 2002 the company has subscribed 500 people while the plans for 2003 include 3 thousand clients. However at present the company is able to offer only a few channels. It keeps the company from competing with cable and satellite networks as equals.

In chapter six, we will also emphasize the main obstacles for the further development of the new media. These are, for example, the low rate of Internet and broadband access and the low quality of the last-mile telecommunications infrastructure. Also, the limited scale of business and lack of competition keep prices for the services high. Thus, most new services are in the first stage of their development on the market, if we consider the cycle of development of new services in Figure 5.12.

Nevertheless, new media services are expected to be the main engines for the development of ICT industries in the future. St. Petersburg is considered to be the cultural capital of Russia and a greater demand as well as opportunities and capabilities for providing new content can be expected here. Today, there is a place for new participants in the new media market of Northwest Russia, and there is a need for improved in-

vestment and business climate in order to attract new companies and stimulate the development of the sector.

5.9 Other Industries

We have considered the major industries of the Northwest Russian ICT cluster above. However there are a number of other industries, role of which in the cluster is less significant but also worth discussing. In this part we will consider the following elements of the cluster:

- Distribution chains;
- Equity market;
- Consumer electronics production.

Distribution chains have a significant impact on the whole cluster development. Having emerged in 1990s when a series of telecommunications companies passed the distribution of their services to the independent dealers, this sector gradually transformed into the separate business.

In the beginning the Northwest Russian telecommunications services distribution was carried out by a great number of small organizations. However the large chains (including more than 10 outlets) started to emerge within the sector as the ICT markets developed. They initiated acquisitions and evaporation from the market of smaller players. At present this process continues while the distribution is divided mainly between the major local trade chains and Moscow-based companies entering the Northwest Russian market.

Box 5.8 UltraStar –
Cellular Communications Distribution Chain

UltraStar Company was established in 1988. It consists of 3 departments: telecommunications, complex security issues and car intruder alarms. The emergence and development of mobile communication operators in Northwest Russia focused company on the distribution of their services and related equipment (e.g. user terminals, cellular accessories, etc) and development of its our distribution network.

At present the company's chain makes up more than 15 retail stores and this is the leading distribution chain on this market. The company's staff makes up more than 500. The company is the official distributor of a wide range of mobile phones and accessories producers. It has an agreement on the services distribution with all major local cellular communication operators.

The development of this business has a positive impact on the whole cluster growth. At present there are more than 200 outlets in St. Petersburg offering the mobile phones, subscription for local telecommunications operators etc. It facilitates access to the market for new players as well as the existing markets development.

The financial market also plays an important role in the ICT cluster growth. The emergence of the Russian stock market dates back to 1991. However it started to operate in a stable way in mid–1990s when the RTS stock exchange was established and absorbed separate regional exchanges. At present RTS handles the significant part of domestic and foreign investors trading in Russian stocks (there are more than 400 listed stocks at the RTS today). Besides there are several major regional stock exchanges (Moscow, St. Petersburg) that handle also the ICT stocks trading.

The Russian stock market is characterized by high volatility, low efficiency and low liquidity. Investors consider it to be of high risk and therefore the majority of the stocks are traded at low valuations to offset risks. The main part of trading volume in Russian exchanges concentrate on the energy companies stocks with less attention paid to the telecommunications companies. For example during the first 9 months in 2002 the average stock trading volume of the largest wire operator in Northwest Russia (North-West Telecom) reached just USD 70,000 per day.

Box 5.9 IPO on the Russian Stock Market. RosBusinessConsulting Company

RosBusinessConsulting Company (RBC) was established in 1993 as the information agency. Later RBC started offering not only information services but also analytical products concerning the Russian and CIS markets. The company's main office is located in Moscow delivering services to customers in CIS, Europe and North America.

At present RBC provides also consulting, PR, marketing and advertising services. The company's IT department develops ERP and CRM software products, participates in e-business projects and provides full range of Internet solutions and consulting services. The company's turnover accounted for USD 17 mln in 2001 and according to the forecast it will show 54% growth in 2002.

RBC was the first in Russia to go through IPO on the Russian market in April, 2002. The two main Russian exchanges: RTS (Russian Trading System – a computer-based, NASDAQ type trading) and MICEX (Moscow Interbank Currency Exchange – a conventional type of exchange) were selected for the placement. Having issued 16% of stocks, the company received more than $13,28 mln, that is considered as a big success if the timing and ratio of actual price to earnings is taken into account.

The low efficiency of the local equity market impedes its active use as a tool for fund raising. There is the only one example of the ICT company's IPO at the Russian stock exchange (see Box RosBusinessConsulting). Many other companies either seek other sources of investment resources or list their stocks at the major international exchanges (thus, MTS and Vympelkom, the major mobile communication operators in Russia, are listed at NYSE[22] through ADR's – American depositary receipts).

Among the related industries consumer electronics production plays an important role. Since the beginning of the last century the Northwest region was the consumer electronics production center in Russia. In this very region the first Russian radio and television set were produced at the Kozitsky factory (it was Siemens and Halske plant before 1917). Moreover, the first semiconductor radio and color TV were put into production here. During the development of radio electronics industry in Northwest Russia the enterprises producing TV sets were founded in Novgorod and Pskov.

However after the Soviet Union collapse the consumer electronics producers faced the problems similar to those considered above for the telecommunications equipment producers. The obsolete technology, low efficiency of production and lack of competitive products etc, didn't allow local producers to equally compete with the Western companies. The locally produced goods held their position for some time due to the lower prices and brand recognition. Unfortunately the rapidly increasing operating costs, inefficient production facilities and management, and inability to reach economies of scale eliminated this advantage by mid 1990s.

Thus the TV sets production in Russia fell dramatically during 1990-1996 (see Figure 5.13). The similar situation may be observed in other segments of the consumer electronics market. The local industry crisis was aggravated by the strong consumer attitude to the domestic industry products as low quality and obsolete.

The use of imported components became the way out of the predicament for the local companies. Following this strategy the companies increased TV sets production (see Figure 5.13.). Besides, the companies specialized in assembling PC´s started to emerge motivated by steady growth in demand and possibility to gain flexibility and cost advantages due to lower costs and customs for parts and components. It evidences that this industry possesses the potential for the development requiring certain efforts of governmental bodies in order to exploit this potential.

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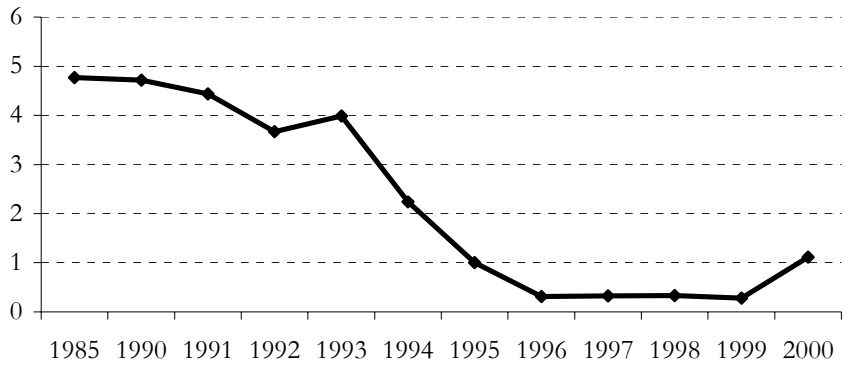
[22] NYSE – New York Stock Exchange.

Figure 5.13 TV Sets Production Volume in Russia, million



Source: Goscomstat, 2001

Besides the described industries, there is a number of those that could also be examined within the Northwest Russian ICT cluster. However we have already considered the main elements of the cluster and below we proceed to the analysis of cluster's competitiveness factors influencing its current development and being able to serve as a basis for its sustainable growth.

6 Factors of Competitiveness

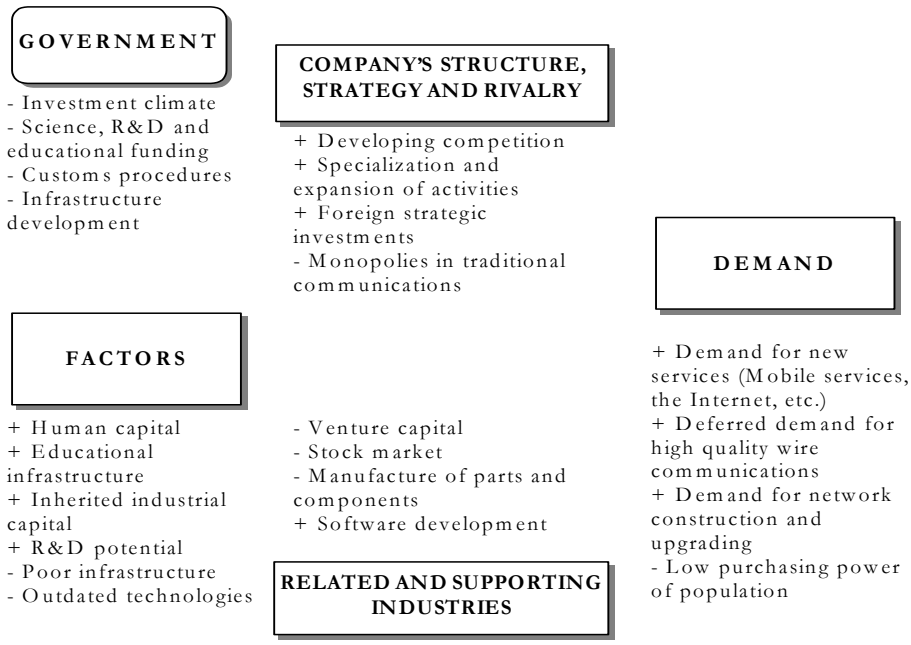
In the preceding chapters, we described the general structure of the Northwest Russian ICT cluster. We also examined the current state and dynamics of development of its main components. In this chapter, we will attempt to determine and analyze factors that can be considered a basis for the creation of competitive clusters, and encourage the emergence of competitive producers on the basis of existing prerequisites. We have used Porter's "Diamond" as a methodological basis for this analysis.

In the analysis of competitive advantages we used available statistics and primarily information collected from case studies. We have agreed not to disclose the names of respondents and companies in this publication, in order to guarantee unbiased and open discussion during the survey. The case studies were carried out as structured interviews with selected executives of the companies. The results of the case studies are presented in the text below, and outline various opportunities, bottlenecks and obstacles to achieving sustainable growth and competitiveness in the ICT cluster in Northwest Russia.

Figure 6.1 shows the major factors of competitiveness established by the research. The competitiveness of the companies of the cluster is in the first place based on human capital, traditions and experience, as well as on a well-developed educational system, which provides a constant influx of qualified specialists into ICT industries. An important role in the development of the cluster is also played by inherited industrial capital, which may serve as a basis for the emergence of new market-oriented manufacturers.

Nevertheless, opportunities for further utilization of local production factors are limited by an unfavorable investment climate. The development of new flexible and efficient manufacturers is impossible without significant investments in facilities and the development of new products, which have thus far been inhibited by high investment risks. In order to provide for the further growth of competitiveness in the cluster, it is also necessary to invest in the development of already existing production factors, i.e. the educational system, basic and applied research, as well as the infrastructure (business and science parks, territories prepared for new production facilities, energy, telecommunications and other networks, etc.).

Figure 6.1 Factors of Competitiveness on the "Diamond" Model



The rapid development and introduction of new technologies and products, as well as the opportunity of maximum utilization of available resources, are important for the successful development of the ICT companies. In order to achieve these goals, it is necessary to provide efficient financial markets, allowing companies to gain access to financial resources at every stage of their development. The lack of an effective venture capital and financial market infrastructure in the region significantly impedes the growth of companies and the competitiveness of the cluster.

The rapidly growing domestic demand for key products and services f the cluster may become a catalyst in the growth of competitiveness of the companies of the cluster when accompanied by utilization of other factors of competitiveness, i.e. industrial capital, human resources etc. Development of competition in a range of new ICT markets has already resulted in active growth. It has allowed local companies to expand beyond the regional boundaries and to introduce their products and services onto national and international markets. However, the insufficient competition in some of the ICT services markets, as well as non-market barriers erected for new companies, hinder the growth of demand, and therefore the further development of the cluster.

The lack of modern related and supporting facilities has a negative impact in the development of the cluster. This may be compensated by the integration into production networks of well-developed and closely situated Finnish, Swedish and German ICT agglomerations. However government bureaucracy, customs barriers, and the unfavorable investment and business climate strongly discourage international collaboration and cooperation.

The experience of developed countries shows that the successful growth of innovative and research-intensive industries is possible only when a deliberate and purposeful industrial policy has been implemented. At present, there is no long-term industrial policy for the development of the ICT industries in Russia. As a result, the government actions have a largely negative impact on the development of the cluster. This is partly due to the fact that changes in legislation do not keep pace with the formation process of the ICT industries. Government bodies at all levels tend to follow short-term goals, thus creating instability, whereas the development of the cluster in fact requires a long-term approach.

A more detailed analysis of the aforementioned factors is presented below.

6.1 Factors

The production factors, which are inherent to the particular regions, form an important foundation for the competitiveness of local companies and the formation of the cluster. The uniqueness of these factors may provide a basis for the sustainable development of the industries and the achievement of global competitiveness.

In interviewing top executives, we asked that they outline the major factors in the competitiveness of their organizations in order to discover the key production factors of the competitiveness of the Northwest Russian ICT companies. Figure 6.2 shows the results of this poll.

The interviews revealed that the major competitive advantage here is *human capital*. Respondents were unanimous in this opinion.

In carrying out an in-depth analysis of the quality of human capital, we suggested that company representatives evaluate the quality of labor force available in the region, as well as the quality of their own specialists.

Figure 6.2 Key Factors of the Competitiveness of Northwest Russian ICT Companies

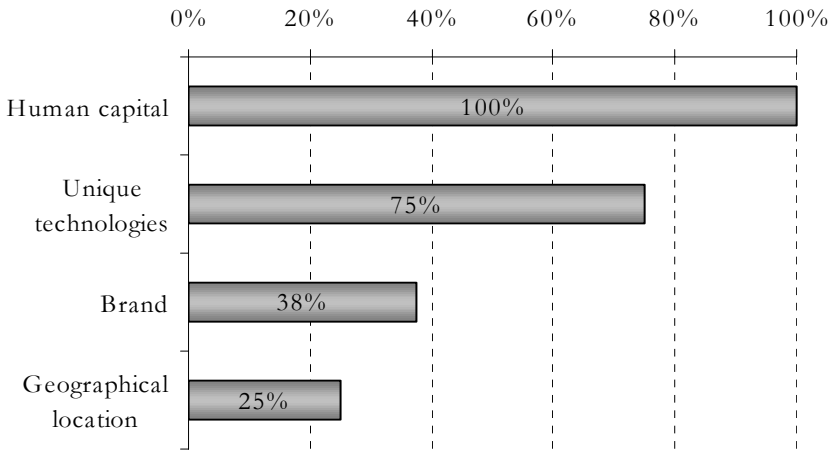
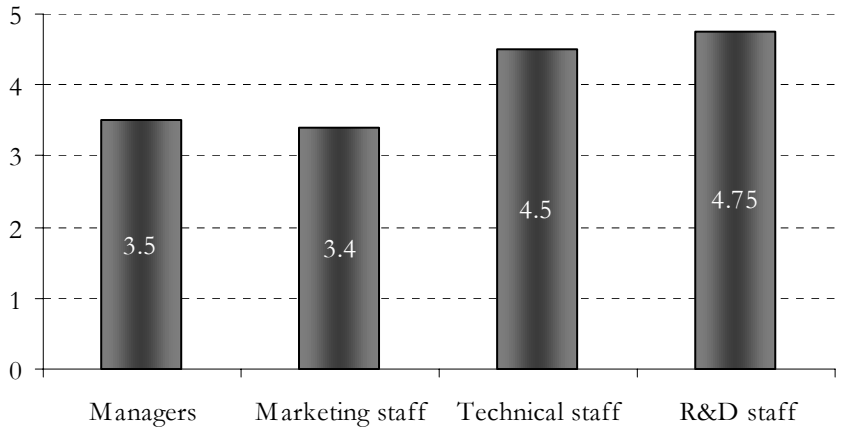


Figure 6.3 The Quality of Personnel and University Graduates in Northwest Russia

As Figure 6.3 demonstrates, 50% of the respondents evaluated the quality of the labor force available in the region as high. The majority considers the level of qualifications of local university graduates to be high, as well. This testifies to the fine quality of specialized higher education, as well as the availability of specialists with the required experience and professional skills in the region.

Figure 6.4 Assessment of the Quality of Personnel



Notes: 1) Likert Scale, 2) It should be noted that evaluations of personnel by Russian respondents were made without reference to Western standards. Such evaluations are likely to be more pessimistic when Western standards are taken into consideration.

The respondents noted that despite the generally high estimation of human capital in the region, the professionalism of managers and marketing staff is insufficient. As suggested in Figure 6.4, the quality of the personnel in the companies under examination is considered to be significantly lower than that of the technical and R&D personnel. The respondents pointed to a lack of specialists capable of conducting marketing abroad, as well as managers for large-scale projects that are carried out in collaboration with Western partners, etc.

This implies that although Northwest Russia has a well-developed system of higher education (St. Petersburg is the second largest educational center, home to more than 100 universities, of which more than sixteen train ICT specialists[23]), it has not completely adapted to the new economic environment. During the last decade, i.e. the transition to the market economy, the demand for specialists significantly changed in scale and in structure, whereas the profile of graduates of the universities has not undergone such fundamental changes.

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[23] Detailed data on specialties offered by ICT-related universities in Northwest Russia and numbers of graduates are presented below in the special study on Growth of Human Resources.

While technical education has traditionally maintained a high level, the training programs for specialists in economics, finance and marketing have not yet been fully established. Thus, we see a gap between the current needs of the companies of the cluster and the educational programs of institutions of higher learning.

At present, this discrepancy is being diminished by building ties between the companies and the leading universities. Thus, about 75% of the companies that participated in the survey have long-term agreements with local institutions of higher learning in arranging special training programs. Moreover, many local universities are anxious for close cooperation with the corporate sector.

Box 6.1 Bonch-Bruevich St. Petersburg State University of Telecommunications – a Public University that Seeks to Cooperate with Industry

This is a leading university in Northwest Russia in the sphere of telecommunications. The university was founded in 1930. The university is named after Professor Bonch-Bruevich, who in 1915 invented electronic tube, which revolutionized the radio technology. Today, it has more than seven thousand students and offers an education in more than 20 fields. The university includes 37 departments, 13 R&D laboratories, a graduate school, and experimental manufacturing departments.

A distinctive feature of the University's educational program is that total number of educational hours is divided into those determined by federal standards (the requirements stipulated by the federal program of Russia for each specialist), and those determined by the university itself. Thus, the university is able to modify educational programs according to the needs of certain companies.

At present, the university has already engaged in cooperation with large local telecommunications companies in introducing specialized lecture courses and programs. Among the local partners of the university are Megafon, Northwest Telecom, and a number of other operators. At the moment, however, these cooperative programs have a short-term focus (introduction of several special courses to seniors, internships at companies, etc). Long-term partnerships, which imply modification of the educational program in response to company requirements beginning already in the first years of study is only in the planning stages.

The university also engages in active cooperation with western educational institutions (mainly in Germany), and the best students are given the opportunity to take courses abroad, where they can acquire the necessary skills for working with the most advanced ICT technologies.

The second important factor of competitiveness that the interviewed executives underlined was unique technologies. However, comparative analysis of the level of technological development of innovative ICT companies in Northwest Russia and in developed countries shows that representatives of companies overestimate the uniqueness of their technologies. We believe, therefore, that this factor may be more appropriately defined as *R&D potential.*

The unique technologies, that unquestionably existed in large R&D institutes and enterprises before the beginning of the 1990s formed a solid foundation for the emergence and development of new industrial companies. Neither old organizations nor new companies, however, had enough investment resources for the development of existing and fundamentally new technologies.

Moreover, the majority of developments and technologies do not reach the stage of product implementation and marketing. This is once more due to the lack of competent marketing specialists in R&D promotion. There are specialists capable of inventing, but only few are able to transform these ideas into products, and there are virtually no opportunities for promoting ideas and products on the market (no venture capital and other forms of early stage financing, no public – private schemes, no focused state support of selected research areas).

