Yulia Panova

PUBLIC-PRIVATE PARTNERSHIP INVESTMENTS IN DRY PORTS – RUSSIAN LOGISTICS MARKETS AND RISKS

Thesis for the degree of Doctor of Science (Technology) to be presented with due permission for public examination and criticism in Honka Hall, Kouvolan kiinteistöt Oy, Kouvolan taloyhtymän talo, Kouvolan kaupunki, Finland, on the 8th of April, 2016, at noon.
Abstract
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Public-private partnership investments in dry ports – Russian logistics markets and risks
Lappeenranta 2016
218 p.
Acta Universitatis Lappeenrantaensis 689
Diss. Lappeenranta University of Technology
ISBN 978-952-265-924-8
ISSN-L 1456-4491
ISSN 1456-4491

The investments have always been considered as an essential backbone and so-called ‘locomotive’ for the competitive economies. However, in various countries, the state has been put under tight budget constraints for the investments in capital intensive projects. In response to this situation, the cooperation between public and private sector has grown based on public-private mechanism. The promotion of favorable arrangement for collaboration between public and private sectors for the provision of policies, services, and infrastructure in Russia can help to address the problems of dry ports development that neither municipalities nor the private sector can solve alone. Especially, the stimulation of public-private collaboration is significant under the exposure to externalities that affect the magnitude of the risks during all phases of project realization. In these circumstances, the risk in the projects also is becoming increasingly a part of joint research and risk management practice, which is viewed as a key approach, aiming to take active actions on existing global and specific factors of uncertainties. Meanwhile, a relatively little progress has been made on the inclusion of the resilience aspects into the planning process of a dry ports construction that would instruct the capacity planner, on how to mitigate the occurrence of disruptions that may lead to million dollars of losses due to the deviation of the future cash flows from the expected financial flows on the project. The current experience shows that the existing methodological base is developed fragmentary within separate steps of supply chain risk management (SCRM) processes: risk identification, risk evaluation, risk mitigation, risk monitoring and control phases. The lack of the systematic approach hinders the solution of the problem of risk management processes of dry port implementation. Therefore, management of various risks during the investments phases of dry port projects still presents a considerable challenge from the practical and theoretical points of view. In this regard, the given research became a logical continuation of fundamental research, existing in the financial models and theories (e.g., capital asset pricing model and real option theory), as well as provided a complementation for the portfolio theory.

The goal of the current study is in the design of methods and models for the facilitation of dry port implementation through the mechanism of public-private partnership on the national market that implies the necessity to mitigate, first and foremost, the shortage of the investments and consequences of risks. The problem of the research was formulated on the ground of the identified contradictions. They rose as a continuation of the trade-off between the opportunities that the investors can gain from the development of terminal business in Russia (i.e. dry port implementation) and risks. As a rule, the higher the investment risk, the greater should be their expected return. However, investors have a different tolerance for the risks. That is why it would be advisable to find an optimum investment. In the given study, the optimum relates to the search for the efficient portfolio, which can provide satisfaction to the investor, depending on its degree of risk aversion.

There are many theories and methods in finance, concerning investment choices. Nevertheless, the appropriateness and effectiveness of particular methods should be considered with the allowance of the specifics of the investment projects. For example, the investments in dry ports imply not only the lump sum of financial inflows, but also the long-term payback periods. As a result, capital intensity and longevity of their construction determine the necessity from investors to ensure the return on investment (profitability), along with the rapid return on investment (liquidity), without precluding the fact that the stochastic nature of the project environment is hardly described by the formula-based approach.

The current theoretical base for the economic appraisals of the dry port projects more often perceives net
present value (NPV) as a technique superior to other decision-making criteria. For example, the portfolio theory, which considers different risk preference of an investor and structures of utility, defines net present value as a better criterion of project appraisal than discounted payback period (DPP). Meanwhile, in business practice, the DPP is more popular. Knowing that the NPV is based on the assumptions of certainty of project life, it cannot be an accurate appraisal approach alone to determine whether or not the project should be accepted for the approval in the environment that is not without of uncertainties. In order to reflect the period or the project’s useful life that is exposed to risks due to changes in political, operational, and financial factors, the second capital budgeting criterion – discounted payback period is profoundly important, particularly for the Russian environment. Those statements represent contradictions that exist in the theory and practice of the applied science. Therefore, it would be desirable to relax the assumptions of portfolio theory and regard DPP as not fewer relevant appraisal approach for the assessment of the investment and risk measure.

At the same time, the rationality of the use of both project performance criteria depends on the methods and models, with the help of which these appraisal approaches are calculated in feasibility studies. The deterministic methods cannot ensure the required precision of the results, while the stochastic models guarantee the sufficient level of the accuracy and reliability of the obtained results, providing that the risks are properly identified, evaluated, and mitigated. Otherwise, the project performance indicators may not be confirmed during the phase of project realization. For instance, the economic and political instability can result in the undoing of hard-earned gains, leading to the need for the attraction of the additional finances for the project. The sources of the alternative investments, as well as supportive mitigation strategies, can be studied during the initial phases of project development.