As a result, we are only able to point to the existing potential for R&D at present. The regional R&D infrastructure has deteriorated dramatically, and the numbers of employees in this area has significantly decreased. It must be noted, however, that the research infrastructure in the ICT sector suffered less than in other industries, i.e. in the forest and metallurgy sectors. In the majority of large R&D institutes in the ICT industries, the research process continues, although it does not keep pace with that of Western countries, due to insufficient funding. The Ioffe Physics & Technical Institute, headed by the Nobel Prize winner Zhores Alfyorov, may be cited as an example. It continues to carry out basic research in the ICT sphere, as well. The institute is renowned worldwide for numerous achievements in such fields as optical and laser technologies.

The adoption of achievements of R&D organizations, however, is significantly hindered by their lack of experience in interacting with the corporate sector. This situation is aggravated by the underdeveloped system of financing at all levels, from initial and first round venture financing to IPO.

Almost 62% of the companies involved in our research maintain partnership with the R&D institutes. These are for the most part, however, relations between parent organizations and spin-off companies. These kinds of links between research institutes and compa-

nies seriously impede opportunities for development, because they tie developers to the needs of specific manufacturers. There are several examples of the successful adaptation of R&D institutes to new economic conditions, i.e. the Giprosvyaz design institute described in Box below. Nevertheless, such examples are few.

Box 6.2 Giprosvyaz – the Largest Russian Institute in the Sphere of Design of Telecommunications Networks

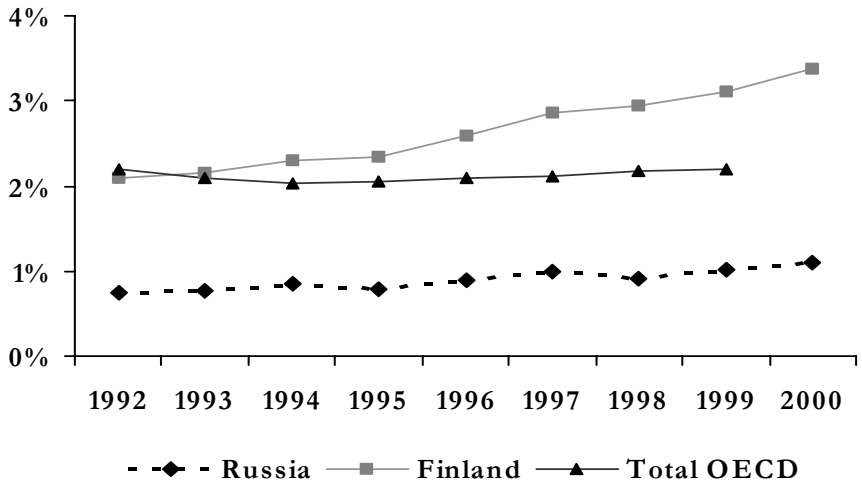
The Institute was established in 1937 as a major center for designing telecommunications networks. Since then, the institute's specialists have designed thousands facilities in the countries of the former USSR, as well as abroad. Today, about half of all telecommunications networks in Russia have been designed by the specialists of Giprosvyaz.

During the transition period, the institute lost a number of its former clients. It acquired, however, a number of new clients among the new alternative operators that appeared on the market during this period. This enabled the institute to survive and retain most of its personnel. Today, the staff of the institute includes about 350 specialists.

Presently, the institute continues to engage in active cooperation with telecommunications companies. Its clients include the largest telecommunications companies in Russia, such as cellular operators (MTS and Megafon), operators of fixed communications (Northwest Telecom, Rostelecom, Peterstar), and many others. Virtually all clients are pleased with their cooperation with the institute and plan to continue partnership relationships in the future. This suggests that the institute will remain the key organization for network design in Northwest Russia. Moreover, it plans to broaden its activities and become an engineering organization, which will not only design networks, but carry out the whole process of their construction.

Thus, it is clear that research potential has been important for the competitiveness of the cluster. It requires, however, decisive government efforts for its further development if its importance is not to dwindle even over a medium-term perspective. The most topical issue is the low level of basic science and R&D financing. As demonstrated in Figure 6.5, the level of state and corporate R&D expenditures in Russia is significantly lower than similar indexes in developed countries. Poor financing adversely affects both the scale and scope of the development of technology and the professional skills of the staff in this area. Our special study *Growth of Human Resources* presented below proves that financial limitations force the youngest and most energetic specialists to leave the research institutes to find better-paid opportunities. It also drains the R&D institutes of their potential.

Figure 6.5 R&D Expenditures, % of GDP



Source: Goscomstat (2001), *Russian Statistical Yearbook*, Statistics Finland, www.stat.fi

Inherited industrial capital is yet another important potential advantage of the Northwest Russian ICT cluster. As mentioned above, Northwest Russia was the center for electronics and telecommunications equipment production during the Soviet period. Manufacturing facilities for all stages of production of this kind of equipment were assigned to the region. During the transition period, however, many enterprises either collapsed or almost shut down their core activities for a number of reasons, i.e. the inability to compete with foreign companies on the open market, low efficiency, etc.

As a result, there is a considerable production infrastructure in the region that has been left by extinct enterprises. This infrastructure remains unused, however, because of the unfavorable investment climate, the lack of an infrastructure for international integration, the low domestic demand for obsolete products of these manufacturers, etc.

Inherited industrial capital has already served as a basis for the emergence of a range of new industrial companies. The production facilities of the majority of the spin-offs are located on premises of parent organizations. Joint ventures and branches of foreign companies also often locate their facilities at existing production complexes. Thus, the shops of the leading contract manufacturer from Finland, Elcoteq in St. Petersburg were located in the Program Management Systems plant, which formerly produced industrial electric equipment. This plant also provided

the subsidiary of another Finnish company, Asva Stalservis (subsidiary of Rautaruukki from Finland), with facilities for the customization of metal products (so called service enter), including production of casings for electronic equipment. This is a vivid example of the utilization of inherited capital, since Asva Stalservis acquired not only the premises, but also the equipment already in place, thus fully satisfying the company's needs (not more than 1% of the equipment in the shop was replaced by the new owner).

There are a number of topical issues related to the utilization of inherited industrial capital, however, primarily because it is gradually becoming outdated, thus undermining its potential utilization. There is also a lack of infrastructural development of new premises. This hampers the process of establishing new production facilities. The solution to these problems is strongly affected by the unfavorable investment climate and the lack of a purposeful industrial policy for specialized manufacturing development in Northwest Russia.

Geographical location, which was also cited by company representatives as a factor of competitiveness, reflects the advantages provided by the concentration in St. Petersburg of the aforementioned factors. Such concentration of production factors allows for reducing costs, while the concentration of demand enables the expansion of the scale of business. In addition, the geographical proximity to European countries encourages collaboration with foreign companies.

Thus, it is clear that Northwest Russia has inherited significant production factors from the Soviet period, when considerable investments were directed into the development of the educational system, the science and R&D infrastructure, as well as into industrial assets. The large volumes of these investments even resulted in overdevelopment of some factors in particular sectors (e.g. industrial assets). However, during the period of transition, these factors were poorly exploited as a result of structural problems.

Despite the substantial decrease in investments, the potential of production factors in Northwest Russia is still considerable. In order to provide for its effective exploitation, however, a purposeful industrial policy oriented toward the development of existing production factors of the cluster, as well as measures for improvement of the investment climate, are urgently needed. These measures could stimulate growth in domestic and foreign investments in activities based on the exploitation of local production factors.

6.2 Demand

The ICT markets are among the most rapidly growing in the world. Substantial investment resources are directed at the development of new technologies, products, and services. This results in continuous market growth. Therefore, demand should be considered as one of the major factors of competitiveness and a driving force for the development of the ICT industries.

One of the most vivid examples of the technology race results in the expansion of the ICT market is the processes induced by the convergence of information, telecommunications and media technologies. These processes result in the appearance of new products and services providing for the growth of new demand, and thus accelerating development of the ICT industries. Another example is the change of generations of standards of cellular telecommunications (1G (NMT/APMS) – 2G (GSM) – 2.5G (GSM+GPRS[24], EDGE[25]) – 3G (UMTS[26]) – etc), due to rapid technological development and investments in the infrastructure.

These processes are typical for the Northwest Russian ICT cluster, which has been characterized by growing demand for telecommunications services so far. Below is an analysis of current rates of increase in demand in the cluster, its further potential for growth, as well as major problems and obstacles for its development.

According to theory, the creation of product competitiveness requires the following from the demand side:

- Existence of a well-developed and capacious domestic market, supported by competition and allowing the achievement of economy of scale,
- Export opportunities for local manufacturers that are already integrated into global networks.

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[24] GPRS (General Packet Radio Service) represents the first implementation of packet switching within GSM, enable users to send and receive data at speeds of up to 115 kbit/s.

[25] EDGE (Enhanced Data for GSM Evolution) represents the final evolution of data communications within the GSM standard. EDGE uses a new modulation scheme to enable data throughput speeds of up to 384kbit/s using existing GSM infrastructure.

[26] UMTS (Universal Mobile Telecommunications System) is the European member of the IMT2000 family of third generation cellular mobile standards.

Thus, in this part of the study we will consider the dynamics and potential of the domestic demand for the main products and services of the cluster, as well as the export opportunities for local companies.

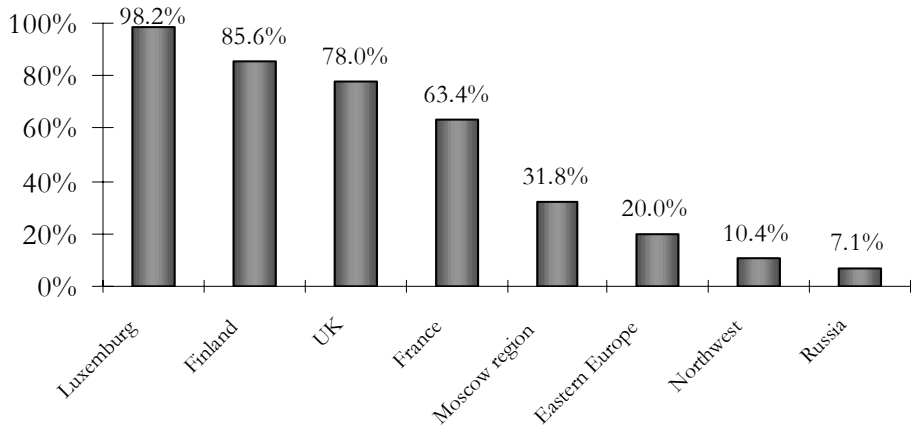
Domestic Market

The dynamics and potential of demand of the domestic market are examined within the major sub-industries of the Northwest Russian ICT cluster, i.e.:

- Mobile communications
- Internet services
- Wire communications
- Software

The *mobile communications* sector is one of the key driving forces of growth in the cluster. As shown in chapter 5, the reduction of prices for the GSM technology and the growth of competition in the Northwest Russian market resulted in a spectacular leap in demand for mobile communications services. In order to evaluate the potential of the sector's further growth, we compared data on the penetration of cellular phone use in other countries.

Figure 6.6 The Penetration Rate of Cellular Communications, March 2002



Source: EMS, Issue 161, April 2002, Author's calculations

As illustrated in Figure 6.6, the level of mobile phone penetration in Northwest Russia is significantly lower than that in developed countries. The level of developed countries is unlikely to be achieved

in the medium-term perspective in Russia. However, we estimate that within the next few years the penetration rate of cellular phone usage in Northwest Russia may reach 30-40%. The example of the Moscow region, where 31.75% of the population uses cellular phones and the market is still not saturated, justifies the assumption that such levels may be achieved in Russia.

Table 6.1 Basic Indexes of Selected Countries

Country	*Population density (persons per km²), beginning of 2001*	*GDP per capita (USD), 2000*
Northwest Russia	8.6	1,753
Russia	8.5	1,702
Bulgaria	73	1,473
Poland	124	4,078
Hungary	107	4,561
France	109	21,738
Germany	231	22,666
Finland	14	23,338
UK	245	23,694
Canada	3	23,048
Sweden	20	25,603
USA	31	36,211

Sources: ITU, Goscomstat

The majority of subscribers have been using only basic cellular networks services, i.e. voice communication and SMS[27], thus far. Nevertheless, a demand for additional services (e.g., data transmission via GSM networks, and information services) is emerging. The introduction of HSCSD[28] and GPRS technologies allowed for bringing these services to a higher quality level, and in the near future, a greater demand for additional services provided to corporate and private consumers may be expected. At present, the growth of demand for wireless data transmission is inhibited by the lack of attractive applications and content. With the advent of new popular services (the so-called killer applications) one may expect a growth in demand for data transmission in the existing networks, as well as an increase of popularity of networks based on 3G technologies.

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[27] SMS (Short Message Service) is the ability to send and receive text messages to and from mobile telephones.

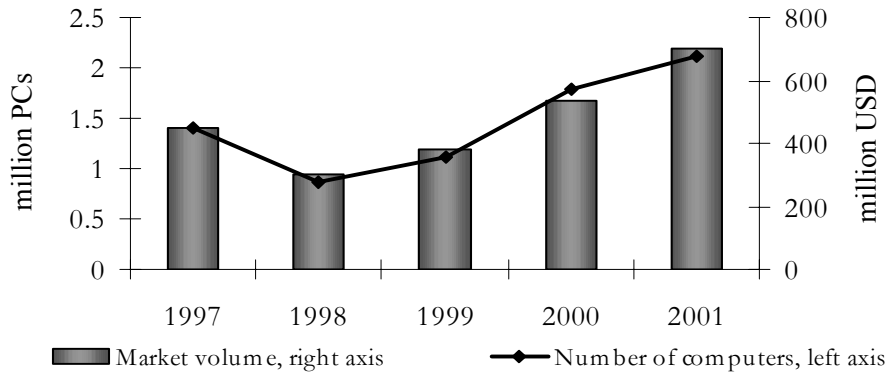
[28] HSCSD (High Speed Circuit Switched Data) is the final evolution of circuit switched data within the GSM environment, enables the transmission of data over a GSM link at speeds of up to 57.6 kbit/s.

There are a few obstacles to the further growth in demand for mobile communications. One is the low purchasing power of the population, as well as the unavailability of these services in sparsely populated regions. Another is that prices for cellular services in the region are still high. This is a result of insufficient competition on the regional market. However, as described in chapter 5, the competitive struggle on the cellular market in Northwest Russia is becoming more evident. Hence, price reduction and an increase in GSM coverage may be expected in the near future.

Thus, the current rate of growth and the potential for development suggest that the demand for mobile communications will grow rapidly in the medium-term perspective, due to the popularity of basic services, as well as an increase in attractivity of additional services. The other major factor behind potentially very high growth in demand for mobile communications will be failure of traditional wire operators to provide reliable services and to extend coverage. The major growth in demand will be concentrated in large cities and regional centers with a higher GRP per capita, which make investments into currently developing GSM networks effective. The current demand for mobile communications in sparsely populated rural areas, however, calls for the introduction of low-band standards that provide the opportunity for covering larger territories with substantially lower investments than, for example, the GSM 900/1800.

Another driving force for the development of the cluster is *data transmission and Internet services*. The demand for these services is growing, due to an increase in the rate of PC penetration. Unfortunately, statistics on the number of PCs in Northwest Russia is not available. Therefore,

Figure 6.7 Russian PC Market



Source: www.idc.com, author's calculations

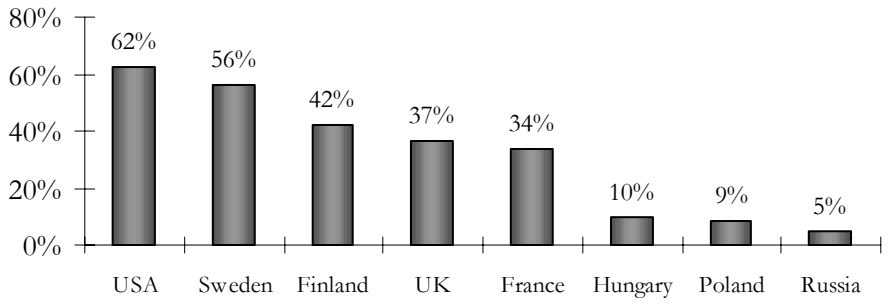
data for the whole of Russia is presented below. The trends observed in an analysis of the statistics for the whole of Russia, however, may be implied for the Northwest Region.

The PC market in Russia is one of the most rapidly growing in the world today. While the markets of developed countries are characterized either by a decrease in sales or by a slight increase, the Russian PC market has been showing a spectacular 25% annual growth rate during recent years. The market volume is expected to reach $1 billion soon.

Nevertheless, the rate of PC penetration in Russia is comparatively low, not exceeding 5%. At the same time, this index is 30-70% in developed countries. Thus, there is significant potential for further growth in demand for PCs, and consequently for Internet services that are available to PC users. Such services include access to various media contents (information, audio and video, etc.) via the Internet. As we will discuss below (see Table 6.8), these services have already experienced a boom in popularity, due to the convenience and efficiency of access they demonstrate over traditional media.

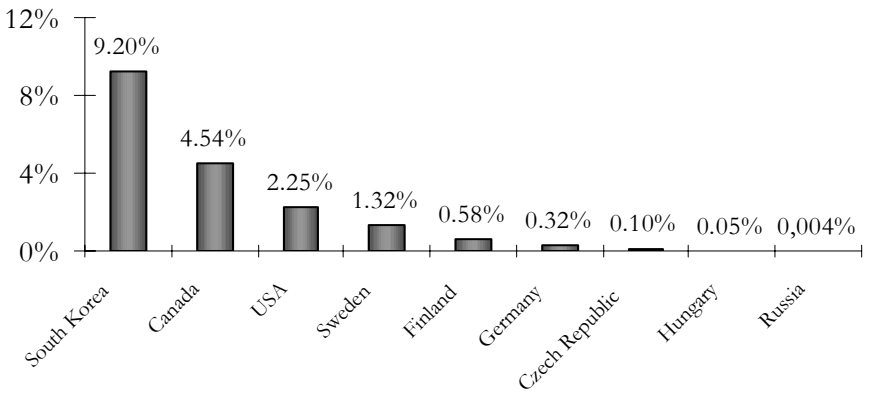
At present, one of the obstacles for the growth of further penetration of the Internet and PCs is the low purchasing power of the population in Russia, and the Northwest Region in particular. The demand for new services and content available through the Internet is restricted also by the deterioration of basic telecommunications networks and the low level of development of last-mile technologies. Popularity of Internet and PC's is high among the younger generations. Hence there is envisaged a growing concentration of younger and more active population in areas that are better connected. In the near future this trend could alter substantially the current distribution of population.

Figure 6.8 PC Penetration Rate, January 2001



Source: ITU, Russian Ministry for Telecommunications and Informatization (http://www.minsvyaz.ru/)

Figure 6.9 Penetration Rate of Broadband Access, January 2001



Source: OECD, Telecommunications database, 2001. Author's calculations

As seen in Figure 6.9, the penetration rate of broadband access in Russia is much lower than that of developed countries. Many promising services, i.e. digital radio and TV, as well as media content (audio and video), require broadband access, while the majority of users in the region have no alternatives to wide-spread dial-up access. The development of broadband access has already begun in Northwest Russia. The rate of its penetration is inhibited by the exorbitant prices caused by a lack of competition in the market segment and low levels of activity of existing companies.

The insufficient development of the infrastructure of modern wire communications provides opportunities for the growth of wireless Internet access in the region, when accompanied by technological development and a reduction in prices in this sector. Here we might include new generations of existing GSM networks (GPRS, EDGE, UMTS, etc), as well as other high-speed wireless technologies for data transmission (the 802.11 protocols[29], etc.).

Thus, it may be concluded that the demand for data transmission will continue to increase rapidly in the medium-term period. This process could be hastened by the appearance on the market of new popular services and content, as well as by the emergence of price-competitive offers for high-speed Internet access.

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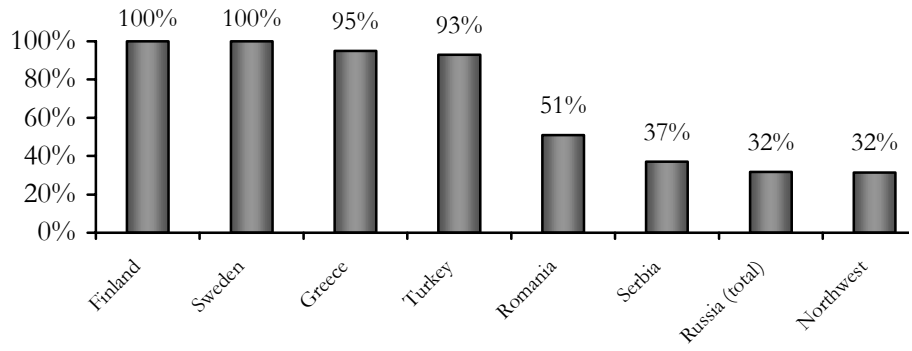
[29] 802.11 specifications (also known as Wi-Fi) allows for the wireless transmission of approximately 11 Mbps of raw data at indoor distances from several dozen to several hundred feet and outdoor distances of several to tens of miles.

The low capacity of the regional data transmission market today will lead to an emergence of new technologies in areas with a prosperous population and a concentration of business activity, i.e. in large cities. The rapid development of broadband access may be expected here. In sparsely populated regions of Northwest Russia, one may predict the development of data transmission services primarily around the cheapest dial-up access technology.

In our opinion, the sector of *wire communications* possesses a substantial deferred demand for high-quality digital communications and new services that are not affordable to analog-exchange users. As indicated in Figure 6.10, the level of digitalization of wire networks in Northwest Russia comprises only 31.5%. Even in countries of Eastern Europe, this index exceeds 90%, and in the OECD countries it amounts to 100%.

Figure 6.10 Digitalization of Fixed-Line Phone Networks, 2001



Source: ITU, Ministry for Telecommunications and Informatization, Hellenic Telecommunications Organization

As shown above in chapter 5.3, the penetration rate of wire communications in Northwest Russia amounted to 30.6% in 2001. It should be taken into account, however, that one fixed telephone line is usually shared by a single household. Thus, the actual portion of the population that has access to wire telephone networks is large (the number of telephones per 100 families in the Northwest was 73.9% in 2000[30]). The majority of people is connected to analog exchanges and is thus unable to use basic high-quality services (e.g. voice calls) offered by digital networks. Nor can they afford such popular services as card- and IP-telephony[31], which offer savings on

[30] Goscomstat, 2002.

[31] IP telephony is transport of telephone calls over the Internet (IP means Internet protocol), which makes long distance telephone calls much cheaper if compared to traditional technologies, when traffic is transferred through telephone networks.

long-distance and international calls, because these services also require digital equipment. Additionally, analog exchanges substantially affect the quality of dial-up access to the Internet of the majority of Russian users. Thus, the mere modernization of analog networks provided by traditional operators could create additional demand for services technically unavailable to most users today.

The existence of areas that are not covered or poorly covered (capacity, quality, accessability, reliability) by the wire communication infrastructure provides opportunities for the development of wireless technologies. According to expert evaluations, the costs of construction of one subscriber line utilizing wire and cellular (GSM) technologies are almost equal in Russia. Thus, when implementing a modern, low-frequency standard it might be more profitable to provide telephone services to remote areas utilizing wireless technology. This, in turn, can create additional demand for the services of mobile-phone companies, as well as for products and solutions of local manufacturers capable of adjusting their products to regional requirements.

The existing potential for the growth in demand for final ICT services is likely to result in a respective increase in demand for *telecommunications equipment*. The Russian Ministry for Telecommunications and Informatization estimates the whole market for telecommunications equipment to be $40 billion for the period 2002-2010. Thus, the estimated share of Northwest Russia amounts to about $5 billion[32]. This estimate is likely to reflect an optimistic approach to the development of domestic ICT industries. It may, however, serve as a certain guideline for determining the capacity of the equipment market.

The development of the equipment market is hindered by the unfavorable investment climate, a lack of local partners and suppliers, as well as problems connected with the integration of existing manufactures into international networks (customs procedures, tariffs, bureaucracy etc.). The unstable political situation in Russia results in high investment risks, which in turn increase the value of capital. Thus, in order to attract substantial investments for the development of the telecommunications infrastructure and to upgrade existing networks, it is necessary to provide a stable political environment and create favorable conditions for investors.

Software and IT represents another rapidly growing industry. The Russian IT market, having experienced a recession in 1998-1999 as a result

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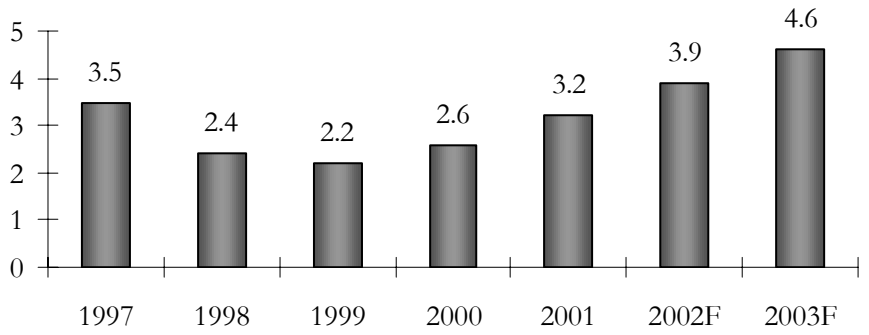
[32] We assume that the equipment market is proportional to the telecommunication services market. The Northwest Region accounted for 12.3% of the Russian telecommunications services market in 2000, as shown in chapter 4.

of the financial crisis, has already recovered and shown impressive growth during recent years. According to estimates of experts, this growth will continue over the medium-term perspective.

Figure 6.11 The Russian IT Market, billion USD

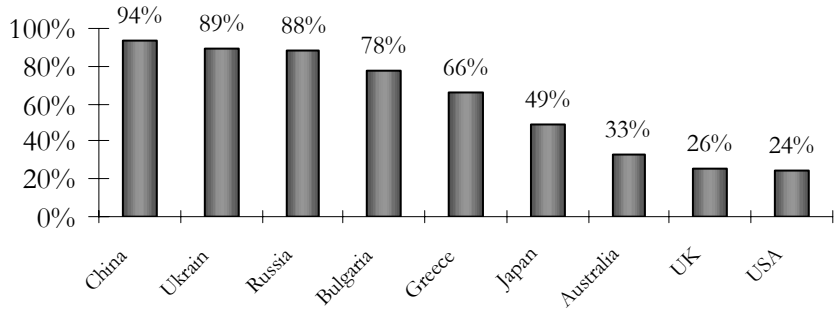


Source: Brunswick UBS Warburg

One of the factors determining the substantial current demand for software and IT is the late appearance of consumer IT in Russia. Before the 1990s, computers and software were developed mainly for military purposes. Consumer PC and software markets appeared in Russia only at the beginning of the 1990s. As a result, there is now a growing demand for software among individual users, and companies applying IT solutions. Further prospects for growth of these markets are very promising, as the individual and corporate markets are still far from being saturated.

One of the major problems of the domestic software market is a considerable share of pirated products. This is primarily a function of the low purchasing power of the population, as well as rudimentary Russian

Figure 6.12 Pirated Software Use, 2000



Source: International Planning and Research Organization (IPR), 2001

Box 6.3 1S – the Leading Accounting Software Developer in Russia

The company was established at the end of the 1980s by the employees of the Russian State Statistics Committee. One of the company's first projects was the distribution in Russia of Lotus 1-2-3, a product that was popular throughout the world at that time. Fruitful collaboration with Western partners provided the company with experience in the marketing and distribution of packaged products.

The next project consisted of the introduction of the company's own product, 1S:Bukhgalteria, a program for the computerization of business accounting. The product was crowded out by its competitors, which were already numerous by that time (1992). All of them, however, represented complex, customized systems, while 1S:Bukhgalteria was a packaged product with an integrated macro language, allowing users to adjust the system parameters to their own needs.

Experience in sales and a well-developed distribution network helped the company rapidly to gain a substantial market share. The uniqueness of the company's activity is that it did not market and support its product, leaving this for the distributors and offering them considerable discounts. The distributors also carried out product customization using the integrated macro language. The company runs product development, global marketing support and development of the dealership network. This strategy resulted in supplanting small competitors from the market and significant expansion of the company's dealership network.

At present, 1S offers a wide range of products, with the software package of computerized business accounting being the key product. According to various estimates, the company's share on the Russian market of accounting software in 2000 amounted to 55-70%.

legislation in the field of intellectual property rights. Solving these legal problems may facilitate the rapid growth of the market.

Thus, we see that the domestic market is an important factor for the development of the Northwest Russian ICT cluster. The demand for almost all the products and services of the cluster is increasing, and possesses significant potential for further growth. However, there are a number of obstacles that retard further growth in demand. Insufficient competition in particular markets (this issue will be considered below), as well as underdeveloped state of the protection of intellectual property rights are among the problems impeding the development of the market for software and new media services. The unfavorable investment climate restrains the influx of capital resources in the development of telecommunications networks and new services, which also moderates the growth in demand.

International Market

As we discussed above, Northwest Russia has significant factors of production that may be used for developing export-oriented manufacturing. These factors are much less expensive than similar factors in developed countries, and their application together with the introduction of modern technologies could allow for exporting price-competitive products and solutions if the average transaction costs related to operations in Russia could be lowered by the purposeful government policy.

The major barrier to the development of the export-oriented production sector in Northwest Russia is the lack of investment resources at the domestic companies, as well as insufficient experience and skills in global marketing, prohibitive taxation, bureaucracy etc. that are impediments also for the FDI. Thus, in order to stimulate exports, government policies aimed at the development of the investment climate are urgently needed. It is also essential to support development of infrastructure for cross-border business relations and cooperation.

Software development is another industry with significant export potential in the Northwest Russian ICT cluster. As illustrated above, the Northwest Region is one of the major Russian centers for offshore programming. The region has favorable factors and obvious potential for the development of this business. An example of a company engaging in successful offshore programming was described above in Box 4.1 XJ Technologies.

The share of Russian companies on the global market of tailor-made software has been thus far low. The existing potential, however, implies the possibility of substantial growth of offshore programming in terms of export volumes and global market share. In order to achieve this goal, it is necessary to follow a purposeful policy for the development of the software production industry. The Indian experience suggests that the effective implementation of this policy may result in a remarkable increase in export volume.

Table 6.2 Offshore Programming in Russia and India, 2001

	Russia	*India*
Software Export, million USD	154	6,800
Software Export Share of GDP	0.05%	1.34%
Global Market Share	0.2%	8.7%

Sources: NASSCOM, GosComStat

Box 6.4 PROMT – a Strong Participant in the International Software Market

PROMT, a St. Petersburg-based software company, is the developer of Stylus, a computer translation system, which is one of the best-known Russian software packages abroad.

The system's prototype was created as early as 1990 by members of the laboratory for engineering linguistics at the Herzen Pedagogical University (St. Petersburg). The laboratory had been studying issues related to machine translation since the mid-1970s. In 1991, PROMT was established in order to commercialize the laboratory's developments.

The company began by developing software for translating from English into Russian. Later, the technology for translation was licensed, which allowed the program algorithm to be promoted on foreign markets. At present, PROMT offers not only finished software products, but also patented technology for developing translation systems in different languages. The latter allows it to enter new markets at a rapid pace.

The Stylus system has won numerous rewards in Russia and in Europe. At present, the company occupies up to 80% of the market for computer translation software in Russia and the CIS. It is trying to garner success on foreign trade markets by continuous improvement of its technology. According to estimates of experts, the quality of Stylus translations is 25-30% better than that of its competitors.

There are two basic models for the development of export-oriented software industries, Indian and Israeli. The Indian approach presupposes the export of man-hours. The Israeli model of development implies the export of finished products, which provides higher value added; however, it requires larger investment resources, marketing opportunities, and quality of personnel than the Indian model.

It would be logical for Northwest Russia to adopt the Israeli approach, as the region possesses advanced factors of production for complex software development. In order to follow this scenario, however, it is necessary to improve considerably marketing channels, as well as to provide training for managers capable of carrying out international projects and improve operating infrastructure, i.e. business and technology parks duly equipped with modern equipment and well connected to the global communication networks. This approach also requires a substantial influx of funds in the industry, an influx that is hardly likely at the moment.

The development of the offshore programming industry in Northwest Russia along the lines of the Indian model is considered to be inex-

pedient for various reasons. Nevertheless, this approach offers certain possibilities. Orders requiring research activity and implying existence of alternative ways for their fulfillment account for 5% to 10% of the global offshore programming market. In our opinion, the man-hour export represents an attractive business model for software companies in Northwest Russia, as it allows them to exploit their scientific and research potential. A number of regional companies have already adopted this strategy. Among them are XJ Technologies and Lanit Tercom described in Boxes above.

Thus, the development of export-oriented industries in the Northwest Russian ICT cluster is hindered by an unfavorable investment climate , poor infrastructure and insufficient integration of local companies into global networks. These issues may be resolved only within the framework of a purposeful and comprehensive industrial policy. At present, the absence of such a policy discourages cross-border collaboration and the direct influx of investments into the ICT cluster. Local companies possess considerable export potential, which can be exploited only if a purposeful program for development of the industry is implemented by federal and regional authorities.

6.3 Firm's Strategy and Rivalry

As seen in Table 6.3, in certain industries, such as cellular communications, obvious leaders occupying large market shares can be singled out. On the other hand, in a number of other industries, e.g. software development and telecommunications equipment production, the structure of the industry is formed by a range of small and medium-sized companies, each occupying an insignificant portion of the market.

The current state of the industry, competition and structure of companies are to the large extent defined by the history of transition from the Soviet planned economy to the current market environment. Thus, before analyzing the contemporary situation, we will look briefly at the structure and strategic targets of Soviet ICT industries.

There were no markets in the Soviet Union. Companies in ICT sector, as well as in other industries, were completely owned by the state. Decision-making about investments, allocation of resources, and technology choice were centralized and carried out by the Gosplan[33]; individual or-

[33] A governmental body responsible for planning and forecasting economic development and resource allocation in the Soviet Union.

ganizations did not manage their own processes of strategy development. The main goal for making decisions was to achieve self-sufficiency in the Soviet Union, in everything from basic components to final products, equipment and technologies.

Table 6.3 Selected Companies of the Northwest Russian ICT Cluster

Company	*Turnover, 2001, million USD*	*Staff*
Wire Communications		
Northwest Telecom	134.9	9,000
PeterStar	47.9	400
Sonera Rus	20	70
Metrocom	18	150
Ruscom	15	100
Cellular Communications		
MegaFon (N-W Region)	117*	300
MTS (N-W Region)	40**	n/a
Delta Telecom	30	240
Equipment Manufacturing		
Neva Cable	7	60
Sevkabel-Optic	7	50
Bercut	n/a	150
Svetlana	2.8*	600
Supertel	2.5	110
Software Development		
Lanit-Tercom	3	200
Digital Design	2.5	120
Resksoft	2.5	150
Astrosoft	2.5	170

Note: * Data for 2000, ** Estimation for the first nine months of 2002

In order to produce a specific commodity, one or several giant enterprises were founded that would supply the entire Soviet Union with this product. Thus, each industry was represented by large manufacturers, and small organizations did not play an essential role.

The planning and management of ICT industries were divided between five ministries[34]. The period was characterized by a special kind of

[34] Ministry for Communications, Ministry for Manufacturing of Telecommunications Equipment, Ministry of the Radio Industry, Ministry for Instrument-Making and Automation Facilities, Ministry of the Electronic Industry.

competition, in which companies manufacturing similar products were controlled by different ministries and competed by achieving disproportional distribution of resources and funds[35]. Normally in these circumstances, manufacturers of military technology and equipment received preferential treatment. Naturally, this kind of "socialist competition" was different from normal market competition, in terms of the skills and abilities it fostered. As a result, when the Soviet Union collapsed and market reforms began, the most prosperous manufacturers suffered most.

Table 6.4 The Structure of the Northwest Russian ICT Industries

	Telecommunications Equipment Manufacturing	*Telecommunications Services*	*Software Development*
Industry Structure during the Soviet Period	A few giant enterprises, each focused on a narrow market segment.	State telecommunications operators, one per region.	No separate industry. Software development was carried out by specialized departments of organizations from different industries
Main Events and Processes during the Transition Period	The losses of outmoded plants in competition with international leaders, dramatic decline of output. Appearance of a large number of spin-offs, which were more effective and competitive.	Appearance of numerous companies focusing on new services (mobile communications, Internet access, etc.). Traditional telephony remained monopolized.	Industry formation, with the emergence of a large number of specialized companies (spin-offs, incorporation of groups of specialists, etc.).
New Industry Structure	Many participants, occupying insignificant market shares (outmoded plants, newly appeared spin-offs, and branches of international companies)	Obvious leaders in each market segment. Ongoing consolidation of assets by the industry leaders.	A large number of specialized companies. No obvious market leaders occupying substantial market shares.

[35] For example, televisions and radios were produced primarily by the enterprises of the Ministry for Manufacturing of Telecommunications Equipment. However, the Ministry of the Radio Industry produced domestic radio equipment under the Radiotehnika brand, the Ministry of the Electronic Industry, home appliances under the Electronika brand. Computer equipment was manufactured by enterprises of the Ministry of the Radio Industry and the Ministry for Instrument-Making and Automation Facilities simultaneously.

Thus, the initiation of market reforms in Russia clearly led to vast changes in ICT industries, for which most companies were not prepared. Moreover, during the first years of the transition period, the efforts of managing boards aimed primarily at acquiring former state companies through the process of privatization, and paid little attention to strategic issues. Thus, the old giants began to lose their positions on the markets, which led to the creation of a new industrial structure. In Table 6.4, we illustrate this process in the main industries of the cluster.

Below we will describe in greater detail how market reforms and the transition influenced company strategies and rivalry in the primary ICT industries, namely

- Telecommunications equipment manufacturing;
- Telecommunications services;
- Software development.

The shift from a planned economy to open markets transpired very rapidly. Suddenly, the *manufacturers of telecommunications equipment* were subject to tough competition, not only from domestic, but also from the leading global companies. Russian enterprises were poorly equipped to handle such changes. The lack of skills and knowledge essential in the market economy was pervasive (marketing skills, quality and cost management, etc.).

Moreover, their production processes were based on the different criteria of efficiency than those generally accepted in the market economy. During the Soviet period, the main criteria were national self-sufficiency, full employment, and the maximization of the production output, which were realized to the detriment of efficiency and profitability. Products were never oriented toward the needs of the customer except for those for military purposes.

The consequences of these criteria were inherited by the enterprises. Accordingly, most manufacturers inherited large organizational structures, old technologies (many products during the Soviet period were copies of foreign counterparts and thus lagged behind the innovation process), with very high rate of consumption of materials and energy (energy was very cheap and was not expected to be used sparingly), high employment per unit of production, and so on.

Most outmoded enterprises seemed to be incapable of operating their gigantic structures in the new economic environment. Thus, the transition to the market economy resulted in a dramatic decline in production

and in layoffs. This situation was aggravated by a rapid decline in government orders and funding. The reduction of rates of employment and low salaries offered by traditional manufacturers led accordingly to the flight of highly qualified personnel to other companies and activities.

At the same time, the low efficiency of operation and management in outmoded enterprises resulted in numerous spin-offs, which were more effectively organized and market-oriented. These new companies benefited from already available human capital, which provided access to the experience and knowledge accumulated in large companies and institutions, and ties with former clients.

Box 6.5 SuperTel – a Typical Example of an Effective Spin-off of an "Old Giant"

The Supertel research and production company was established in 1993 by the former employees of the Dalnyaya Svyaz state enterprise, the largest developer and manufacturer of equipment for long-distance communications in the USSR. The new company focused on a specific, though quite broad, market niche: devices for high-speed data transmission (ATM, SDH, DWDM[36], etc.).

A distinctive feature of the company's activities is the use of original technology, the basis for which had been established in the parent organization. Certain products, such as high-speed radio segments of networks, are presently the best in their segment on the Russian market. The company also continues to use the potential of its R&D institute, which is still a structural division of Dalnyaya Svyaz, and is financed by the government.

An important competitive advantage of the company is its personnel, most of whom left Dalnyaya Svyaz. Having attracted professionals, the company focused on developing new products, and presently outsource manufacturing to partner companies of Dalnyaya Svyaz, which have more comprehensive production facilities.

Supertel is not the only spin-off from Dalnyaya Svyaz. It was, however, the first and the most successful of them. Presently, the company's customers include large state holdings and monopolies, such as Federal Railroads, regional wire communications operators, and large private telecommunications companies.

The emergence of the spin-off companies, together with the opening of the market for foreign products, created strong competition, theretofore unknown in the Soviet period. In addition, a number of joint

[36] ATM – Asynchronous Transfer Mode; SDH – Synchronous Digital Hierarchy; DWDM – Dense Wavelength Division Multiplexing. More information on technical standards and explanations could be found in Russian Technologic Choices and Local Technology Development special study below.

projects and manufacturing departments were established in the region by the world's leaders, which were attracted by the existing production factors and growing demand. They introduced new manufacturing technologies and a new style of management, thus intensifying competition on the market.

Today, the manufacture of telecommunications equipment in the Northwest is represented by a large number of small and medium-sized companies, and also by the trade offices of foreign manufacturers. In many segments, it is hard to single out the leaders who occupy substantial shares of the market.