During this period, the effectiveness of the investments undertakings can also be improved by the inclusion of the various investors, e.g. Russian Railways’ enterprises and other private companies in the dry port projects. However, the evaluation of the effectiveness of the participation of different investors in the project lack the methods and models that would permit doing the particular feasibility study, foreseeing the quantitative characteristics of risks and their mitigation strategies, which can meet the tolerance of the investors to the risks. For this reason, the research proposes a combination of Monte Carlo method, discounted cash flow technique, the theory of real options, and portfolio theory via a system dynamics simulation approach. The use of this methodology allows for comprehensive risk management process of dry port development to cover all aspects of risk identification, risk evaluation, risk mitigation, risk monitoring, and control phases.

A designed system dynamics model can be recommended for the decision-makers on the dry port projects that are financed via a public-private partnership. It permits investors to make a decision appraisal based on random variables of net present value and discounted payback period, depending on different risks factors, e.g. revenue risks, land acquisition risks, traffic volume risks, construction hazards, and political risks. In this case, the statistical mean is used for the explicacy of the expected value of the DPP and NPV; the standard deviation is proposed as a characteristic of risks, while the elasticity coefficient is applied for rating of risks. Additionally, the risk of failure of project investments and guaranteed recoupment of capital investment can be considered with the help of the model.

On the whole, the application of these modern methods of simulation creates preconditions for the controlling of the process of dry port development, i.e. making managerial changes and identifying the most stable parameters that contribute to the optimal alternative scenarios of the project realization in the uncertain environment. System dynamics model allows analyzing the interactions in the most complex mechanism of risk management process of the dry ports development and making proposals for the improvement of the effectiveness of the investments via an estimation of different risk management strategies. For the comparison and ranking of these alternatives in their order of preference to the investor, the proposed indicators of the efficiency of the investments, concerning the NPV, DPP, and coefficient of variation, can be used. Thus, rational investors, who averse to taking increased risks unless they are compensated by the commensurate increase in the expected utility of a risky prospect of dry port development, can be guided by the deduced marginal utility of investments. It is computed on the ground of the results from the system dynamics model. In conclusion, the outlined theoretical and practical implications for the management of risk, which are the key characteristics of public-private partnerships, can help analysts and planning managers in budget decision-making, substantially alleviating the effect from various risks and avoiding unnecessary cost overruns in dry port projects.

Keywords: dry ports, Russian Railways, public-private partnership, portfolio theory, Monte Carlo method, resilience, system dynamics simulation, risk management strategies, marginal utility of investments.
The thesis consists of the introductory part and the following five articles:


Contribution of the author

1) Sole author.

2) The author was the principal contributor to the publication, conducting literature analyses, gathering the statistical data and analyzing the results of qualitative and quantitative research to write most of the paper. The co-author was responsible for the formalization of the task and the development of the analytical model in one section, and finalizing of the article.

3) The author was the primary contributor to the research, collecting the data through semi-structured interviews, creating the simulation model, analysing its outcomes, writing all parts and finalizing of the paper. The co-author provided the literature for making analyses and helped in organizing visits to the company (without these, the qualitative and quantitative research would have been scarce).

4) The author was the minor contributor to the publication, gathering and evaluating Russian literature to write a section of the research. The co-author was responsible for conducting the study, collecting the data, and finalizing the publication.

5) The author was the main contributor to the research, writing all parts based on the literature review, semi-structured interviews, and designed and tested mathematical model. The co-author provided the books and journal articles for analyses, helped with the formalization of the model and in the process of analytical algorithms’ writing, as well as finalizing of the paper.
Acknowledgments

I am most grateful to my supervisor, Professor Olli-Pekka Hilmola, for helping me in the conquest of the ‘mountains of knowledge’ towards their ‘peak’. I found a special attractiveness in the difficulty of this process, since it is only by coming to the grips with the pain, the potential was realized. On the path of writing the thesis, the importance of your encouragement and counseling cannot be overstated, it is unique. I want to give thanks endlessly for your trust at ‘the foot of a hill’, accepting my application for doctoral studies. If it were not for your support, I would have never lived my lifelong dream. Finland (Lappeenranta University of Technology) became the land of opportunity for me.

At the same time, I offer my apology for those people, whose place I occupied at the beginning of the research. Looking ahead, I think that the biggest thing is never to let age and gender be a barrier, and not just dream, but dream big without letting anyone tell you no.

My motto is forward and higher step by step to the chosen destination. A launch point in this target was the railway station Golenki. For this simple reason, I was familiarized with the railways since my early childhood. The attributes of the everyday life were rail tracks, sleepers, and locomotives, by the whistle of which I used to wake up in the morning. The personal values and life experiences were gained through the biography (studying at the Boarding School No. 29 of JSC ‘Russian Railways’ and further higher education in Far Eastern State Transport University, FESTU, and Petersburg State Transport University, PSTU, which is my current working place).