As we see from Table 6.5, at the moment the potential for further growth of production lies in new spin-offs and joint ventures. They have already established strong competition on the local market and are fighting to increase their share of the market. However, most of the effective domestic manufacturers require investments and in some case partner-.

Table 6.5 Comparison of Major Types of Manufacturers of Telecommunications Equipment

	Old Manufacturers	*New Manufacturers*	*Joint Ventures and Subsidiaries of Foreign Companies*
Structure	Large and inflexible organization includes inefficient departments, worn-out assets and outdated technology.	Flexible and efficient organization. No unnecessary departments and subdivisions.	The organization of the companies resembles that of western manufacturers. Such organization guarantees a high level of efficiency and a high technological level in the company.
Competition	Lack of investments into R&D renders companies uncompetitive in respect to western manufacturers.	Successfully compete with western manufacturers, primarily because they offer lower prices for products of similar quality.	Use western technologies and local advantages. Competitive on both domestic and international markets.
Development strategy	Usually do not have clearly defined development strategies, and rely mostly on federal orders.	Focus on the niche markets. Further specialization and enlargement of activities.	Development by enlarging their presence on the national market.

ship with leading international companies for further development. Thus, there is a call for a more friendly business environment and investment climate to facilitate investment influx and international cooperation.

As we have demonstrated above, the demand for *telecommunications services* is one of the main engines of cluster development. Company strategies and competition on the markets, however, strongly influence the growth in demand. As shown below, new services offered by a large number of new companies make the largest contribution to the cluster development here. Traditional services such as wire telephony do not contribute significantly to the sector's growth, due to the low quality of services and the absence of competition.

New Services

In new sectors of the ICT market, such as mobile communications, Internet access, and data transmission, a large number of companies have been created, thus generating strong competition. Due to these factors, the price of services has fallen sharply and their quality has increased, in the struggle to win customers. The lack of government regulation of pricing (in contrast to traditional telephone services to households), as well as the absence of new services on the market in the early 1990s, have attracted considerable investments to fill this gap.

The industrial structure of the new telecommunications services is changing today. The large number of small companies that appeared on the market in the early 1990s is decreasing, as a result of acquisitions and mergers. At the moment, there are few obvious market leaders in each segment of the industry, and their share is continually growing, leaving less space for small companies.

Among the typical strategies of development of new operators is the trend toward providing a full range of telecommunications services. For instance, wired networks operators try to provide a wide spectrum of telecommunications services, from telephony to broadband Internet access. Wireless operators are beginning to use HSCSD and GPRS technologies and offer wireless data transmission services. It is expected that in the future, most of the revenues of mobile operators will come from additional services such as data transmission and content provision. The main companies have already tested 3G network fragments; however, broad networks are not expected to be constructed in the near future, as at the moment there is little demand for such services in Russia. The implementation of these strategies requires large-scale business and is another reason for the expansion of operations and the ousting of small companies from the market.

Table 6.6 Comparison of Major Types of Telecommunications Operators

	New Operators	*Traditional Operators*
Structure	Flexible and effective structure. Their own modern, basic infrastructure and renting of last-mile infrastructure of the traditional operators to gain access to private users	Large and inflexible structure, including numerous supporting departments. Their own basic and last-mile infrastructure, both worn-out
Competition	Strong competition caused by high profitability of the new services and lack of government restrictions	Absence of competition, due to ownership of single last mile infrastructure and lack of legislation regulating access issues.
Development strategy	Expansion of activities, reaching economies of scale, trend toward offering a full range of services. Specialization is also a widely used strategy.	Focus on increasing investment attractiveness and weakening of federal charges regulation. Attempts to offer new services.

The development of the new technologies has led to the convergence of telecommunications and media. Several projects have been launched in which cable and satellite TV networks offer broadband Internet access. There are many news portals, which have already begun to compete with traditional media, as they are not subject to strict Russian legislation in the media sector and offer a quick and objective flow of information. There are plans to launch interactive television, and there is pilot project for digital TV in St. Petersburg.

At the same time, specializations of companies are developing. For example, there are companies that focus on a very narrow range of services, such as long-distance data transmission, telephone line offering to new operators, etc.

Traditional Services

During the Soviet period, very little attention was paid to quality and variety of services. Their range was determined by the state. There were only state operators in the country, one in each region, and there was as a consequence no competition between them. Thus, operators had no incentive to improve the quality of their services and develop new services. As a result, old operators found themselves unable to develop new services in the new economic environment. Having inherited old networks, and large and inefficient organizations with no experience in marketing, they forfeited their positions on the new services market.

Traditional operators have become natural monopolies in the private sector, because they have inherited the only existing access network to virtually all households. Private users do not yet have any real alternatives to their local regional operators. Traditional operators resist the attempts of other companies to gain access to households.

Thus, the industry structure of traditional telephony is monopolistic. New operators are competing with traditional operators only in small segments of the market, such as long-distance calls, where IP- and card-telephony offers much cheaper services. Cellular services are beginning to substitute fixed phones, due to better quality and easier access. Despite the tremendous discrepancies in the price of services, this tendency is becoming evident.

Currently, traditional operators are trying to increase their investment attractiveness (reorganization and integration, time charges) in order to provide an influx of investment into the upgrading of networks and the development of new services. This is a very important process, in that individual regional companies are of little interest to potential investors, as they are comparatively small and most of them are located in regions of Northwest that are less attractive for investors than those in St. Petersburg. Unfortunately, the organization of telecommunications networks created in the Soviet period directed interregional traffic in the Northwest partially through Moscow. Therefore, integrating wire communications in the newly created entity in the Northwest requires substantial time and effort.

At present, all clients pay a fixed rate, regardless of the time they spend on the line. The introduction of time charges will certainly lead to an increase in company revenues over the medium-term perspective. Unfortunately, the authorities are slowing down this process, as telephone charges are one of the elements of the federal social policy, and they are reluctant to increase these charges. However, time charges are essential for increasing the profitability of traditional wire operators, as the experience of all developed countries shows.

During the Soviet period, there was no separate sector for *software development*. Various R&D institutions, scientific centers or enterprises had their own groups of programmers or specialized departments, which performed only internal tasks for the companies.

In the early 1990s, after the economic crisis and collapse of many large enterprises and R&D institutions, groups of professional IT specialists began to look for orders outside their parent organizations. This led to a large number of spin-offs, which were market-oriented, and from the beginning used an efficient organizational structure and western styles of management.

Table 6.7 IT Company Structures, Strategies and Rivalry

Structure	Competition	Development strategies
Project-oriented flexible structures	Strong competition on both packaged software and project markets	Focus on core competence, enlargement through expansion to new national and global markets.

IT companies generally inherited some specific expertise and competence from their parent organizations, and thus focused on narrow niche markets. However, the emergence of numerous IT companies created strong competition from the beginning of the Russian IT market.

Thus, the structure of the IT industry in the Northwest is represented by a large number of companies. It is possible to single out certain leading companies in terms of turnover and number of employees; however, their share of the market is not large. The process of expanding activities and ousting small participants is in its early stages of development and has not yet singled out its market leaders.

Today, major IT companies are beginning to accumulate experience and skills in working with western clients, what has brought them to a new level of development. The high level of professionalism of employees and relatively high price competitiveness enables them to compete actively on the global offshore programming market with European, North American, and Asian companies.

In order to develop further, local IT companies should focus on the core competence sectors and extend their marketing activities on local, and primarily on the global, market, as there is a comparatively low demand for software in Russia today. This requires large investments, which most of the companies can only obtain by merging with the world's leading companies. Another way is to consolidate companies for a joint break-though on new markets.

In summarizing our analysis of company structure, strategy and rivalry in the main industries of the ICT cluster, we will outline the general issues for all sectors examined that have a noticeable impact on the competitiveness of the cluster.

The competition on ICT markets should be discussed first. As we have shown above, the development of competition of the majority of local ICT markets in Northwest Russia has already resulted in growth in competitiveness of the leading companies, as they tend to improve their operational and technological effectiveness.

Company structure is also an important influence on the development of competitiveness. We have pointed out that a large number of old enterprises inherited large organizational structures, which include numerous inefficient departments, from the Soviet period. Meanwhile, the fact that newly emerged companies maintain only necessary and efficient parts of organizations helps them to achieve the high effectiveness and flexibility required by the contemporary markets.

Among the typical development strategies followed by the companies of the cluster are specialization and increase of the scale of activities. The focus on such targets leads companies to the achievement of economies of scale, and the high quality of products and services urgently required to compete with international leaders.

Whereas issues concerning company structure and strategy planning should be addressed primary to the company's management, the key role in the development of competitive environment must be played by the government and organizations for industries regulation. As we can see, despite the liberalization of the major ICT markets, a great deal remains to be done in order to create a competitive environment. In Chapter 7, we will outline possible government policies for stimulating the development of competition.

6.4 Related and Supporting Industries

The existence of an advanced system of related and supporting industries is vitally important for achieving sustainable competitiveness. Synergy effects from cooperation between key and supporting companies could help to improve the long-term competitiveness of local products and solutions.

It is possible to point out those *supporting industries* within the Northwest Russian ICT cluster that have a significant impact on the competitiveness of companies in the primary industries. These include:

- Capital market
- Parts and components manufacturing
- Specialized software
- Other supporting activities

As discussed above, the development of companies in the primary sectors of the cluster requires significant investments. The majority of the companies participating in our survey, however, noted the difficulties of accessing investment resources.

Small and medium-scale enterprise are facing the most noticeable problems, because they cannot afford loan capital (loan rates are too high for them, and only the most prosperous are able to afford such financing). The only way out for them is to use equity financing. The infrastructure of the venture capital and private equity market has not been developed in Russia, however. There are several funds in the region, but the capital they manage is insufficient for satisfying the needs.

Large companies, e.g. mobile communications operators, already have gained access to loan resources on affordable conditions, as the financial institutions consider them to be first-class borrowers. These companies, however, do not have the opportunity to make IPOs on local stock exchanges (it is under-developed), although this could be a more efficient way of attracting resources than loan financing. As a result, the compa-

Box 6.6 The Russian Technology Fund – Provider of Venture Capital in Russia

The Russian Technology Fund, a pioneer on the Northwest Russian venture capital market, was founded in 1995. Its major partners are SITRA – the Finnish National Fund for Research and Development and the British Top Technology venture capital fund. Financial resources for the Fund were also provided by the European Bank for Reconstruction and Development, the International Financial Corporation, and a number of European and American corporations and private investors. The first fund of 5.3 million US dollars is already closed. Now the Fund authorities are raising a second fund in the targeted amount of $30-50 million.

The key feature of the Fund is its specialization in investments in hi-tech enterprises with significant scientific potential. The Fund has operated only on the St. Petersburg market thus far, but its expansion onto the Moscow market is also planned.

The Russian Technology Fund now owns an equity portfolio of more than fifteen companies from different industries. One should mention the Network Technologies Institution (information security) and Alkor Bio (biotechnologies) as the most successful of the Fund's projects. The value of stock in the Fund's portfolio has increased by up to 40 times.

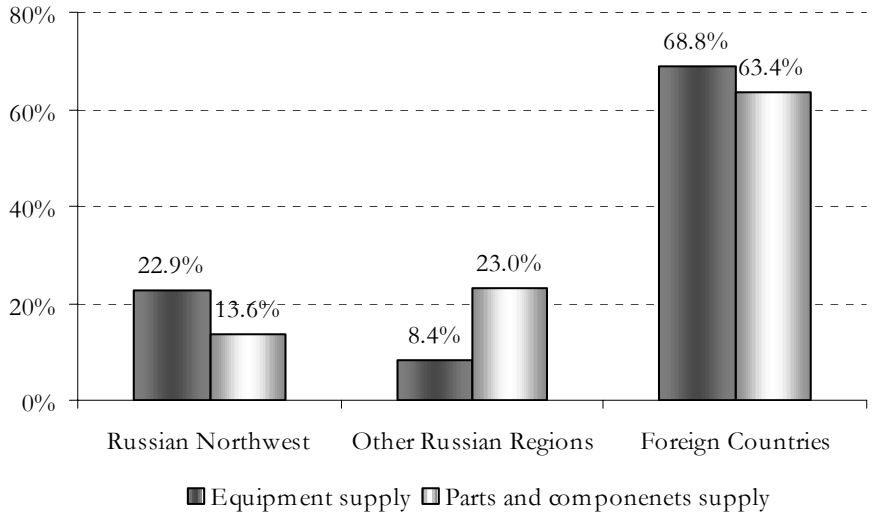
According to the Fund's board of managers, the major problem in carrying out venture capital projects in Russia is an absence of an efficiently operating financial market. This results in a drop in the liquidity of shares, an inability to make IPO, and to provide fair estimation of the company's market value. A lack of favorable conditions (infrastructure, and initial financial resources) for the emergence of new science-intensive companies is another serious problem.

nies are forced either to use only loan resources, or to list their stocks at European and US exchanges which are much more efficient if compared with domestic exchanges. The latter is a more complicated option, and at present there are only three Russian telecommunications operators that list their stocks abroad (at the NYSE).

In order to provide for the further growth of the cluster, it is necessary to develop the private equity, seed financing venture capital and stock markets. The underdeveloped infrastructure of these markets is noticeable both in the Northwest region, and in Russia, in general. The majority of the respondents made special note of it. We believe that in order to overcome these obstacles, purposeful government policies at both the regional and federal levels. Adjustment of the Russian national innovation system is urgently model.

As stated above, the major producers of the cluster follow the strategy of focusing on core competences. This strategy implies cooperation with numerous specialized suppliers. However, as shown in Figure 6.13, the share of local equipment and components suppliers is meager, amounting to 23% and 13.5% respectively.

Figure 6.13 Place of Origin of Equipment, Parts and Components



In addition, the lack of specialized supporting companies, e.g. construction and maintenance of telecommunications networks, forces companies to create their own departments, though it reduces their efficiency.

Among the well-developed supporting industries is specialized software development, which focuses on telecommunications applications. The majority of regional operators and equipment manufacturers use ready-made and custom software by local companies.

We propose that the major efforts for the development of supporting industries should be focused on the improvement of the capital market and growth in the local supplying industries as well as removing barriers for international cooperation and trade. As is evident from the example of the Finnish ICT cluster, both factors are essential for the competitiveness of the manufacturers of primary products.

In our opinion, there are two main directions for the development of local supplying industries. The first is associated with investments in existing and new local supporting manufacturers. According to this scenario, one might consider stimulating the subcontracting business in the region, by such means as attracting international leaders. For example, a branch of Elcoteq is already functioning in Northwest Russia. A second possible direction for the development of the local supporting sector is cooperation with ICT agglomerations in Finland and Sweden that possess an advanced system of supporting industries. Both lines of development require substantial government support; in particular for the improvement of the investment and business climates, and the simplification of cross-border collaboration procedures.

Among the major *related industries* influencing cluster development, one may point to the media and entertainment sectors, as well as the new sub-industries that have emerged as a result of the convergence of these industries with ICT. All these new industries may be defined as digital content production. It is envisaged that the future of the Northwest Russian ICT cluster depends on the growth of this sector, as may be seen from global trends in the development of the ICT industries.

Digital content production in Northwest Russia is in the initial stages of its development. Companies involved in this business have just begun to emerge and develop. However, it is already possible to trace the major trends.

The convergence of ICT and media technology has resulted in the emergence of the *new media* industry. It includes various projects for integrating traditional media and telecommunications. The emergence of companies offering access to the network via cable TV networks, TV and radio broadcasting through the Internet, and other similar services may be observed in the cluster. Traditional media companies also provide new services, i.e. broadcasting through the Internet, the creation of their own information portals, and so on. We have examined recently emerged Rus-

sian news portals, as a vivid example of the development of new media. As shown in Table 6.8, the size of their audience is already comparable to that of regional printed media (newspapers) and TV news programs.

We would like to investigate in more detail the phenomenon of news portals. In our opinion, the fact that the portals have achieved a level of readership comparable with that of the major regional newspapers, testifies to a higher pace of development of new media in Russia than in Western countries, where the circulation of newspapers substantially exceeds the popularity of similar portals. We believe that these alternative kinds of access to news content are spreading quickly, due to the deterioration of the traditional media infrastructure (problems of newspaper delivery, the aging of equipment at TV stations and reduction in coverage areas, etc.). Traditional media companies do not have substantial funds, nor do they have opportunities for attracting external financing for their development and upgrading of associated broadcasting and distribution infrastructure, while the data transmission infrastructure is continually expanding. Hence, a further shift toward new media services can be expected in the near future.

Table 6.8 Daily Audience of St. Petersburg Newspapers, TV News Programs, and Russian News Portals (August 2002)

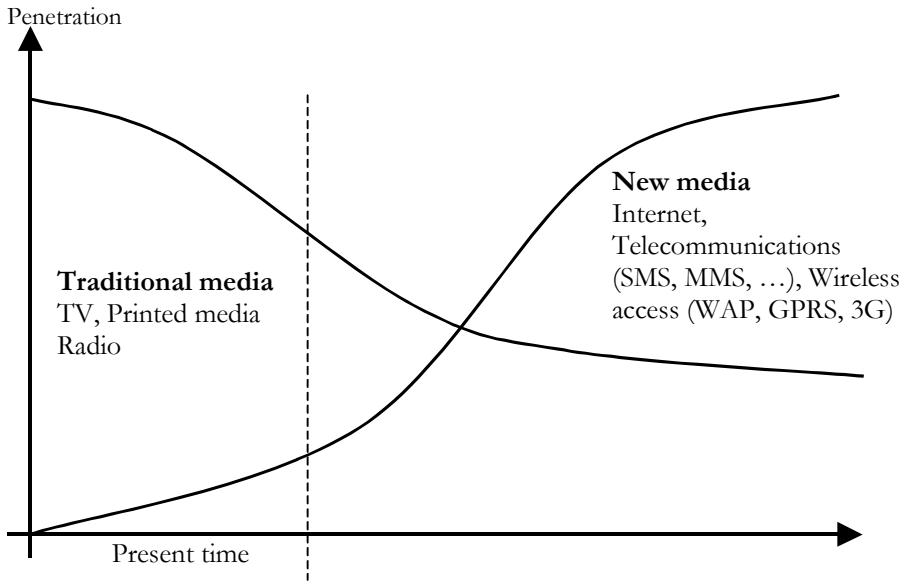
	Audience, thousands	
	Min	*Max*
Daily circulation of the main newspapers in St. Petersburg	20	71
Daily audience of the main TV news programs in St. Petersburg	150	520
Daily number of visitors to the main Russian news and information portals	30	90

Source: www.spylog.ru, www.top100.rambler.ru, *TV ratings. Itogi magazine*, No. 33(323), 2002, author's calculations

The sectors of new business applications are also growing rapidly. These applications vary from B2B and e-commerce systems, to business information, and reference solutions.

Figure 6.14 sketches the trends in development of content access in Northwest Russia. This chart is based on the available statistics and our own estimates. We consider the cluster to be on the threshold of exponential growth of new media technology, due to the popularization of new solutions and partial ousting of traditional technologies.

Figure 6.14 Changes in Content Access over Time



The advantages provided by the convergence of ICT and the media to the companies of the cluster are as follows:

- Services distribution through the Internet and global telecommunications networks expands the potential audience of regional companies to the population of Russia and Russian-speaking citizens in other countries. The potential audience is worldwide if services are provided in English.
- The use of the telecommunications infrastructure and the Internet allows for economizing on logistics. Considering the large geographical area of Russia and worn-out basic infrastructure (roads, transport, etc.) such savings may be substantial. The shift in consumers of news from printed to new media, due to cheaper and simpler access may serve as a vivid example of such opportunities (see Case Box www.rbc.ru in chapter 5.8 above)
- New services arising from the convergence of ICT and media technologies generate new demand, provide new incentives for cluster development, and create opportunities for existing companies. The implementation of these opportunities is hindered by the small scale of existing businesses involved in providing digital content, however. Nevertheless, we expect substantial growth of these industries in the near future, if there is the necessary influx of investments. This might bring the companies to a higher operational level, in which they could reach economy of scale and establish prices acceptable for a wide range of consumers.

In our opinion, the gradual displacement of traditional content access by new means of communications, based on new media technologies, may be expected in the medium terms, particularly in the area of news and mass media, given the realization of certain scenarios of development. Even now, one may notice relatively high levels of penetration and rates of growth here.

The further development of the digital content may be promoted by addressing such issues as author's and intellectual property rights protection, as well as the improvement of legislation in the area of operations within the information networks (electronic payments and transactions, digital signature, etc.).

6.5 Government

The government plays a significant role in the development of such science-intensive industries as ICT. In developed countries, the government not only legally determines precise rules of the game in ICT industries, but also serves as an important customer and supporter for the development of these industries. The latter implies both direct public investments and indirect attraction of financial resources to science, R&D, education, infrastructure etc.

In order to estimate the role of the government in the Northwest Russian ICT cluster, and its influence on the competitiveness of its companies, we asked respondents about their views concerning the impact of the government on their businesses. The majority of the respondents considered the influence of the government to be largely negative. An analysis of the critical issues in current government policy that were articulated in company surveys is presented below.

In processing the data collected during the interviews, we discerned the following major problems related to government regulation of the industry:

- Unfavorable investment climate;
- Complicated and unclear customs procedures;
- Insufficient and unfocused financing of science, R&D and the system of higher education;
- Poor development of infrastructure.

Companies noted the difficulties in gaining access to investment resources for business development. They mentioned insufficient private and government venture funds, the lack of loan guarantee systems for

small and medium-sized companies, and the inefficient stock market as typical problems. All these issues are primarily related to the unfavorable investment climate in Russia, and in the Northwest region, in particular. Our respondents pointed to the unclear and complicated procedures for licensing in the sphere of telecommunications, and bureaucracy, as among the key factors with a negative impact on the investment climate.

The majority of the companies mentioned problems concerning customs. This primarily involves the poor state of the customs infrastructure, resulting in delays in export and import trade flows. In addition, respondents noted unstable and high import duties for electronic components, which discourages the development of national manufacturing. Complicated and vague customs procedures hinder Western manufacturers in launching their operations in Russia.

Another critical issue restricting the development of the cluster is the lack of a purposeful policy in the areas of basic science, R&D, and the development of the system of higher education. There is no strategic planning adjusted to the current and prospective needs of industries, which would establish long-term goals for universities and R&D institutes.

In addition, respondents named insufficient financing of basic science, applied research, and the system of higher education. Indeed, as shown above, the level of public and corporate spending in these sectors is considerably lower than it is in developed countries. Moreover, as we have stressed above, specialists and R&D potential are among the key factors of production in the Northwest Russian ICT cluster. Thus, the insufficient development of these factors seriously limits further growth of the cluster.

The last issue cited by company representatives is the insufficient development of the infrastructure. Thus, potential investors pointed to the lack of territories with a ready infrastructure and able to accommodate the construction of new facilities. The basic infrastructure (roads, energy, heat and other networks, etc.) is also considered to be inadequate.

We also present the issues related to the role of government in the development of the cluster, which were not mentioned directly during the interviews, but were, however, outlined in our analysis. They are as follows:

- Lack of competition in a number of telecommunications markets (wire communications, high-speed Internet access, etc.),
- Lack of focused government policy encouraging international collaboration and integration of local companies into international manufacturing and information networks.

It may be concluded that there is no purposeful industrial policy for the development of ICT industries in Russia, and in the Northwest Region, in particular. The main reason for this is the decision-making vacuum in industrial policy that emerged after the break-up of the state planning system. As a result, industrial development issues and policy making is either neglected, or lacks coordination among various branches of power. Most decisions are imposed as a result of short-term concerns, while sustainable growth of the cluster requires a long-term policy and stable rules of the game.

The state of affairs described above, deters the development of the competitiveness of the cluster and calls for coordination and a long-term perspective in industrial policy. In the concluding chapter of our study, we will sketch basic directions for an industrial policy in the Northwest Russian ICT cluster, which focuses on the development of competitiveness and achievement of sustainable growth.

Box 6.7 Federal Program Electronic Russia

Low penetration of the ICT technologies in the Russian government organizations was the main reason for the development of the measures aimed at implementation of modern ICT solutions in public institutions. These measures formed a core of the state federal program named Electronic Russia (eRussia), which was approved by the government in February 2002.

The adaptation of eRussia covers the period from 2002 to 2010 year with forecasted total budget 2.6 billion USD. The main targets of the program include increase in effectiveness of government operation, development of the information transparency of the federal and local authorities as well as improvement of industry legislation. Still stimulation of the ICT related higher education is also one of the key goals of the program.

The key long-term effect of the eRussia on the domestic ICT industries is seen in spur of the market development due to investments in the telecommunications infrastructure, content development and related education.

However, the first results of the program didn't meet the initial expectations. The majority of projects financed from the eRussia budget have focused on computerization of government structures, while projects aimed at creation of the specialized software and content were very much limited so far. Moreover, the program's budget for the 2003 has been reduced more than twice, thus implementation of the program is being hindered at the moment.

Nevertheless this program may serve as an example of the increasing interest of the Russian government in ICT technologies and their impact on the overall economic development. It is obvious that some stage of learning by doing is inevitable in this kind of complicated and first of its kind project in Russia. It is still envisaged that as the time goes and if the commitment of government is still in place the program will finally generate some good results in terms of upgrading the government infrastructure and improving its efficiency as well as giving a jump-start to local ventures in the field.

7 Conclusions

The analysis of competitiveness in the previous chapter demonstrates that there are no obvious and sustainable advantages in the Northwest Russian ICT cluster today. The competitiveness of the cluster is rather a matter of potential than of reality, since the majority of the competitive advantages defined in the present study are tenuous and unstable. This may be explained in large part by the fact that these factors were inherited from previous stages of development, and have not been subject to economic processes that enable their effective exploitation, renewal, and growth.

Thus, the major production factors that provided the basis for the emergence of new companies in the cluster, i.e. human capital and R&D potential, are gradually becoming less significant. The apparent reason for this is that the government has not implemented a focused and coordinated policy for the development of the educational system, science and applied research. Institutions of higher learning and R&D institutes do not have enough resources to satisfy the contemporary requirements for quality of education and scope of fundamental and applied research. Besides, the resources allocated to the educational system by the government are scattered among numerous colleges and universities. As a result, none of them has enough funds for sustainable development, and they are beginning to lag behind the technological development of the industry world wide.

As the experience of developed countries proves, the development of ICT markets requires intense competition. We have shown that there is a lack of competition in the majority of the markets of the Northwest Russian ICT cluster. Government decisions on the privatization, licensing and state regulation of ICT companies has significantly influenced the existing industrial structure. At present, there is no purposeful government policy regulating these markets. Low levels of competition and high prices restrict the growth of potentially high demand. It adversely affects the general rate of development of the cluster and cluster companies, and decreases their competitiveness on a global scale.

In order to provide sustainable long-term growth in the Northwest Russian ICT cluster, it is necessary to support the development of related and supporting industries. It is evident that today the nature of relations between the key participants of the cluster is shifting from contacts established during the period of planned economy to partnership relations based on market principles. An efficient organization of related and

supporting industries has not yet been formed. In our view there is a potential for implementing a focused industrial policy for the development of this sector. The absence or low competitiveness in certain related and supporting industries retards the development of main manufacturers by decreasing their competitiveness.

One of the considerable obstacles for the further growth of the cluster is the insufficient development of the infrastructure. This concerns both the manufacturing infrastructure (logistics, territories for constructing manufacturing facilities, energy and other networks, etc.), and the infrastructure promoting international trade (customs, cross-border contacts between colleges and universities, R&D institutes, etc.). Insufficient attention to these issues limits the rate of growth of the cluster. Thus, it is necessary to address the problems mentioned above in order to facilitate the rapid growth of the ICT industries.

Solving these problems will inevitably necessitate addressing the key issue for the further development of the cluster - the attraction of investments. Previously we have demonstrated that the development of competitive advantages depends primarily on creating a favorable investment climate in the region. The poor investment climate at the present time impedes the growth of the cluster in all directions. Improving the situation is a complicated task for industrial policy decision-makers on both the regional and federal levels. One of the essential issues here is the creation of a financial market infrastructure. Its inefficiency considerably limits the influx of investment resources in the cluster.

Below, we will introduce our views on possible elements of industrial policy relating to the development of the ICT cluster. These are based mainly on improving the investment climate, and focus on raising the competitiveness of the cluster. The authors believe that the development of the cluster has a clearly defined regional character. Thus, we will also address regional issues of cluster development, i.e. the concentration of efforts in existing agglomerations. In conclusion, we will list key trends for the further development of the cluster identified by the study.

Industrial Policy Highlights

The analysis in the previous chapter suggests that the industrial policy for the development of the Northwest Russian ICT cluster should, in the first place, start from facilitating the evolution of the existing factors of production that have already played in the previous stages an important role in improving the competitiveness of the cluster. It should also be aimed to creating the most favorable conditions for the effective use of

these factors. This may include the creation and upgrading of the necessary infrastructure and development of a favorable operating environment for optimal exploitation of the existing factors, as well as the development of the investment climate that is essential to ensure growth. The creation of an auspicious environment also implies measures for reducing the transaction costs related to use and access to the existing factors, operations, cooperation between parties, trade etc. Realization of these measures by the governments on both federal and regional level may help domestic companies to gain more sustainable and strong advantages. Although simple in theory, in practice such implementation is a challenge to any policy-making body and requires substantial knowledge and skills.

We believe that in order to achieve the goals indicated above, the industrial policy shall take into consideration the following points:

1. *The development of higher education, science, and R&D*

We believe that it is reasonable to focus on the development of existing factors in order to ensure the creation of sustainable competitive advantages. We have observed that despite the lack of focus and coordination in government policy in the sphere of the development of higher education and R&D, the educational infrastructure and R&D potential represent essential advantages of the existing cluster.

The further development of ICT industries requires not only the efficient exploitation of existing factors of production but also, as far the education and R&D is concerned, achievement of the new level of their development that will allow to open up new areas for business and help it to gain competitive advantages in a global sense. It is also important to increase government spending on higher education and research. The lack of available resources make it necessary to direct these investments into certain, high priority areas, thus stimulating growth in particular market segments and supporting the creation of competitive solutions and manufacturers. As illustrated above, Russia lags behind developed countries in R&D spending, and without radical changes in this area the country will never catch up in the global technology race.

It is also important to increase federal financing of education and to spread it over fewer leading colleges and universities, in order to provide modern training levels of excellence that would meet the existing and prospective requirements of the industry's leading companies. Large investments from foreign companies in new companies of the region will be forthcoming only if there are highly qualified specialists in the cluster. Today, despite the existence of a number of ICT-related universities, many companies emphasize the lack of specialists to meet their specific needs.

In addition to an increase in financing, the further development of these factors of production also implies the creation of an efficient infrastructure and environment for their exploitation. The industrial policy in this area may include measures for mutually beneficial partnership between the corporate sector and the system of higher education and R&D institutes. This policy may also include measures for promoting international contacts (international student exchange, joint educational and R&D projects, etc.). The needs of the industry should be taken into consideration in the long-term planning of the development of educational and R&D systems. Legislation could be created in order to involve business in financing both educational and research programs (as is the case, for example, in Finland).

2. Simplification of regulation procedures and rules

The efficient exploitation of existing factors of production depends primarily on procedures and regulations of the market. These issues, i.e. coherent economic and industrial legislation, have a considerable impact on the business environment and the investment climate within the cluster. At present, Russian legislation in these areas is far from acceptable in terms of promoting competitiveness. We believe that the following actions are therefore justified.

It is necessary to adopt the industrial legislation corresponding to the current needs of the sector, i.e.:

- To reduce the number of licenses which are currently required for operating on the telecommunications market and to abolish those licenses which are considered unnecessary in developed countries
- To define clear rules and criteria for licensing
- To establish longer periods of validity of licenses, as well as to provide clear rules for extending those periods
- To promote the adoption of the ISO 9000 standards and solutions complying with international technological standards.

In addition to the simplification of the process of licensing, the reforms of customs regulations play an important role in promoting the emergence and development of new companies within the cluster. These measures should be oriented not toward protecting uncompetitive local manufacturers through direct interference (high import duties, etc.), but toward supporting domestic manufacturers, including those established on the basis of foreign capital indirectly, i.e. by moving efforts and resources to such areas as improving institutions and regulations, i.e. business operating climate, infrastructure, facilitating networking and new business development. Possible measures could include the following:

- Reduction of customs duties for imported components, particularly for those having no competitive substitutes in the domestic market.
- Simplification of customs procedures for the products of the ICT cluster (creation of economic areas with favorable conditions for assembling and manufacturing export-oriented products).

Development of the favorable climate on the ICT markets could imply abolition of obligatory imported equipment testing in Russia in case features of this equipment conform to widely accepted international standards[37].

In order to ensure the development of the ICT cluster it is also essential to address the following basic issues:

- Development of domestic accounting and tax standards in accordance with internationally accepted practices
- Reduction of tax burden and simplification of filing and reporting
- Guarantee of fair and equal treatment of domestic and foreign companies
- A possibility to get substantial tax credits and much lower asset tax levels for the companies that invest in upgrading and new projects
- Improving visa procedures and easing other ways the business travelling

It should be noted that possible solutions for most of the aforementioned problems has long been on the agenda at both the federal and regional levels.

3. Encouragement of competition and stimulation of domestic demand on the ICT markets

The lack of competition in a number of markets of telecommunications services decreases the attractiveness of these markets for new participants and limits growth. In order to improve the situation it is possible

- To provide clearly defined rules and principles for new operators in gaining access to the basic networks of traditional wire operators, which are today natural monopolies.
- To abolish the strict government regulation of charges related to traditional telephony services, and to introduce time charges nationwide.

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[37] Conformation to ETSI (the European Telecommunications Standards Institute) standards could be considered as sufficient reason not to be additionally tested in Russia.

- To promote a competitive environment on the markets of new telecommunications services, i.e. cable television, ADSL-access to the Internet, other broadband access, etc.

In addition to the development of the competitive environment on the ICT markets, the stimulation of domestic demand requires the improvement of legislation in the field of protection intellectual property rights and other matters concerning software, operations in information networks (digital signatures, etc.), and the content provision (government programs oriented toward the creation and support of digital content), etc.

4. Developing export-oriented industries.

In previous chapters, we have demonstrated that within the Northwest Russian ICT cluster there are two major industries with export potential: telecommunications equipment manufacturing and software development. Both industries could offer internationally competitive products. At present, however, their export volume is rather low in comparison with other countries where these industries are developing.

Taking into consideration the relatively low domestic demand for both equipment and software, the export orientation of these industries will allow for exploiting the potential of the region (existing assets and human capital). The realization of this strategy requires the attraction of large investments, however, which in turn is only possible if favorable conditions are created.

In order to develop an export-oriented manufacturing industry, it is essential to simplify customs procedures, i.e. to undertake actions described above in *Simplification of regulation procedures and rules* section, as well as other measures for creating opportunities for Just-in-Time delivery. In addition to modified customs procedures, the latter also implies the development of a transportation infrastructure, the necessary IT networks, etc.

We believe that in order to ensure significant export growth in the field of offshore programming it is crucial to create environment and conditions favorable for the development of IT companies. The realization of the following measures would assist in achieving these goals:

- Supporting contacts between local companies and potential customers by promoting opportunities in Russia by all available means
- Promotion of Northwest Russia as a beneficial location for target groups

- Facilitating traveling and contacts between Northwest Russia and nearby areas where ICT is developed
- Creation and development of technology or business parks oriented toward software development with appropriate infrastructure
- Unification of national and international quality standards, facilitating diffusion of the knowledge related to these changes
- Support of specialized IT education (benchmarking and more cooperation with global leaders) etc.

The simplification of cross-border contacts (including those on the personal level) may also encourage the development of offshore programming (this issue will be considered below in *Support of international integration* section).

5. Facilitating networking development of related and supporting industries

As discussed above, the structure of relations between the key and related companies of the ICT cluster is undergoing transformation. The government could facilitate this process by implementing the following actions:

- Encouraging contacts between companies, on one hand, and college and universities and R&D institutes, on the other. This could include regulations and measures providing more independence for state universities and R&D organizations in collaboration with the corporate sector.
- Creating an efficient infrastructure in the financial markets by taking legislative measures and steps aimed at the reduction of investment risks, increasing public financing availability for businesses on the early development stages, cooperation with private institutions in venture capital and private equity, etc.
- Supporting the exploitation of opportunities of local industries in the field of manufacturing of components and related services. The facilitation of user-producer contacts and cooperation (organization of specialized exhibitions, conferences, etc.) could help to improve the competitiveness in the cluster.

In those spheres where a lack of effective local related and supporting organizations may be observed, it is expedient to direct regulating activity at measures for integrating local companies into the advanced ICT agglomerations of neighboring countries (e.g. Finland, Sweden, Germany).

6. Support of international integration

The attraction of investments in the region, and the facilitation of integration of existing companies into international networks, is impossible without efficient cross-border relations at the individual and corporate levels. In order to simplify international contacts, it is necessary to create a favorable infrastructure. We believe that the following measures may be undertaken in order to achieve these goals:

- Simplification of procedures surrounding business trips of Western partners to Russia (and the Northwest region in particular). This may include simplified visa and registration procedures, etc.
- Spurring contacts between local and foreign universities and R&D institutes (student exchange, joint research projects, partnership programs, etc.)
- Unification of the industrial standards in compliance with international requirements

We consider Northwest Russia to have important prerequisites for creating such relations, especially with neighboring Finland, Scandinavian countries and Germany. It is necessary to identify the focal sectors, companies and organizations, as well as to coordinate the development of such interaction (federal and regional programs, government orders, related conferences and other events, etc.).

Regional Issues

We have seen in the previous chapters that the Northwest Russian ICT cluster is primarily concentrated in St. Petersburg. Thus, the major factors of production, key participants, as well as a significant part of the demand for final products and services are all concentrated here.

We argue that in the contemporary economic situation it is not reasonable to disperse the efforts for the development of ICT industries throughout the Northwest region as it was done in the late Soviet period. At present, the resources necessary to fulfill such task are not available to federal and regional authorities. In view of the current requirements for the development of ICT industries and the available resources, it is necessary to concentrate efforts on the existing ICT agglomeration in St. Petersburg and Leningrad region.

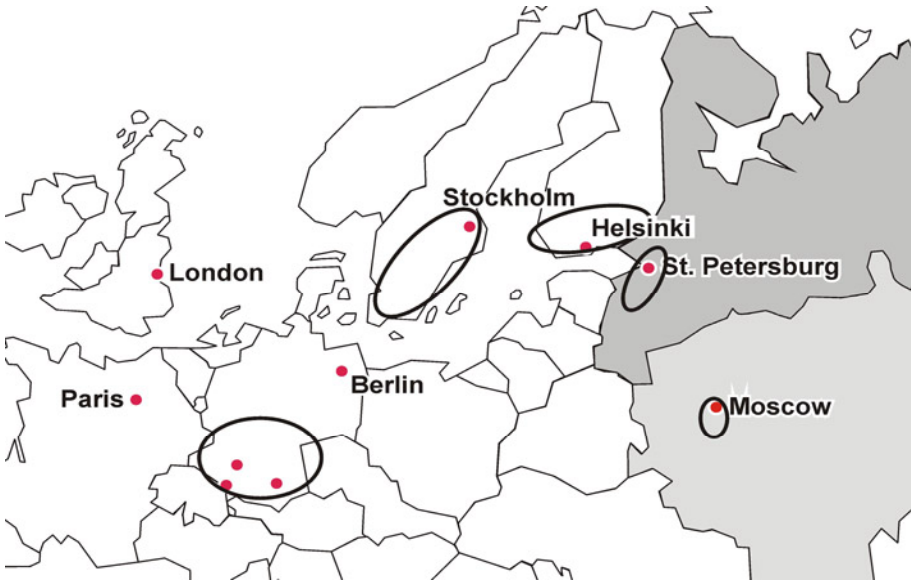
If the ICT industries in the existing agglomeration grow exponentially, one may expect further geographical expansion of the ICT technologies within the whole Northwest Region. Thus, the concentration of efforts

in St. Petersburg is more likely to result in a boom in development of the ICT in Northwest Russia rather than if efforts are dispersed throughout the region.

Information and telecommunications technologies have a global and generic nature. Thus, the ICT industries should not be viewed only within their concentration in a single country, in light of the gradual integration of various regions and advanced ICT industries into the global networks. As indicated in Figure 6.15, there are at least three highly developed agglomerations of ICT activity located close to St. Petersburg: Finland, Sweden and Germany. Therefore, it is reasonable to direct measures for the development of international cooperation at these countries (development of telecom connections, conferences, meetings, etc.).

In our opinion, it is practical to direct the major efforts of the industrial policy in the area of development of integration processes at the relations with the neighboring ICT agglomeration of Finland. Such integration may be of mutual benefit. Northwest Russia could gain access to an efficient system of related and supporting industries capable of providing an influx of new technologies into the local cluster. The Finnish cluster may gain from the access to cheaper factors of production and a potentially large market as well as such integration may be an important source of new ideas and provide an access to inherited diverse fundamental research base.