I am taking the opportunity to thank all the colleagues at the Department of Logistics and Commercial Operations and the Department of Railway Stations and Junctions, belonging to Petersburg State Transport University. Especially, I wish to express my appreciation for all the efforts of my former supervisor, Professor Eugene Korovyakovsky, and endless support from a scientific adviser, Professor Yuriy E. Efimenko, saying that the accomplishing of the thesis in Russia is not a full stop. It is a comma in my further life. Your professionalism and insightful discussions motivated me during my research and through the present days onwards.

I am also thankful to Professor Albert Tan and Doctoral student Ville Henttu for the proofreading of the thesis proposal at the first stages of the revision process by Dissertation Committee and respectively to Professor Olli-Pekka Hilmola for the iterative reviewing of the work until the final stages. Your suggestions were wholesome and needed in the improving the theoretical and practical significance of the thesis and meeting formal requirements of the postgraduate research process. I am very much obliged to Professor Yacan Wang and Professor Per Hilletofth for the pre-examining critics, which have generally been kind and helped to unveil the originality of the research. Likewise, I express my appreciation to Associate Professor Andres Tolli and Professor Per Hilletofth for contributing to my dissertation, agreeing to be the opponents.

During the short period (from the start of the conduction of the research until the current time), I have met so many intelligent people. I would hardly ever get acquainted with marvelous places, if I did not start writing my thesis. The singer-songwriter, poet, and actor, Mr. Vladimir Vysotsky, of whom I am a fan, is an incredibly charming and talented person, numerously stressing this idea in metaphoric forms. He admires the ‘beauty of the mountains’, and so do I. He also mentions about ‘plain beside the hill’, indicating the
beginning of ‘human activity’.

In this regard, I express my gratitude to Lecturer Mrs. Paula Haapanen for her useful practice in academic English; Professor Binshan Lin for beneficial recommendations on how to write the world-class papers; Doctor Andrei Borschchev and Mr. Ilya Grigoryev for improving simulation skills in AnyLogic; Professor Richard Germain for training in statistical analyses by using SPSS software; Professor Lauri Ojala and Professor Harri Lorentz for providing a valuable toolkit of comparative characteristics in logistics and mastering the trade, and transport facilitation analytical capabilities; Professor Olli-Pekka Hilmola for teaching system dynamics in Vensim; Professor Stanley E. Fawcett, Professor Gyöngyi Kovács, and Professor Árni Halldórsson for their suggestions on the methods development and borrowing of theories in logistics and supply chain management. Your considerable assistance represents a significant milestone in the process of thesis development. In the meantime, it is neither an end nor a beginning, but a going on with all the wisdom and experience that you unlocked to me for the new frontiers that were once inaccessible.

I was also glad to learn a lot from the colleagues who almost in parallel to me tested themselves in the higher education. Dear Lena Volkova, Katya Siraya, Milla Laisi, Natalia Komovkina, Anastasia Gogoleva, Artem and Anton Sugorovsky, Sergey Komlev, Maxim Chetchuev, Ville Henttu, Lauri Lähtilä, Evgeny Oparin, Irina Fiegenbaum, Marina Karamysheva, Sumkhuu Gombosed, Alexander Badetsky, Anton Radaev, Evgeny Konstantinov, Timo Nykänen, Sonke Behrends, and Kirill Tulenev thank you all for sharing your erudition and competencies with me.

I highly appreciate the support of the Ministry of Education and Science of the Russian Federation for this study. I would also like to thank the Kouvola Unit of LUT and Far Eastern State Transport University (Associate Professor Elena Chervotenko, Associate Professor Anna Kalikina, and Professor Alexander Balalaev) for their assistance.

In pursuing my research, an actual help was provided by my friends, being beside me and never let me alone in need. Dear Igor Ivakin, Vitaliy and Irina Korzh, Katya Kazaku, Larisa Kozzerod, Wolfgang Seeeger, Huili Shen, and Derek Duffy, please accept my heartfelt thanks for your kindness and generosity.

In always debt, I am to my family, especially to my father, Nikolay, and brother, Oleg. Together with you, all of the routes, even like ‘the military trails’, is never dangerous to me. My beloved ladies, Irina and Arina, thank you respectively for your mother and sister love, in which I am enfolded.

In conclusion, I am thanking all people who contributed to this research. I am sorry, if due to some reasons, I did not include your names. Nonetheless, I wish each of you good health and well-being in life.

Kouvola, April 2016

Yulia Panova
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<tr>
<td>APEC</td>
<td>Asia-Pacific Economic Cooperation</td>
</tr>
<tr>
<td>BAM</td>
<td>Baikal-Amur Mainline</td>
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<td>BCR</td>
<td>Benefit-Cost Ratio</td>
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<td>BI</td>
<td>Billion</td>
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<td>BOO</td>
<td>Build-Own-Operate</td>
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<td>BOT</td>
<td>Build-Operate-Transfer</td>
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<tr>
<td>CAPM</td>
<td>Capital Asset Pricing Model</td>
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<tr>
<td>CBA</td>
<td>Cost-Benefit Analysis</td>
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<tr>
<td>CCTT</td>
<td>Coordinating Council on Trans-Siberian Transportation</td>
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<td>CER</td>
<td>Community of European Railway and Infrastructure Companies</td>
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<td>CSCMP</td>
<td>Council of Supply Chain Management Professionals</td>
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<tr>
<td>CV</td>
<td>Coefficient of Variation</td>
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<td>DCF</td>
<td>Discounted Cash Flow</td>
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<td>DES</td>
<td>Discrete-Event Simulation</td>
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<tr>
<td>DPP</td>
<td>Discounted Payback Period</td>
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<td>EDBI</td>
<td>The Ease of Doing Business Index</td>
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<td>EU</td>
<td>The European Union</td>
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<tr>
<td>EUR</td>
<td>Euro</td>
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<tr>
<td>FDI</td>
<td>Foreign Direct Investment</td>
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<td>FEU</td>
<td>Forty-foot Equivalent Unit</td>
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<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
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<tr>
<td>GLS</td>
<td>General Logistic Services</td>
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<tr>
<td>IRR</td>
<td>Internal Rate of Return</td>
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<td>ITLC</td>
<td>Integrated Transport Logistics Company</td>
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<td>JSC ’RZD’</td>
<td>Russian Railways</td>
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<tr>
<td>MCDA</td>
<td>Multiple Criteria Decision Analysis</td>
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<td>MI</td>
<td>Million</td>
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<td>MUI</td>
<td>Marginal Utility of Investments</td>
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<td>Abbreviation</td>
<td>Full Form</td>
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<tr>
<td>NPV</td>
<td>Net Present Value</td>
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<td>NSR</td>
<td>Northern Sea Route</td>
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<td>OECD</td>
<td>Organisation for Economic Co-operation and Development</td>
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<td>PFI</td>
<td>Private Finance Initiative</td>
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<td>PPP</td>
<td>Public-Private Partnership</td>
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<td>RBGC</td>
<td>Rail Baltica Growth Corridor</td>
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<td>RDIF</td>
<td>Russian Direct Investment Fund</td>
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<td>RMG</td>
<td>Rail-Mounted Gantry Crane</td>
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<td>RMS</td>
<td>Risk Management Strategy</td>
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<td>RTG</td>
<td>Rubber-Tired Gantry Crane</td>
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<td>RUB</td>
<td>Russian Rouble</td>
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<td>SCC</td>
<td>Supply Chain Confidence</td>
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<td>SD</td>
<td>System Dynamics</td>
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<td>StDev</td>
<td>Standard deviation</td>
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<td>STS</td>
<td>Ship-To-Shore Crane</td>
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<tr>
<td>TEU</td>
<td>Twenty-foot Equivalent Unit</td>
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<td>Ths. sq.m.</td>
<td>Thousand square meter</td>
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<tr>
<td>Tkm</td>
<td>Tonne-kilometer</td>
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<td>TLC</td>
<td>Terminal Logistics Centre</td>
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<td>TSR</td>
<td>Trans-Siberian Railway</td>
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<tr>
<td>U.S.</td>
<td>The United States</td>
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<tr>
<td>UIC</td>
<td>International Union of Railways</td>
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<tr>
<td>ULCV</td>
<td>Ultra Large Container Carrying Vessel</td>
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<td>UNCITRAL</td>
<td>United Nations Commission on International Trade Law</td>
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<tr>
<td>USD</td>
<td>United States Dollar</td>
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<tr>
<td>VAS</td>
<td>Value-Added Service</td>
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<td>VAT</td>
<td>Value-Added Tax</td>
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PART I
1 INTRODUCTION

1.1 Motivation and Background of the Research

1.1.1 Risk Management Processes for Doing Rail Related Transport Businesses

In the current economic climate, more attention has been paid to the supply chain risk management (SCRM) processes that by and large include four stages: risk identification, risk evaluation, risk mitigation, and risk monitoring and control phases (Kirilmaz and Erol, 2015; Moslemi, 2016). The reason behind the interest in the SCRM is rooted in the uncertain business environment, on one hand, and an opportunity for unveiling high revenues from commercial development, on the contrary. As a rule, greater profits imply the likelihood of taking higher risks (Shapkin and Shapkin, 2013).