Figure 6.15 Northwest Russian and Neighboring ICT Agglomerations



The ICT clusters of Northwest Russia and Finland do not compete in many spheres. Moreover, one can see that in numerous activities they could potentially supplement one another. Their strengths and weaknesses also differ significantly. Thus, if there is the political will, and if physical and intangible barriers between the regions are removed, it is reasonable to expect the efficient integration of these clusters into a closely interrelated structure. A probable first action in the framework of Finnish-Russian cooperation development could be creation of the business infrastructure in Vyborg. In case relevant infrastructure provided strong linkages between Vyborg and closely located Lappeenranta could easily arise, providing for first effective step in integration of Northwest Russia and Finland.

Vision and Trends

The realization of the aforementioned trends of industrial policy may become an efficient incentive for the development of the Northwest Russian ICT cluster. It may also serve as an important impulse for the emergence of competitive companies in the region. Such a policy may affect the speed and possible directions in the development of the cluster. The lack of an industrial policy, however, may result in a serious delay in the growth of the cluster, as well as in the loss of the inherited advantages.

In conclusion, we would like to present our views on the major long-term trends for further development of the Northwest Russian ICT cluster, derived from the present study. The trends include:

- Further concentration of the ICT activity in St. Petersburg, and further growth of the relative share of ICT in the city's GRP.
- Active replacement of traditional media with new technologies
- Persistence of the gap between the technological level of the ICT services in St. Petersburg and the level in other regions of Northwest Russia. While the optimistic scenario for the development of telecommunications in the regions implies growth in the rate of penetration of digital wire telephony and the spread of 2G mobile communications over the medium-term perspective, St. Petersburg is likely to witness the extensive use of broadband Internet access technologies and the introduction of 3G wireless networks.
- Development of competition in the key markets for ICT products and services.

- Improvement of relations between universities and cluster companies, with restructuring of the higher educational system according to the prospective requirements of the cluster.

The development of these trends reflects an optimistic scenario, however, which is feasible if the industrial policy measures considered above are implemented. The political factor has for the most part introduced instability into the development of the ICT cluster thus far. A dramatic change in political focus from short-term issues to a strategic perspective will require considerable effort on the part of industrial policy decision-makers.

We hope that the analysis of problems and opportunities for the development of ICT industries in the present study will serve as an initial basis for making decisions, both in the area of long-term industrial policy-making and in corporate strategy planning. We also anticipate that this study will serve as an additional incentive for the purposeful development of the Northwest Russian ICT cluster, which has already become an essential part of the regional economy.

Appendixes

A1. Growth of Human Resources

As demonstrated above, human resources is a major competitive factor of Northwest Russia ICT cluster. The high level of personnel qualifications in the region is explained mostly by the highly developed educational infrastructure, which dates back to the early 18th century, when St. Petersburg State University was founded. In late 19th – early 20th century a number of specialized technical universities were established in St. Petersburg, and they still produce thousands of highly qualified specialists each year.

The recent growth of ICT industries in Northwest Russia created significant demand for qualified personnel trained in modern technologies and equipment. Local universities try to follow these trends and admit more students to the degree courses required for development of Northwest Russian ICT cluster. A number of postgraduate educational programs also successfully train specialists while taking into consideration current demands of the industry. Besides, old R&D institutions and enterprises were another important source of qualified personnel: the most active young specialists left those organizations to find better-paid jobs and thus provided a significant personnel supply in the labor market.

Leading ICT Universities in Northwest Russia

Leading Northwest Russian higher schools that train ICT specialists are concentrated in St. Petersburg.

In addition to the universities listed, there are other higher schools in St. Petersburg training specialists for ICT industries. Besides these, there are a number of universities and higher educational institutes are located in the regional centers of Northwest Russia.

St. Petersburg State University

This is the oldest university in Russia. It comprises 20 departments, 11 R&D institutes, as well as some other support facilities. Departments training ICT specialists are

Department of Mathematics and Mechanics and Department of Applied Mathematics and Control Processes.

St. Petersburg State Polytechnic University

This is the leading technical university in Russia founded in 1899. The University trains its students in 91 degree subjects. Its structure includes 17 departments and 12 R&D institutes.

St. Petersburg State Electro Technical University

The University was established in 1886 and presently it is one of the largest centers preparing electrical engineering personnel and conducting fundamental and applied research in the sphere of radio, computer technologies and information science.

St. Petersburg State University of Aerospace Instrumentation

The University comprises 8 departments and trains specialists in the spheres of electronics, communications systems and information systems management.

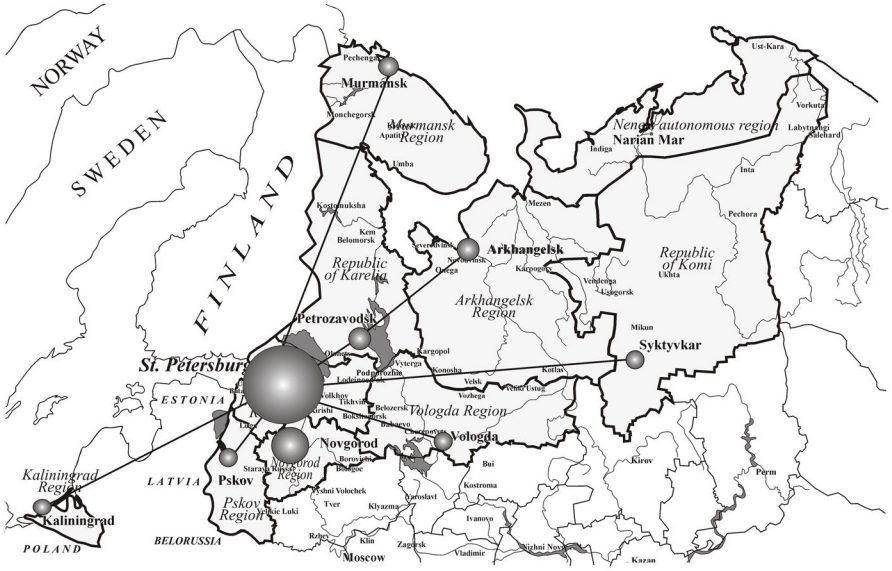
St. Petersburg State Institute of Fine Mechanics and Optics

The Institute was founded in 1900. Presently, the Institute is included into the top ten technical schools in Russia. The main spheres of training are optical communication systems (the oldest research and training department in this sphere in St. Petersburg), computer technologies and fine mechanics.

Bonch-Bruevich St. Petersburg State University of Telecommunications

It is the key educational establishment in telecommunications and related industries in Northwest Russia.

Figure A1.1 Main Educational Centers in Northwest Russia



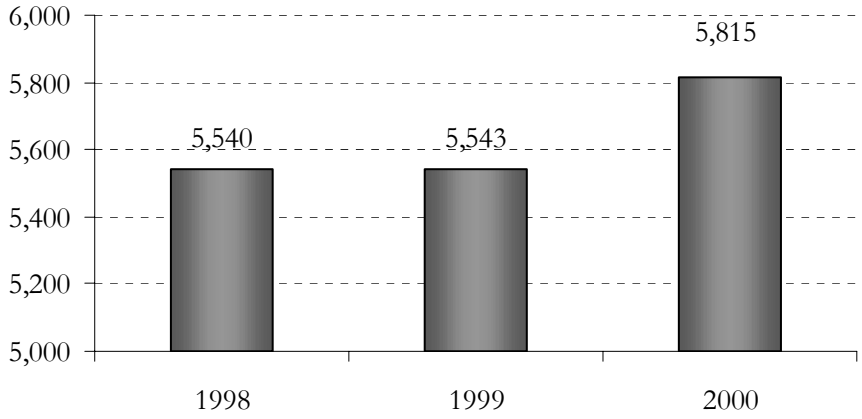
Note: Size of circle is proportional to the number of students in ICT-related fields
Source: www.informika.ru

Number of ICT Students

The total number of graduates in ICT-related study fields in St. Petersburg exceeds 5,000 people per year, and this number is constantly growing, as we can see in Figure A1.2. The real number of ICT specialists is in fact even higher than official figures, because nowadays many students get jobs in ICT sector after completing university courses in technical fields not necessarily related to ICT.

There are over 100 higher educational establishments in St. Petersburg, and a number of them train specialists for ICT sector. However, some technical universities are considered more prestigious in the labor market, and offer higher level of technical education (see Table A1.2 for detailed list). Table A1.1 presents the data on the number of full-time students in the leading technical universities of St. Petersburg and other regions in Northwest Russia.

Figure A1.2 ICT Graduates in St. Petersburg



Source: Peterburgcomstat, 2001

As is clear from Table A1.1, higher education in the ICT sector is actively developing. In 2000, admission of first-year students in St. Petersburg universities exceeded the number of graduates of ICT specialists almost twofold, and this proportion in the regions is even higher. This trend reflects the general dynamics of University graduates number: over the last five years the number of graduates in St Petersburg increased by 1.54 times.

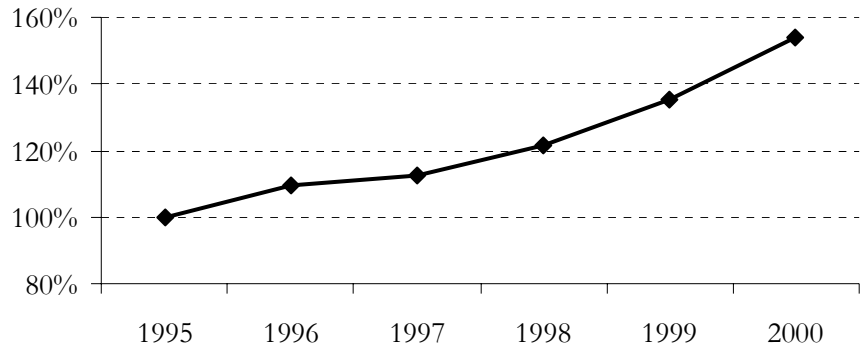
Table A1.1 Number of Students in ICT-related Fields of Study in Major Universities in Northwest Russia, 2000

Speciality Groups [1]	*St. Petersburg*			*N-W regions*		
	1st year	Graduate	Total	1st year	Graduate	Total
Programming and applied mathematics	1,070	573	4,048	458	267	1,838
Radio technologies and electronics	893	455	4,162	175	126	803
Laser and optic technologies	441	197	2,008	0	0	0
Automation, control and information systems	2,013	1,047	8,179	916	252	2,385
Telecommunications	524	314	2,346	0	0	0
Total [2]	4,941	2,586	20,743	1,549	645	5,026

Notes: 1) See Table A1.3 for more detailed information about speciality groups. 2) Total number of students excluding distant learning students.

Source: State Institute of Information Technologies and Telecommunications, Russian Higher Schools Database, http://db.informika.ru/vuz/index.htm

Figure A1.3 University Graduates in St. Petersburg, Index, 1995 = 100%



Source: Peterburgcomstat, 2001

Leading Schools of Higher Education

Many St. Petersburg universities are renowned for high quality of specialists training and the so called "academic education", which assumes that the student must acquire knowledge not only in his specialization, but also in other disciplines, which gives him/her an opportunity to understand the problems not only within his narrow specialization but also within a broader technical and research context. At the same time, there is a number of educational establishments or departments in St. Petersburg that can be distinguished from others, even though the average level of education is very high. The high quality of education provided by these institutions stems from their vast experience in the field of their specialization (in some cases, research and development activities in the relevant fields have been carried out for more than a century). Below is a list of such schools.

Department of Mathematics and Mechanics of St. Petersburg State University

It is the most famous mathematics department in Russia. Its graduates are highly valued both in Russia and abroad. It is well known for its fundamental education in the sphere of mathematical disciplines, high level of the faculty and rigorous admission requirements. The team of the department has won the first prize in the International Programming Contest over the last two years, which clearly proves the level of education here.

Ioffe Physics and Technical Institute

This is a R&D institute which also offers post-graduate training in the sphere of physics, optics and laser technologies for top undergraduates of St. Petersburg State Polytechnic University. It possesses modern technical facilities, professional personnel and significant financial resources. The Institute also op a specialized secondary school which has few analogies in Russia in its quality of education and educational facilities. All that became possible after worldwide recognition of research carried out by the Institute's director Zhores Alferov (Nobel Prize in physics in 2000) and consequent governmental support.

Department of Information Technologies and Programming of St. Petersburg Institute of Fine Mechanics and Optics

It is considered second best center for IT education, inferior only to St. Petersburg State University. Students of this department are selected from the ranks of winners of different contests and from the most talented graduates of best St. Petersburg secondary schools specializing in mathematics and physics. The team of this faculty won the third prize at the International Programming Contest in 2002.

Faculty of Optical Information Systems and Technologies of the Institute of Fine Mechanics and Optics

It is one of the first departments of the Institute, established at the same time with foundation of the Institute in the early 1930s. It is the largest institution in Russia training specialists in the sphere of optical technologies. It has rich experience in the field and runs a number of its own R&D programs.

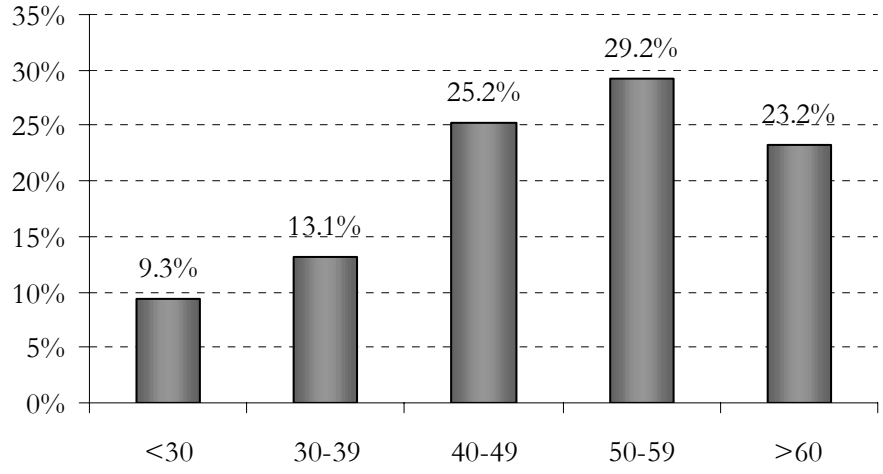
Other Sources of Qualified ICT Personnel

R&D Institutes

Another major source of personnel for ICT industries in the region are various R&D organizations. Financing of fundamental science and R&D decreased considerably during 1990s, and the number of personnel in R&D institutions has decreased by 2.5 times during the last 10 years. Highly qualified workers looked for employment in other organizations, which offer higher salaries and better carrier opportunities.

However, at present the human resources potential of R&D institutions has been almost exhausted. Most of energetic and motivated staff of stagnating institutions has already left them. At the moment, there are few successful R&D institutes provided with sufficient financial resources for conducting research in the sphere of telecommunications technologies and keeping their specialists (for example, Ioffe Physical and Technical Institute, LONIIS, etc.). However, young university graduates tend not accept jobs in such institutions, as even the successful ones do not offer competitive salaries and work conditions. Thus, significant aging of personnel in R&D institutions takes place, and as of now they cannot be considered a major source of highly qualified ICT personnel, as was the case in early 1990s.

Figure A1.4 R&D Personnel Distribution by Age Group, St. Petersburg, 2000



Source: Peterburgcomstat, 2001

Such aging pattern results to a notable decrease in modern skills of R&D personnel and can be an obstacle for competitive R&D activities in ICT sphere.

Centers for Continuing Education

Dramatic changes in the Russian economy the mid-90s resulted in significant misbalance between the content of training of university graduates, which almost has not changed since the Soviet period, and the

structure of demand for personnel[38]. To satisfy the demand for most popular specialities, a number of continuing education centers were created both within the structure of leading universities, and as independent entities.

Over the last decade the list of courses offered by these centers has changed significantly. In early and mid-1990s especially popular were programs in economics and law, while now more attention is paid to technical programs, primarily in software development and telecommunications. These centers are very flexible in choosing educational programs, which gives them the opportunity to quickly adjust to the changing requirements of the industries.

Now there are several large specialized centers retraining specialists for ICT cluster in Northwest Russia, for example, St. Petersburg Center of Telecommunications jointly established by the Bonch-Bruevich St. Petersburg University of Telecommunications and a number of large telecommunications companies operating in the city. Small establishments were moved out of the market by large and professionally organized centers founded by major universities, or by those which invite best professors and instructors from these universities as visiting teachers. Many centers offer courses and certificates authorized by major international companies, such as Microsoft, Cisco and Intel, and these certificates are recognized worldwide.

Conclusions

Nowadays Northwest Russia becomes the national leader in IT specialists training. It is the place where the most prestigious mathematical and technical universities are located. The process of qualified specialist training starts at secondary schools with intensive mathematic and technical training and continues in leading universities. St. Petersburg students and graduates win in many international mathematical and computer programming contests and have highest rating among other Russian universities.

Other regions of Northwest Russia also have developed training facilities, including local universities and branches of St. Petersburg institutions. This serves to provide high quality of education and specialized

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[38] See, for instance, Helsinki School of Economics, Economic Monitoring of Northwest Russia Report for St. Petersburg, 2002, www.hkkk.fi/netc.omm/ImgLib/2/43/PietariEnMay2002.pdf

training not only in St. Petersburg, but also in the regional centers, as well as to cater for demand for skilled specialists on part of ICT companies in Northwest Russia. The leading Universities also become an excellent basis for post-graduate and continuing education centers, so that they can use knowledge and facilities and provide high quality education in a wide range specialized spheres. Many of retraining centers cooperate with international companies and offer internationally accepted certificates.

Thus, the educational infrastructure is sufficiently developed to provide ICT labor market with qualified specialists. The increasing number of University graduates in ICT is an evidence of the fact that the educational system is following the industry's growth trends. The leading schools are ready to cooperate with companies in organization of targeted programs and courses, which makes labor supply correspondent to the current demands of the market. That is why there is clearly a potential for the further development of the higher education infrastructure.

However, there also certain problems, including the low level of funding received by universities, presently insufficient level of cooperation with the corporate sector, etc. Targeted government actions are required in order to overcome these problems and make the educational system more efficient.