This controversial situation can be easily witnessed in the Russian economy. At a first sight, Russia is rising sharply second consecutive year in the ranking of countries by the Ease of Doing Business Index (EDBI) that annually is published by the World Bank. According to the Index (The World Bank, 2016), Russia is on the 51st place (i.e. + 69 positions from 2011, when analysts of the World Bank put Russia on the 120th place in the ranking). If the aggressive trend continues, then in 2018, the country will have a chance to get into the top 20 economies with the best investment climate (+100 points from 2011), as prescribed by Presidential Decree on the Long-Term Government Economic Policy (Ministry of Economic Development of the Russian Federation, 2015).

Meanwhile, the financial inflows in transport infrastructure remains on the low level (2.2% of GDP), if compared to the countries with a highly developed transport infrastructure, such as USA, Canada, and countries of Western Europe, where figures are within 3% of GDP, and in China, 6% of GDP. As a result, for example, in the U.S., transportation is the critical component of the country economy, providing 20% of GDP (Chen et al., 2013), while in Russia, transport accounts for 6% of GDP (Nikolaev et al., 2014). A particular attention requires the development of railway projects in Russia that are characterised by budget constraints and insufficient attractiveness for the private investments due to long payback periods (approx. 20 years). In the world practice, the challenges, related to the deficit of governmental investments for the mega-infrastructure projects of high social importance are mitigated by the hand-in-hand cooperation of public and private sectors.

Public-private partnerships (PPPs) stimulate the innovative strategies of the economies, contributing to the advanced development of transport sectors by accelerating projects completion time (Chen et al., 2013). The high efficiency of PPPs projects is proved by international experience and nowadays gains popularity in Russia. However, the realisation of the infrastructure projects is not without uncertainties and risks because of the specific development of national market (Goriaev and Zabotkin, 2006; Hilmola et al., 2008; Saleem and Vaihekoski, 2008).
Working in partnership allows anticipating the effect of risks and building resilience (World Economic Forum, 2015). The strategies for building resilience are tailored to different risks that generally can be divided to global and local risks. The World Economic Forum (2015) specified 28 global risks, which were grouped into the five main categories, such as economic, environmental, geopolitical, societal, and technological risks. Awareness about impacts from risks and trends in the uncertain environment help the government and private sectors to mitigate the exposure to the risks. At the same time, the local hazards, related, for example, to the specific transport projects, are not lesser importance than global risks, and should be adequately addressed in the methodological tools for their management. That is why the analysis of all risks and their assessments, as well as coordinated, long-term and multi-stakeholder approach is at main request. First and foremost, there is a need for neutralizing the substantial pressure from risks and, therefore, facilitating the attraction of the investments in infrastructure, since the upgrading is essential, in the acknowledgment of resilient infrastructure as the backbone of a competitive economy (World Economic Forum, 2015).

The processes of risk management are essential, because risks cause the deviation of the future cash flows from the expected financial flow, as well as the postponement of the investment payback periods of the project. For the mega infrastructure projects, the risks involved are high, but they are treated in a deficient manner in feasibility studies and project appraisals (Bruzelius et al., 2002). Due to this fact, authors conclude that the cost overruns of 50–100% in the fixed prices are common for major infrastructure projects, and overruns of 100% are not uncommon, e.g., Channel Tunnel (Great Britain-France) >100%, Great Belt link (Denmark) >55% overruns three years before the estimated completion of the project, Öresund link (Sweden) equaled 10% for the cost-to-cost link even before the construction of the link was started.

Without question, the improvement of the quality of project management and risk minimization can be a tool for the growth of the efficiency of investment projects. From this point of view, a considerable attention should be paid to the railway infrastructure projects. For example, the sum required for the reconstruction of the main Russian rail lines of Trans-Sib and Baikal-Amur Mainline (BAM) ballooned to 1 trillion RUB from 562 billion RUB (Aleksandrova, 2014). These issues in construction practice, as a rule, cause the necessity for the additional financing. In the railways sphere, the efficiency of the investments can be improved by the attraction of the additional investors to the new sectors of business, providing the enlargement of profits to the basic transportation services from the supplementary activities. These principles, in turn, stimulate the development of the comprehensive services for the clients (JSC ‘RZD’, 2013). The lack of infrastructure does not take an advantage of it (Volkov et al., 2014).

In the light of the liberalization and restructuration of the railways, the financial inflows can be generated from the terminal and warehousing business (e.g. dry ports), because these areas are opening for private competition similarly as used to be for the
wagon market during the initial phases of reformation period of Russian Railways 2001–2015 (Hilmola and Panova, 2014; Hilmola and Panova, 2015; Laisi and Panova, 2013; Panova et al., 2015). The evolvement of wagon market resulted in the establishment of rail companies (an estimated 2000 companies are operating in the Railway market), among which nowadays UCL Rail, JSC ‘Federal Freight Company’, and Globaltrans Investment PLC lead the ranking (Investinnrussia.com, 2015; Mozgovoy, 2015). According to the experts estimations (Kurkin, 2015), starting from 2015, especially after Mr. Belozerov replaced the former president of Russian Railways Mr. Yakunin, the discussions among railway companies about the prospects of liberalization of the sector began with a new force. Particularly, there are the intentions of JSC ‘RZD’ and the state to bind the investments in locomotives and infrastructure, because those markets are closely related from the technological point of view. That is the replacement of locomotive naturally implies the development of the railway. The idea is supported by some of the railway companies, and, at the same time, is opposed to the option of the necessity to maintain competition with Russian Railways for customers on some routes by receiving the right of running own locomotives and pick up more profitable directions of cargo transportation (Kurkin, 2015).