Table A1.2 Number of ICT-related Students in Major Universities in Northwest Russia, 2000

High School	Number of ICT-related students, 2000		
	1st year	Graduates	Total
St. Petersburg State University	489	245	1,822
St. Petersburg State Polytechnic University	439	178	1,895
St. Petersburg State Electro Technical University	813	580	3,981
St. Petersburg State Institute of Fine Mechanics and Optics	703	289	2,740
Bonch-Bruevich St. Petersburg University of Telecommunications	755	464	3,393
State University of Aerospace Instrumentation	810	481	3,314
Baltic State Technical University	215	50	850
St. Petersburg State Technological University	141	36	574
St. Petersburg State Marine University	91	62	521
St. Petersburg State University of Railroad Transport	69	16	245
St. Petersburg State Academy of Refrigerating and Food Technologies	28	13	119
St. Petersburg State Institute of Economics and Finance	30	0	108
St. Petersburg State University of Polymers	66	43	256
St. Petersburg State Institute of Machinery Construction	79	40	379
St. Petersburg State Forest Academy	59	33	136
Leningrad State Regional University	154	56	410
Arkhangelsk State Technical University	87	0	244
Primorsk State University	80	54	382
Novgorod State University	276	152	1211
Kaliningrad State University	167	82	365
Vologda State University	160	47	524
Cherepovets State University	314	114	774
Murmansk State University	145	49	534
Syktyvkar State University	119	40	349
Petrozavodsk State University	201	107	643
Total	**6,490**	**3,231**	**25,769**

Source: State Institute of Information Technologies and Telecommunications, Russian Higher Schools Database, http://db.informika.ru/vuz/index.htm

Table A1.3 Number of Students in ICT-related Fields in St. Petersburg and Northwest Russia, 2000

State ID Code	Field of Study	Number of students					
		St. Petersburg			N-W Regions		
		1 year	Graduates	Total	1 year	Graduates	Total
Programming and Applied Mathematics		**1,070**	**573**	**4,048**	**458**	**267**	**1,838**
10100	Mathematics	184	281	677	236	208	1,157
10200	Applied mathematics	284	162	1,194	110	0	138
10300	Applied mathematics and physics	25	1	55	0	0	0
30100	Computer science	0	0	0	52	0	95
220600	Information protection technologies	119	0	192	0	0	0
510200	Applied mathematics and computer science	68	44	401	60	38	280
552800	Computer science and computing devices	309	85	1,262	0	21	168
7553000	System analysis and control	81	0	267	0	0	0
Radio Technologies and Electronics		**893**	**455**	**4,162**	**175**	**126**	**803**
71500	Radio physics and electronics	25	24	161	0	11	15
200100	Materials and components for solid materials electronics	69	11	172	0	0	0
200200	Microelectronics and semiconductors	0	18	139	0	20	34
200300	Electronic devices	81	33	376	0	0	0
200400	Industrial electronics	14	0	14	0	0	0
200700	Radio devices	199	129	1,032	20	19	57
200800	Radio electronic technologies and design	141	83	733	0	21	44
201300	Transport radio devices operation	11	12	70	16	26	108
201600	Radio electronic systems	152	79	656	0	0	0
201700	Electronic warfare devices	31	0	85	0	0	0
550700	Electronics and microelectronics	16	17	129	43	0	143
551100	Radio electronic technologies and design	30	15	145	39	6	160
552500	Radio technology	124	34	450	57	23	242
Laser and Optic Technologies		**441**	**197**	**2,008**	**0**	**0**	**0**
71700	Physics and devises for optical communication	70	7	299	0	0	0
72300	Laser devices and technologies	97	34	467	0	0	0
131200	Laser systems	53	22	219	0	0	0
190700	Optical and electronic devices	198	123	898	0	0	0
191100	Optical technologies and materials	23	11	125	0	0	0

State ID Code	Field of Study	Number of students					
		St. Petersburg			N-W Regions		
		1 year	Graduates	Total	1 year	Graduates	Total
Automation, Control and Information Systems		**2,013**	**1,047**	**8,179**	**916**	**252**	**2,385**
71900	Information systems	461	149	1,136	235	0	625
190300	Aviation apparatuses and measure-computing devises	35	39	190	0	0	0
190900	Computer measure technologies	43	26	186	25	0	25
210100	Computers and management of technical systems	83	80	695	106	52	302
210200	Automation of technological and production processes	256	219	1,107	210	98	557
210300	Robots and robotic technologies	43	12	140	0	0	0
220100	Computers, computer systems and networks	421	258	1,970	84	21	142
220200	Automatic systems for information processing and management	241	98	1,090	80	45	199
220300	Systems for automatic design	46	26	185	0	0	0
220400	Software for computers and automatic systems	324	140	1,263	176	36	535
550200	Automation and management	60	0	217	0	0	0
Telecommunications		**524**	**314**	**2,346**	**0**	**0**	**0**
200900	Networks and commutation systems	133	98	651	0	0	0
201000	Multi-channel telecommunications systems	149	122	730	0	0	0
201100	Radio communications, radio and TV broadcasting	94	63	389	0	0	0
201200	Mobile communications	51	19	213	0	0	0
201400	Audio and video technologies	37	0	85	0	0	0
201800	Secure telecommunications systems	27	0	27	0	0	0
550400	Telecommunications	33	12	251	0	0	0
Total		**4,941**	**2,586**	**20,743**	**1,549**	**645**	**5,026**

Source: State Institute of Information Technologies and Telecommunications, Russian Higher Schools Database, http://db.informika.ru/vuz/index.htm

A2. Russian Technologic Choices and Local Technology Development

The key aspects which determine the choice of telecommunications technologies in Russia are such specific features of the country as uneven distribution of population, and consequently, uneven development of infrastructure. Another important feature is that during the transition period most of the traditional telecommunications operators did not receive sufficient investment resources for upgrading of their networks. As a result, the two very different worlds of technology coexist now in Russia. Both old equipment inherited from the Soviet period, and new solutions introduced by the newly established operators, is now used in the Russian telecommunications industry.

Implementation of new technologies and solutions in Russia is strongly regulated by industry authorities. All new equipment should be certified by specialized certification centers and this process is usually both time-consuming and bureaucratic. A more detailed review of the state policy in ICT sector and its development is presented in the forthcoming special study entitled *Networks: Rules of the Game and Their Development.*

In this chapter we describe the main technologies used in ICT industries in Russia today, and also provide some insight into further technological choices for the country. This analysis concerns the main ICT subsectors, namely:

- Data transmission (provider technologies)
- Internet access (subscriber technologies)
- Traditional telephony
- IP telephony
- Cellular communications
- Software

We also show the potential for the local technology development in the outlined areas of activity.

Data Transmission

This sector is characterized by use of most up-to-date technologies. It happened so that collapse of the USSR and privatization of telecom-

munications industry coincided with rapid development of modern data transmission technologies. That is why new operators, which started to appear on the market in 1990s, were able to establish high-speed networks on the base of modern fiber-optic solutions that are easy and cheap to upgrade. At the same time, traditional operators in big cities started to modernize their infrastructure, although this process is rather slow.

Presently, the major data transmission technologies used in Russia are the following:

DWDM[39]: This technology appeared in Russia not long ago but many large operators have already introduced it or plan to upgrade their networks in the nearest future. Despite high cost of equipment, this technology is quite popular, because it provides opportunities to considerably increase carrying capacity of networks.

SDH[40]: It makes sense to use this technology when the main type of traffic is voice telephone, and the shares of other types are insignificant. That is why SDH technology is popular among Russian telephone operators, and new SDH networks are often used to upgrade the existing infrastructure. Presently this solution is the most acceptable for telephone operators in terms of price/quality ratio. It is very likely that this technology for traffic transmission will be used for modernization of rural telephone networks and telephone networks in medium-sized and small towns (for example, within the framework of the *Electronic Russia* program).

ATM[41]: This technology is used by almost all companies, which provide transmission of different types of traffic (voice, data, video, etc.). Its main advantage is high quality of data transmission. The drawback of this technology is its high cost and rather complicated equipment. Nevertheless, such networks are expected to develop because there is a significant demand for new high-speed data transmission channels in Russia.

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[39] DWDM (Dense Wavelength Division Multiplexing) works by combining and transmitting multiple signals simultaneously at different wavelengths on the same fiber which allows for significant increase in carrying capacity of the fiber-optic networks.

[40] SDH (Synchronous Digital Hierarchy) refers to a standard for synchronous data transmission over fiber optic networks.

[41] ATM (Asynchronous Transfer Mode) is a high-performance, cell-oriented switching and multiplexing technology that utilizes fixed-length packets to carry different types of traffic.

Ethernet (Fast/Gigabit)[42]: Ethernet technology became popular about 3 years ago, when the opportunity to transmit data up to 90 km by optical cables was developed (before that the technology was used only in local networks). Presently this technology is considered an inexpensive and effective solution for data transmission, as well as for connecting corporate networks over small and medium distances.

Satellite Access: This technology allows organizing transmission of traffic in regions located far from populated areas and wire infrastructure. It will obviously develop in near future in such places like gas and oil fields, etc.

All these technologies have technical solutions developed and produced in Russia. A number of companies (for example, the St. Petersburg company SuperTel) carry out research in new types of equipment and consider prospects for mass production of such equipment. Local products are often characterized by lower quality compared to similar western products, but they are cheaper. As a result, several companies already work not only on the Russian market, but also sell their products abroad.

Internet Access

Compared to provider technologies, this segment is rather underdeveloped. In the Soviet period very little attention was paid to technologies of 'the last mile' (low level of telephony penetration, unsatisfied demand for installation of telephone lines, low quality of basic infrastructure, etc.). Nowadays the underdeveloped telecommunications infrastructure is the main factor that slows down the development of subscriber access in Russia.

The major subscriber technologies currently used in Russia are the following:

Dial-up access via telephone lines: It is the most popular way of Internet access for home users. It is the cheapest technology, even if the prices for alternative technologies were reasonably reduced. Availability of a

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[42] The term Ethernet refers to the family of local-area network (LAN) products covered by the IEEE 802.3 standard that defines what is commonly known as the CSMA/CD protocol. Three data rates are currently defined for operation over optical fiber and twisted-pair cables: 10 Mbps – Ethernet; 100 Mbps – Fast Ethernet; 1000 Mbps – Gigabit Ethernet.

large number of providers on the market, as well as low connection costs, make it possible for any computer owner to use dial-up access. Among the drawbacks of this technology is low speed of data transmission, which limits the possibilities of using modern services, such as transmission of streaming audio and video content. Nevertheless, in terms of the number of users this way of Internet access will remain the leader on the market for a long time in the future.

xDSL[43]: DSL technologies of data transmission started to be used in Russia not long ago, in late 1990s. Presently, the market has significant potential: in 2001 the growth of the client base exceeded 200%. On the other hand, the number of subscribers in absolute figures is not very large: about 1,300 in St. Petersburg and about 3,500 in Moscow. Among the advantages of these technologies is high speed of data transmission via copper wires, which is the main solution in 'the last mile' for home users today. As for the drawbacks, the most important one is lack of competition, which leads to high prices and narrow coverage and, as a result, to low level of penetration of these solutions. However, it is a very promising market, which can be proved by the experience of other countries, where the number of subscribers using DSL technology is growing constantly.

HFC[44]: HFC networks allow the operator to provide basic TV signal, as well as additional services (Internet access, telephone lines, digital TV, etc.). This solution is already being introduced by cable TV companies, as they already have the necessary basic cable networks. However, there is no competition in this sector because cable networks of different companies are located in different districts, and thus a subscriber has no actual choice. This results in high prices, although so far the quality is not very high. If the prices do fall, this service could face high demand, as current penetration of cable TV is much higher compared with xDSL technologies.

Radio access: This kind of access exists on the market since mid-90s, and the service has already become well-known and popular. Major consumers of these services are users who are not able to install wire communications, or for whom such installation proves rather difficult.

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[43] DSL (Digital Subscriber Line) is a set of technologies that exploit unused frequencies on copper telephone lines to transmit traffic typically at multi-megabit speeds.

[44] HFC (Hybrid Fiber Coaxial) is a flexible access and transmission system, combining coaxial and fiber-optic cable.

This service provides high-speed access in remote districts located far from cable infrastructure, and thus it has a great potential in Russia, where even some cities are characterized by large areas and uneven distribution of population.

Ethernet/Fast Ethernet: This technology is used to provide high-speed Internet access within a micro district of the city. It partly competes with HFC solutions and is not widespread at the moment, which results in high prices and low penetration.

ISDN[45]: This is the first alternative to dial-up access implemented in Russia. However, at present it is not widespread, with the number of its users smaller than that of xDSL technology users. Still, it has potential for rapid development in the nearest future, as there are ISDN interfaces installed at all digital telephone exchanges, which are now gradually replacing old analogue equipment in telephone networks. If the cost of services decreases and prices for equipment fall, this service might become popular among private users and small companies.

Thus, we can see that now the most popular Internet access technology in Russia is dial-up access. However, the purchasing power of the population is growing, and interest appears towards various high-speed services, such as streaming video (Video-on-Demand) and audio, and the need to exchange substantial volumes of information is also increasing. Thus, there is a certain demand for high-speed access services, which are in short supply at the moment and, in most cases, very expensive. We believe that broadband technologies will occupy a much greater share on the market, if the competition will develop decreasing the price and increasing the quality of the services.

One of the factors, which also hinder development of the subscriber technologies in Russia, is low domestic supply of the corresponding products and solutions. It was mentioned above that in Soviet period little attention was paid to development of 'last mile' technology, and the country has not inherited significant knowledge and R&D potential in this sphere. Now this results in absence of local producers capable to provide successful alternatives to imported products.

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[45] ISDN (Integrated Services Digital Network) is a system of digital phone connections which allows data transmission.

Traditional Telephone Services

Before the collapse of the USSR, telephone services were provided only by state telecommunications companies. In the early 90s new operators started to appear on the market, however they focused on business clients, and by the end of 2001 operated only 3.8 million telephone lines, while the capacity of the networks of traditional operators was 27.6 million lines[46].

The level of digitalization of basic telephone networks is still far from satisfactory. By the end of 2000, for urban areas this figure was 35%, and for rural regions 8%. That is why this sector possesses a huge market potential for modernization of deteriorating equipment, as well as for expansion of telephone networks. Reorganization of the traditional companies and gradual introduction of time charges should increase their profitability and investment attractiveness, which, in turn, will motivate them to invest and, therefore, will create substantial demand for equipment.

One of the actively developing segments of the telecommunications equipment market is manufacturing of automatic office exchange systems. Presently, companies and organizations install digital exchanges, on the basis of which modern corporate networks can be set up (with standard and DECT[47] phones, possibility to use IP telephony, etc.). This market is well developed: both domestic and foreign producers are represented here. The total revenues in this sector in Russia was USD 60-70 million in 2000, but such a low volume of sales is explained by the consequences of the 1998 economic crisis. Now the demand for automatic office exchange boards is growing following the current development of small and medium-sized businesses, as well as the modernization of networks in large companies.

In the sphere of equipment for traditional telephone services local production is quite well-developed in Russia There are many companies manufacturing exchange systems for basic networks and office exchanges of any size. Joint ventures with Western companies are most successful in this sphere, as they use foreign technologies and local advantages, which allow them to offer high-quality technical solutions at competitive prices. Nevertheless, Western companies also actively

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46 Goscomstat, 2001.

47 DECT (Digital Enhanced Cordless Telecommunications) is a flexible digital radio access standard for cordless communications in residential, corporate and public environments.

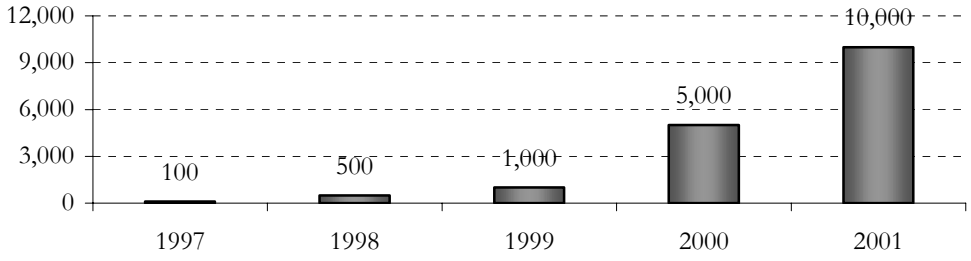
compete with local producers, and presently occupy the largest share of the market.

IP Telephony

IP telephony[48] services first appeared in Russia in 1997. Since 2000 IP telephony market has experienced booming growth, as IP operators offered considerably lower prices for long-distance domestic and international calls compared to traditional operators.

In 2001 IP telephony market had the total volume of about USD 50 million, and now market participants expect further rapid growth. By 2005, according to expert forecasts, up to 70% of all international traffic in Russia will go through IP networks. That is why further growth in demand for IP telephony equipment is to be expected. In 2001 sales volumes of this equipment grew by 100%.

Figure A2.1 Russian IP Telephony Equipment Market (thousand USD)



Source: www.ot.ru

Although IP telephony is a relatively new phenomenon in Russia, many local manufacturers have already established production of equipment for this technology. The rapidly growing market provides opportunities to invest in development of new solutions required by operators and large companies constructing multifunctional corporate networks.

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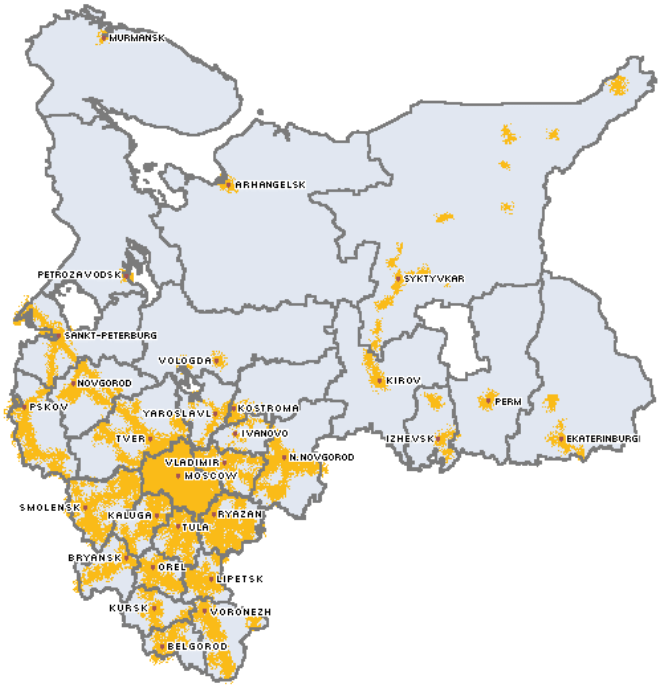
[48] IP telephony (also known as VoIP (Voice over IP)) refers to technology for transporting telephone calls via the Internet.

Cellular Communications

Development of cellular communications in Russia mainly followed European trends. Analogue standards NMT-450 and AMPS-800 were the first to appear on the market, as they required relatively small investment to cover large territories. From the mid-90s, GSM standard has been actively developing in Russia. Due to its advantages (large number of equipment producers, global roaming service, high quality of digital voice and data transmission, wide range of additional services, etc.) this standard eventually occupied the leading position in the market (85% by the beginning of 2002).

However, considerable costs of infrastructure development prevent operators from using GSM 900/1800 standard to cover large territories in Russia. Presently, the network covers only areas around large cities and some important highways, as we can see from the activities of the leading Russian cellular operator, MTS. Its coverage in Central and Northwest Russian regions is presented in Figure A2.2.

Figure A2.2 Coverage of MTS, the Leading Russian GSM Operator, in the European Part of Russia, 2002



Under such conditions, there is an urgent need for new low frequency standards, which require smaller investment and allow for coverage of larger territories. The largest Russian operators in NMT-450 standard, Delta Telecom and Moscow Cellular Network, obtained licenses for providing services in IMT-MC-450[49] standard. However, the leading world producers of telecommunications infrastructure pay little attention to low frequency standards, because very few countries plan to develop such networks. That is why they are not likely to develop rapidly in Russia. Even if operators of these standards focus on providing modern services, such as high-speed data transmission (standard IMT-MC-450 can provide the speed up to 153 Kb/sec, which is 3-4 times higher than real speed in GSM networks supporting GPRS), they are not likely to occupy a significant share on the Russian market due to lack of international roaming services and small penetration within the country. Small number of companies producing terminal equipment (compared to GSM standard) will negatively affect the prices and quality of telephones, as well as the overall popularity of these networks.

Thus, the future of cellular networks in Russia belongs to GSM standard, which is implemented by the three largest operators of the country. These operators now possess significant investment resources and are actively developing their networks in various regions of Russia. Emergence of new national operators, even if they use more effective technical standards, will not cardinally change the distribution of the existing players in the market.

Development of 3G networks in Russia is presently in the stage of construction of experimental networks. Russian 3G Association suggested the major principles for distribution of licenses for 3G networks: due to lack of frequency capacity, only 3-4 companies should obtain these licenses. These are supposed to be major Russian cellular operators (MTS, Vympelcom and Megafon), while the forth license might be given to any other operator, maybe including one of the foreign telecom companies. The conditions for participation in the contest and license cost are not defined yet (it is reported to be minimal), so foreign participants have not publicly shown any interest yet. It is expected that by the end of 2002 the licenses will be distributed, and the first commercial networks will appear in 2004. Perspectives for development of such networks are still quite vague, because effective demand for their services exists only in several large Russian cities.

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[49] IMT MC (IMT-2000 Multi Carrier) is the representative of the set of technologies IMT2000 (International Mobile Telecommunications), and refers to evolution of the CDMA 2000 (IS-95) standard.

Russia does not have its own technologies for cellular communications. All mobile companies currently operating in Russia use equipment produced by foreign manufacturers. However, significant growth potential of the market suggests that it might be profitable to build local plants of Western companies, which would be able to use local competitive advantages (cheap labor force, industrial capital, etc.). This could allow for supplying equipment to Russian cellular operators at lower prices and thus increase competitiveness compared to other companies that offer equipment produced abroad.

Unlike equipment manufacturers, companies developing software for cellular networks are actively growing in Russia. Many of them already supply their products not only to regional and national markets, but also to other countries.

Software

Russian software market is characterized by high penetration of pirate products, which is caused by low purchasing power of the population. The use of unlicensed software by legal entities is to a certain extent controlled, but almost all home users use pirate products. Thus, the software market, especially its segments oriented at private users, is developing very slowly.

Active development of the Russian software sector oriented at corporate clients began only in the 90s, i.e. much later than in developed countries. As a result, local software developers had to compete on the national market with large foreign companies, which already had had considerable experience, promotion power and service support. Nevertheless, the market of corporate software, which had not been practically developed, created conditions for rapid growth of local companies. Their main competitive advantages are flexibility and better knowledge of specific Russian conditions, which allows them to meet customer needs more efficiently. A relatively low cost of labor and high qualification of personnel also facilitate price competitiveness. Thus, the majority of small and medium-sized orders for development and introduction of software products in Russia is now carried out by local companies. Western companies mainly work with very large clients who buy complex and expensive solutions. As an example, one can mention Moscow cellular operator Vympelkom, which originally used billing system produced domestically, but after its subscriber base reached the level of 2 million, it declared plans to introduce billing systems provided by Amdocs – one of the world leaders in this field.