In the future, it is expected that rail operators will be actively investing in the construction of freight terminal and warehouses and renting these facilities, in regard with the Concept of creating terminal and logistics centers in the Russian Federation. For the building of the inland terminal and warehousing infrastructure, Russian Railways plan to attract investors and work out entirely the technology of implementation of projects. Regardless the pragmatically favorable conditions for the improvement of the investment effectiveness in railway sphere, the fundamental scientific approaches to the feasibility studies within railway do not cover the possibility of joint public-private partnership investments in the supportive terminal and warehousing businesses. Moreover, the existing methods and models of the rail projects assessment need development, providing the inclusion of the specifics of the project planning and implementation, which is a highly stochastic and where events happen in the certain probability and rarely turns in deterministic order.

Therefore, the need for the contribution to the facilitation of the investments process is evident from the practical and theoretical points of view. That is the Russian economic environment, suitable for the rail enterprises investments in the infrastructure and the lack of risks resilience infrastructure strategies. Despite the accumulated world experience in risk management in various fields and areas activities, as well as created and constantly improved international standards on risk management (ALARM, AIRMIC, IRM, 2002; AS/NZS, 1995; COSO, 2004; CSA-Q, 1997; Japanese Standards Association, 2001; ISO, 2009; ISO/EIC, 2002), the problem of effective and efficient application of diversity of theories and methods of risks evaluation and mitigation for the dry ports projects development within Russian Railways remains unsolved.

For this reason, the current research develops the theoretical and practical
implications based on the proposals for the feasibility studies of public-private partnerships investments in dry ports with the allowance for the specifics of the Russian markets and existing risks. In order to achieve this goal, the study provides the analysis of risks, the design of models and methods for the facilitation of dry port development on the national market, based on which the rating of the risks factors of terminal and warehousing business were provided. In completion of the phased risk management process of public-private partnership investments in dry ports, comprehensive portfolios of proactive and reactive strategies for risks mitigation have been created. Having these ideas in mind, the given study is geared towards the justification of viability of the combination of Monte Carlo method with discounted cash flow technique, the theory of real options, and portfolio theory on the ground of system dynamics simulation. Doing so allowed the stochastic modeling of cash flows, both inflows and outflows, from the project of dry port. In this regard, the assessment of different risk management strategies and their ranking in their order of preference to the investor has been made based on the principles of the efficiency of the investments, which were denoted by the distributed estimate of the net present value and discounted payback period, as well as by the proposed structure of marginal utility of investments (Black et al., 2012; Law, 2008).

1.1.2 Resilience of Maritime Container Infrastructure

Transport communications are essential ‘platform’ for international relations of countries that are accompanied by border crossing flows of goods, resources, people, investments, etc. The developments in transport infrastructure, information, and technology communications are manifested under the demand of countries and regions to economic activity out of their borders for the last 20–30 years, as globalization implies.

Globalization touches all countries around the world, but some of them have the most stable economic relations in trade turnover (Verny and Grigentin, 2009). Examples would be neighbour countries, such as the United States and Canada, European Union countries, as well as Finland and Russia. Meanwhile, the look of the current twenty-first century is being shaped by ambitious, unprecedented shifts in the global economy and the interactions between countries. The volumes between Asia, Europe, and North America are growing widely in both directions. International trade increases sharply, especially under the influence of Asia. The gross domestic product increases annually by more than 5% and close to 7.5%, in the one billion people countries, such as China and India. These countries generate a so-called ‘mass effect’ for the production and the world trade (UNCTAD, 2014).

It should be noted that recent research reveals that the trade liberalization alone has been a less powerful incentive than containerization for the globalization (United Nations, 2014a). According to long-term data, average annual growth of container turnover surpassed the pace of trade growth by approximately 2–3%. The latter characteristic, in turn, was, by the same level, greater than a rate of GDP
enhancement (Rezer, 2009). Over ten years, liner shipping connectivity of countries and continents increased significantly. Maritime routes that link Asia to the powerful markets in Europe and North America became the main axes of container transport (Rodemann and Templar, 2014; Verny and Grigentin, 2009; Wang and Meng, 2011). This trend is evidenced by global developments in container trade flows (Table 1) and containerships enlargement.

Table 1. Global trade turnover, in million TEUs (United Nations, 2014a, 2015).

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Note: TEU is a unit for measuring the capacity that equals the dimensions of an ISO-container with a length of 20 feet (2×TEU=FEU).

Previously, the primary driver for the development of container traffic was the economy of the North America. Since 2007, the volumes between Asia and Europe became almost a copy of the imports into North America from Asia (Table 1). Consistent growth in the trade between Asia and Europe in last years has prompted carriers to invest in larger ships that hold inarguable leadership in Eurasian container traffic (Ivanova et al., 2006; Rodemann and Templar, 2014; Roso et al., 2015; Trepte and Rice, 2014; Verny and Grigentin, 2009; Wang and Meng, 2011).

According to Worldcargonews.com (2015a), orders of a container carrying vessels are accelerating at a high pace. Statistics shows that around 50 containerships (10,000 TEU capacities each) were in the sales list in 2011. Additionally, the containerships
with a higher capacity were ordered (e.g., 20×18,000 TEU Triple-E ships for A.P. Moller-Maersk; 10×14,000 TEU ships for NOL; and 14×13,000 TEU ships for OOIL). The world’s biggest container ship, CSCL GLOBE, at 19,100 TEU intake was introduced into Asia Europe Express service in 2015. Some companies are in need for mega 20,000 TEU capacity containerships. An example would be OOCL with headquarters in Hong Kong. Similarly, Mitsui OSK Lines is expecting to receive 6×20,150 TEU ships by 2017 (Worldcargonews.com, 2015b). Increasingly, there is a demand for ultra large container carrying vessel (ULCV) and Super Post-Panamax Ships. Generally, the 13,000+ TEU ships hold the majority of trades between Europe and Asia, where sea transport provides 90% of the transit container flow (United Nations, 2014; Worldcargonews.com, 2011) or even 98%, according to some research (Ponomareva, 2014).

As a result, the container traffic is heavily concentrated between Asia and Europe and at their largest seaports. In 2014, the leaders in terms of turnover of containers were traditionally the seaports of the Asia-Pacific region: 1) Shanghai, which includes the ports of Yangshan, Waigaoqiao, and Wusong; 2) Singapore; 3) Shenzhen; 4) Ningbo, and 5) Busan (Worldcargonews.com, 2015c). In 2012, the third place was occupied by Hong Kong (Worldshipping.org, 2012). Port of Hong Kong lost its position as the world’s largest container port in 2004. According to the statistical database of Eurostat, the list of the biggest seaports in the European Union is headed by Rotterdam, followed by Hamburg, Antwerp, and Bremerhaven. The quarterly volumes of these seaports range from two to more than three million TEUs (European statistics, 2014).

In Russia, the volume of containerized cargo handling is below the level of the mentioned seaports. However, the long-term trend is upward, because of country’s economic growth and the accession to the World Trade Organization on August 22nd, 2012 (Karamysheva et al., 2013). Due to these facts, the indicators, such as the growth rate of non-commodity exports; the rankings of the Doing Business report made by the World Bank; the quantity of exporting organizations; all have a positive dynamics (Ministry of Economic Development of the Russian Federation, 2014; The World Bank, 2014a).

During 2004–2008, an average annual growth of container cargo, processing at marine basins of Russia, amounted to 18%. In 2013, Russian seaports handled nearly 5.1 million TEUs (MI TEUs), which is the two-month volume of leading Chinese seaports (Russia’s Merchant Seaports Association, 2014). Approximately, 47% of containerized cargo volumes were handled at the seaport of St. Petersburg, 15.4% in Vladivostok, 13.5% in Novorossiysk, 8.9% in Vostochniy, and 6% in Kaliningrad seaport. These figures show that over 90% of cargo in containers is processed within five seaports of Russia.

The economic crisis and the sanctions resulted in the deterioration of the situation of marine cargo in Russian ports, first and foremost, affecting the container transshipment. On average, the handling volumes of containers for all Russian ports in the 1st quarter of 2015 decreased by 23%. Previously, the biggest drop in containers’
turnover was in 2008 (33%; Sologub, 2015). It is worth noting that, at the largest Russian container seaport, the decline of TEU throughput appeared earlier. The 6% decrease was in 2014, compared to the volumes of 2013, with continued downward trend in 2015. The volumes of TEUs and containerised cargo in tonnes for the first two months of 2015 reduced vs. the same period of 2014 by 29% and 15%, respectively. Meanwhile, the statistics of the previously referenced period (2012–2014) shows the slow growth of the throughput of the seaport, if to consider it in tonnes of containerised cargo, e.g. the 3% increase in 2014 vs. 2013 (Administration of Seaports of the Baltic Sea, 2015).