Nevertheless, domestic companies are growing fast and are already able to compete with the world leaders of IT market. Many of them already actively work not only on domestic, but also on international markets. A number of companies are known worldwide for their successful products; among them are Kaspersky Laboratory (antivirus programs), ABBYY (text recognition systems, electronic dictionaries), Promt (machine translation), etc.

Conclusions

In conclusion, it can be claimed that Russia, at present, has not got any particular technology choices in telecommunications compared to other European countries. In most sectors it follows the established European trends, like development of GSM standard in cellular communications.

The main distinctive feature is that the country is lagging behind Europe in penetration of the new technologies. The main obstacles that hinder the development of the new technologies are low purchasing power of the population and low effectiveness of some markets (like broadband Internet access), which results in high prices and low availability of the services.

Perhaps the main particular trend in telecommunications development in Russia is that the role of wireless technologies in telecommunications is going to be comparatively large for some time in the future. Underdeveloped wire infrastructure and large territories make it possible that wireless technologies could prove more profitable in telephone services and data transmission in places where they are unavailable at the moment.

As concerns local technology development, we could summarize that there are certain competitive local products in those industries where there is substantial inherited human capital and R&D potential. These are software development, data transmission, and telephone exchange equipment. It most other sectors, including mobile communications and last-mile technologies, there is no inherited potential and thus no successful local players. As we have shown above in competitive advantages analysis, this is a promising sector for local activities of global leaders.

A3. Networks: Rules of the Game and Their Development

Russian telecommunications are nowadays among the most rapidly growing industries in the national economy. Any further development strongly requires focused long-term industrial policy, the main targets and regulations of which should be outlined in federal and regional legislation. However, the current legislative base for the telecommunications market is still far from perfect. The present regulations are complex and contradictory and, in most part, do not meet the long-term targets of the industry development.

Review of Legislation

Presently, licensing, management and control over ICT companies is carried out in accordance with the following legislative acts:

1. Federal Law " On Communications" of February 16, 1995 #15-FL (with amendments of 06.01.1999 #8-FL and of 17.07.1999 # 176-FL).

This is the main law regulating the sphere of telecommunications. It includes major regulations, and lists the structures responsible for more detailed development of legal documents in different sectors.

2. Federal Law " On Mail Service" of 17.07.1999 # 176-FL

Determines legal, organizational, economical, and financial foundations in the sphere of mail service in the Russian Federation.

3. Federal Law "On Information and Informatization" of 20.02.1995 #24-FL

Regulates relations resulting from creation and use of information technologies and supporting facilities, and determines the rights and obligations of entities participating in information processes and informatization.

4. Federal Law " On Participation in International Information Exchange" of 04.07.1996 #85-FL

Defines information exchange and its products, and regulates responsibilities of its participants, including government bodies.

5. Administrative Infringements Code of December 30, 2001 (in effect from July 1, 2002)

Determines administrative responsibility for violations in the sphere of telecommunications.

6. Federal Law " On Natural Monopolies" of 17.08.1995 #147-FL (with amendments from 08.08.2001 #126-FL)

Determines legal foundations for federal policy regarding natural monopolies in the Russian Federation, including those in the telecommunications industries.

In addition to laws directly regulating activities in the sphere of telecommunications and informatization, telecommunications enterprises and organizations are strongly influenced by tax, customs, and antimonopoly legislations, as well as by some other legislative acts.

Obtaining a license is required for starting and running a telecommunications business. The procedure of obtaining a license is described in legislative acts issued by the Russian Government, including:

- Regulation on Licensing of Activities in the Sphere of Telecommunications in the Russian Federation (approved by governmental regulation of 05.05.94 #642).

- Regulation on Licensing of Activities in the Sphere of International Information Exchange (approved by governmental regulation of 03.06.98 #564).

- Regulation on Conducting Competition for Obtaining a License for Realization of Activities in the Sphere of Providing Cellular Communications Services Using Radio Frequencies (approved by governmental regulation of 10.06.1998 # 587).

Use, production and import of the radio-electronic communication equipment and devices are regulated by Government Regulation of June 5th, 1994 # 643 "On the Order of Production, Acquisition, Import to the Russian Federation and Exploitation in Russian Federation of Radio-Electronic Equipment (high-frequency devices)".

Direct law enforcement in ICT industries is carried out by the Ministry for Telecommunications and Informatization of the Russian Federation (hereafter referred to as MTI RF) which issues instructions, regulations and other acts binding for all market participants and relevant state authorities.

MTI RF comprises several commissions and departments that carry out specific control and regulation in ICT sector. The following authorities should be listed as the principal MTI RF bodies:

1. State Telecommunications Commission

The commission is responsible for coordination and control of activities aimed at improvement of telecommunications networks, including development of the regulatory base and the regulation on connection to telecommunications networks of general use.

2. State Radio Frequencies Commission

The commission runs frequency allotment and control over usage of radio frequency spectrum by all kinds of radio transmission devices on the territory of Russia. The commission has a right to limit or prohibit use or production of radio transmitting devices, which have not been licensed.

3. State Informatization Commission

The commission coordinates activities in the sphere of regulatory and legal base for informatization, as well as reviews and makes conclusions concerning projects and state programs in the sphere of informatization.

4. The Department for Supervision of Telecommunications and Informatization

This department is responsible for supervision of the condition of telecommunications and postal networks and equipment, as well as for monitoring of the quality of telecommunications and informatization services provided to consumers in accordance with the terms of licenses and quality standards.

Current Regulation Highlights

In the Soviet period, there were no laws regulating the telecommunications industry. Telecommunications bodies were owned by the state and controlled by different ministries and government departments. Only after the first non-governmental telecommunications companies had appeared in the early 90s, it became necessary to establish legislative control over the industry. As a result of little experience in this sphere, newly appeared legislation left a number of unresolved issues and created a rather complex regulatory system.

A very substantial input and support in the conditions of rapid transition to the market economy and changing environment was provided by the EU. The EU was funding a range of projects (in the period from 1993 to 2000 as much as 20 MEUR were invested) related to development of regulative environment in ICT. Among these projects were

- "Secondary Legislation in Telecommunications" (1995, development of telecom and mail service regulations)
- "Legal Support and Policy Advice for the Development of a Regulatory Framework for the Telecommunications Sector".
- "Modernisation of Management and Monitoring of Radio Spectrum Usage"
- "Testing and Harmonisation of Standards in Space Communication"

In addition to the listed above projects TACIS was financing creation of the postgraduate education centers in Russia (we mentioned such center in St. Petersburg in our report) and certification centers (LONIIS as an example).

Notwithstanding substantial help and support the largest part of the law making is made by the Russian authorities themselves. Although there are many important achievements the legal framework remains still underdeveloped and does not fully meet requirements of the industry.

Among the main features of the current legislation in the telecommunications industries are the following:

- Complicated licensing procedure and high extent of controlling and regulative interference of the state in the telecommunications business;
- Policy targeted on limiting of charges for services provided by traditional operators;
- Unclear rules for interaction of new telecommunications operators with traditional companies;
- Practice of subsiding the costs of traditional operators.

First of all, a huge number of licenses required for participants of telecommunications market made the licensing procedure very complicated and confusing. Telecommunications business is divided into many segments, and a special license is required for working in each of them. This caused different kinds of official circumlocutions. The possibility of a single license is now under consideration, but it is still unclear when this project is going to be implemented.

It is worthwhile to describe here in more detail the situation in the market of cellular communications, since it is one of the most dynami-

cally developing segments of ICT sector. Government Regulation #578 of 10.06.1998, an well as the law "On Communications" with all subsequent amendments, do not clearly determine the rules of licensing of cellular services, and the procedure of application and decision-making is very complicated and confusing. This leads to bureaucratic arbitrariness and prevents new players from entering the market. Another problem is that priorities for development of the sector are determined by the ministry itself. It decides what standards are allowed to develop on the market (presently, it is GSM, IMT-MS-450 and NMT-450) and in effect prohibits other standards (CDMA-800, AMPS-800). Current telecommunications legislation, while introducing the concept of state policy of priorities in telecommunications sector, in fact allows MTI RF to set out groundless constraints for the market participants in their development of telecommunications systems.

Apart from licensing, the telecommunications equipment and devices are subject to obligatory certification. Production, acquisition, import and exploitation of radio-electronic equipment are exercised on the basis of permits issued by the MTI RF Department on Supervision of Telecommunications and Informatization.

Finally, starting from 1999 all telecommunications operators were obliged to install and exploit on their own cost the systems of technical equipment for support of criminal investigation activities, such as tapping, control and recording of voice and electronic messages, defining of subscriber's telephone number and location (the so-called 'SORM-systems'). Control over the use of SORM-systems is carried out by MTI RF Department on Supervision of Telecommunications and Informatization. However, specific use of this equipment is exercised in close interaction with law-enforcement authorities entitled to issue orders within their competence, which are obligatory for the relevant telecommunications operators. Should the operator break the rules of SORM-systems installation or exploitation, it will be subject to sanctions applied by the Department on Supervision of Telecommunications and Informatization, including revocation of license. The main legal act in this area is the MTI RF Order of July 25th, 2000 # 130 "On the Order of Implementation of the Systems of Technical Equipment for Support of Criminal Investigation Activities in the Networks of Telephonic, Mobile and Wireless Communications and Personal Radio-Call for General Use".

Consequently, state regulation in this sector remains predominantly restrictive and permissive, which:

- Constrains market development and possibilities for economic growth for existing participants, as well as creates barriers for new players in the market;
- Increases the share of operators' indirect costs, not connected to providing telecommunications services and manufacturing of equipment;
- Favors growth of corruption in relations between market participants and regulative authorities, including protectionism for some operators by the loyal and often directly affiliated government officials, up to the level of federal department heads.

At the same time, efficiency of such state regulation is still very low. Thus, for example, the permissive policy of MTI RF often causing monopolization of regional and interregional markets contradicts the anti-monopoly regulations implemented by the Ministry for Anti-Monopoly Policy of the Russian Federation and its regional offices.

The second important feature is state regulation of charges policy of traditional operators. Telecommunications services have historically had social significance and governments of all levels are constantly implementing measures aimed at limiting charges increase for local telephone services used by the population. This forces traditional operators to compensate losses by setting very high charges for long distance domestic and international calls. State telecommunications operator Rostelecom, the national monopolist on the market of long distance telephone traffic, is constantly increasing its prices for its services subject to authorization by Ministry for Antimonopoly Policy. Besides, the permissive policy of MTI RF, as described above, favors the creation of regional and interregional monopolies in the mobile telecommunications area. That is why appearance of a new strong player on such a market often causes a monopolistic collusion rather than bona fide competition.

The third characteristic feature of the Russian ICT market is lack of regulation on connection of alternative operators to the networks of general use. This allows traditional operators to dictate conditions for connection depending on their own interests, and thus creates additional problems for alternative operators. Access to subscribers of traditional operators is not regulated either, so in order to enter this segment of the market new companies have to construct its own last mile infrastructure. On the other hand, there are no strict requirements and specifications of the networks of telecommunications companies, which allows new players to establish communications, optimal in their

functionality and costs, while traditional operators are forced to use less efficient solutions simply because they must comply with the existing old networks.

An interesting feature of the telecommunications market is state subsidizing of some of its participants. This phenomenon mainly concerns traditional operators, because they bear a significant social burden of providing telecommunications services to underprivileged social groups[50] at lower rates. At present, this subsidizing is implemented through granting funds to companies aimed at compensating the losses resulting from lower rates for services. However, such financing is not sufficient to cover the operators' losses and is often transferred with significant delays.

Possible Solutions for Legal Problems

There are suggestions by the federal government for establishment of a clear legal base in the sphere of telecommunications. Presently, a new version of the federal law "On Communications" is being discussed. The following amendments are suggested:

- Establishment of the Fund for Universal Service – organization, accumulating 3% of the revenues of all active operators. It is suggested to use these resources for development of telecommunications services, which are unprofitable but are required by the population (e.g. development of the networks in under-populated rural areas).

- A concept of "universal telecommunications services" is introduced. It refers to a minimum set of telecommunications services which must be provided to users at moderate prices within a certain period of time, and which must meet certain quality standards. According to the draft law, the list of universal services, procedures and periods of service provision will be determined by the government. Depending on the amount of resources received by the fund, the list of universal services will be adjusted. Besides, this list can vary in different regions of the country.

- The principle of separate revenue and expenditure accounting for different kinds of services provided by telecommunications op-

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[50] This category includes pensioners, war veterans, socially handicapped people, etc.

erators is proposed (it mainly concerns traditional operators which have not, so far, separated different services in their accounts).

- It is claimed that there must be no discrimination in connection to networks of general use, and that this procedure must be transparent. Thus, this solution will put an end to arbitrary decisions on part of dominating operators. At the same time, the draft law suggests setting charges for traditional services on the federal level, equal for everyone, determined on the basis of economically sound costs and standard profitability.

- The practice of 'cross subsidizing', whereby costs for providing short distance communications (where tariffs are low) are compensated by high tariffs for long distance communications, is proposed to be discontinued.

- A procedure for solving a problem of 'discounts the underprivileged categories of population' is determined. The draft law assumes that subscribers will pay the full price for telecommunications services to operators, and then receive monetary compensations in the institutions which provide them with right for discount.

Beside this draft law, a reform of the monopolies, such as Federal Postal Service (privatization) and Rostelecom, is being prepared with the aim of developing the necessary conditions for fair competition in these sectors.

In addition to that, suggestions to simplify tax and customs legislation in the sphere of telecommunications and telecommunications equipment manufacturing are under consideration. The present level of customs duties for electrical components (20-25%), as well as frequent delays at the customs checkpoints, slows down production growth in Russia. Tax legislation in a number of cases assumes double taxation of telecommunications services, which are, in their essence, a single product. Adjustment of legislation to the actual situation in the market will simplify development of old companies, as well as foundation of new companies in telecommunications industries.

Mass Media and Software

It is important to pay special attention to the problems of regulation of mass media and software market, because development of new services and products in this sector to a large extent influences development of modern telecommunications networks. Presently, new media services and digital content are just in the early stages of their development, but

rapid growth of telecommunications and the Internet suggests that popularity of these services will significantly grow in the nearest future.

At the present moment there is a large number of different regulatory documents concerning activities in the sphere of mass media (quite recently, regularly renewed web-pages have also been included into this category):

1. Federal Law "On Mass Media" (amended by Federal Laws of 13.01.95 #6-FL, of 06.06.95 #87-FL, of 19.07.95 #114-FL, and of 27.12.95 # 211-FL)

2. Federal Law "On Copyright and Related Rights" (amended by the Federal Law of 19.07.95 #110-FL)

3. Federal Law "On Communications" of February 16, 1995 #15-FL (amended by the Federal Laws of 06.01.1999 #8-FL, and of 17.07.1999 #176-FL)

4. Federal Law " On Advertising " of June 14, 1995

5. Federal Law " On Procedure of Coverage of Activities of Government Authorities in the State Mass Media" of December 15, 1994

6. Federal Law "On State Support of Mass Media and Publishing in the Russian Federation" of December 1, 1995

7. Some Presidential Decrees, Government Regulations and Recommendations of the Ministry for the Press and Mass Media.

Comprehensiveness and reliability of information is the main requirement imposed on the mass media in Russia. However, at present the traditional mass media are financially dependent on various state and private entities. Private financial groups owning large shares in mass media companies can dictate their conditions of presenting information, and state authorities can use legislation for warning and closing down any mass media facilities. Presently, the laws are developed in order to solve some of these problems and provide more independence to media (for example, procedures for interaction between shareholders and editors concerning information content), and also to allow state authorities more control over mass media companies (giving them rights to limit certain mass media activities or close mass media companies). The fact that regularly renewed Internet information portals have been included into mass media (which means that their activities will also be licensed and regulated by the state) shows the intentions of the government to control not only the sector of traditional mass media, but also the new types of media which until recently have not been subject to any supervision or regulation.

At present, a new draft law is being debated is the State Duma, entitled “On a 25% Restriction for Single-Person Participation in Equity of Russian Mass Media Companies“, developed by the liberal pro-presidential fraction SPS. This draft law is reported to have received a positive response from the President. Adoption of this law will set a restriction to own equity in mass media companies, so that one person will not be able to determine the decisions of a company's shareholders or board of directors. State ownership of mass media will also be subject to these constraints, albeit with some exceptions. The policy of the Government and MTI RF is oriented towards a gradual withdrawal of the state from mass media ownership shareholding, i.e. to the implementation of the 'one TV channel, one broadcasting station, one newspaper' principle for any government body (both on the federal and regional levels). It should also be noted that at present the Russian government directly or indirectly holds majority stock in the three biggest all-Russian TV channels: Channel One (formerly, ORT), RTR and NTV. Regional mass media, primarily most TV channels, are almost totally controlled by regional governments (administrations). Finally, the proposal to restrict shareholding in all-Russian mass media companies on part of foreign individuals and companies, as well as the problem of Russian entities wholly owned by foreigners, is now actively debated. Judging by the latest declarations from the authors of proposed amendments to the Federal Law “On Mass-Media“, the limit would be set for foreign persons and their 100% Russian associates to acquire no more than 50% of shares in any all-Russian media companies. This means that all foreign shareholders of a mass-media company will not be allowed to hold more than 50% of the total equity in any company.

However, unlike the traditional mass media, the sectors of new media and software development are still weakly controlled by the state, which gives them a certain level of editorial freedom and financial independence.

At the same time in this study it is important to touch upon the problems of intellectual property rights protection for software developers and creators and owners of Internet portals and sites. While protection of copyright of software developers is in principle quite effectively regulated by the current intellectual property legislation, the mechanisms and legal procedures of such protection stay ineffective because of extraordinarily spread 'piracy', inadequate administrative and criminal sanctions for breaches in this sphere, lack of skill and frequently displayed unwillingness of law-enforcement bodies to prosecute such breaches. In the sphere of the Internet, legislation gaps cause almost absolute absence of legal protection for owners and creators of

web sites, domain name owners etc. For example, Russian legislation does not recognize intellectual property rights on domain names, even if such names are exact reproductions of registered trademarks or trade names. Besides, Russia has not yet signed the agreement of the World Intellectual Property Organization on procedures of conflict settlements between owners of trademarks and Internet domain names. Legal practice in this area is very meager and courts very often pronounce contradicting judgments.

According to the law "On State Support of the Mass-Media and Publishing in the Russian Federation", mass-media companies have been recently enjoying certain tax, customs and currency preferences. However, these provisions became ineffective on January 1st, 2002, and, as a result, this law is now effective only for regulation of privatization of publishing and printing houses owned by the federal government: it prohibits privatization of federally-owned publishing and printing monopolies, and puts significant restrictions on distribution of shares in regional publishing and printing houses owned by the federal government.

Conclusions

The rules on the Russian telecommunications market are presently rather unclear. It especially concerns the most rapidly developing and profitable segments of the market, such as cellular communications, IP telephony and Internet access. High profitability of these sectors provoked large operators to promote situation when the appearance of new players on the market is not strictly regulated and depends on many various factors. For example, it is now extremely difficult for a new operator to enter the market of cellular communications in GSM900 standard because major operators have already got licenses covering almost the whole territory of Russia and have occupied almost all free frequency bands. Official licensing of new companies is in principle allowed, but in practice it is almost impossible. As a result, the only possible way for the new player to enter the Russian GSM market is acquisition of an existing company, which has already obtained a license.

The market of wire communications also suffers from the absence of clearly defined rules. This especially concerns access of alternative operators to networks of general use, as well as to the existing subscribers of traditional telephone operators. This factor gives the latter an opportunity to dictate conditions, which makes other companies either leave the market, or suffer extra costs.

However, some measures are planned in order to streamline regulation on the telecommunications market. At present, several draft laws are under consideration, including the new version of the Federal Law "On Communications". State telecommunications officials are constantly claiming that they are well informed of all the problems in this market, and in the nearest future are going to work on solving them at the legislative level. Now the sector urgently needs investments, but its attraction in large volumes will be possible only if the rules are clearly defined.

If the country wants competitive and successful telecom or related companies to indicate Russia as their domicile location they need to recognize the importance of competition and fawourable business climate and do everything to legally introduce both wherever is possible in the nearest future.

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