Acknowledging the sensitivity of the port systems to the adverse events, stakeholders pays more attention to the resilience in order to reduce economic impacts from risks and uncertainties that lead to the harbour disruptions (Trepte and Rice, 2014). However, according to the authors, to date, there has not been a great deal of precise work that would include resilience into the planning process for a system and, thus, would help to instruct the capacity planner, on how to mitigate the occurrence of disruptions. For instance, the USA economy was posed at risk due to the earthquake in the port of Kobe in 1995, or Hurricane Katrina to closely located ports near New Orleans, in 2005 (Moslemi, 2016).

Of course, these damages are far higher that Russian and European seaports experience recently because of the governmental regulations, concerning food embargo. Meanwhile, sanctions and the economic downturn have led to a decrease in import freight by 25–40%, depending on the type of goods (Vedomosti.ru, 2015). The result is the subsequent decrease of container throughput via Hamburg, by 35.9% in 1H/2015 than in the last years (Worldcargonews.com, 2015d). At the same time, there was a growth of the volume of goods, passing through the southern ports of Russia, first and foremost, Novorossiysk due to imports of food and other commodities from Turkey, Israel, and the Middle East (Morport.ru, 2015; Vedomostti.ru, 2015).

The above-mentioned examples depict the complexity of the seaport industry that lacks the resilience strategies. According to Trepte and Rice (2014), the focus should be directed at food and farm products and chemicals that acutely need ‘the non-disrupted ports to maintain more than 25% capacity to clear cargo if a port fails’. The lower level of resilience from seaports requires waste and scrap. Therefore, from this point of view, the development of dry ports should be regarded as one of the outstanding alternatives for increasing the resilience of the seaports. More specifically, dry ports are the inevitable back-ups for reefer containers. In the case of seaport failure, the priority is naturally given to containers sensible to the temperature regime so as to avoid food damage and subsequent losses. In this regard, the dry port with reefer plugs is the essential node for the rescue of these containers. To a greater extent, to handle inbound and outbound cargo smoothly, the inland terminals and intermodal connections should be greatly developed (Wan et al., 2014).

Since the sea transport will likely to remain a key player in transportation between Europe and Asia, resilient and efficient operations at the marine terminals of the
seaports are at the high request (Chiu et al., 2015; Roso et al., 2015; Trepte and Rice, 2014). Regardless of the level of resilience and modest growth in port throughput volumes compared, for example, to the pre-economic-crisis levels, the terminal operating sector on the global scale is very active (United Nations, 2014a). Transport and shipping companies (e.g. G6 Alliance, P3 Alliance, and CKYHE Alliance), understanding that their performance significantly depends on the container terminal operations at the seaports, continue to design alliance strategies that allow them to share the resources among the members, and therefore, improve terminal services and efficiency, including the reduction of operating cost and risks (Chiu et al., 2015; Worldcargonews.com, 2014a).

A recent attention of the port management is also paid to the green terminal concept that implies a balanced economic development and environment protections. These trends have already acknowledged in the rankings of green container hub ports in East Asia, which are topped by Singapore, Hong Kong, Tokyo, Shanghai, Busan, and Kaohsiung (Yang, 2015). Thus, in strive to attract shipping companies, which move between Europe to Asia and call at the seaports with better operational services, the idea of sole focus on port competitiveness and container handling volumes is complemented by the resilient comprehensive services, which can meet the clients demand (Wan et al., 2014; Yang, 2015). This tendency is natural nowadays, with the globalization of production and transition of the developing countries to the service-driven economies. As a matter of fact, the role of logistics service and flow of services increases.

1.1.3 Provision of Efficient Services in the International Trade

It is clearly explained throughout the book of Rifkin (2011) that services became a driving force of economic development. The author’s idea is reflected in the earlier research of Shabarova (2002), noting that the growth in commerce of transport services is two times higher than the growth of the trade in goods between countries. The volume of commerce of transport services throughout the world amounted to an estimated 30% of the global trade (Shabarova, 2002).

In this regard, a change in the outlook of managers and other employees, as well as adjustment of the management strategy to the new principles of doing businesses is required. The services of today are at the heart of the modern economy, as it was at the time of the ‘industrial’ economy when the industry was its heart. In the ‘service’ economy, the main factor determining the success of the enterprise is the ability to understand customer preferences, so as to provide the system development trends for improving the consumers’ satisfaction. The level of client services depends on the efficiency of logistics that is measured by qualitative criteria. Examples would be confidence, delivery time, the accuracy of supplies, quality of supply, track and trace services, flexibility, etc. The precise case of such high quality of services, which are extensively exported to the customers, can be the work of Finnish seaports, such as Kotka and Hamina (nowadays one HaminaKotka seaport).
Finnish seaports are specialized in handling transit cargo to Russia, and are considered the long-term partners of Russian companies (Figure 1). In this figure, the separate volumes of Hamina and Kotka seaports are merged in years before the creation of one HaminaKotka seaport in 2011.

![Figure 1. The amount of containers handled at main Finnish seaports, in TEU (Finnish Port Association, 2014).](image)

Thanks to the superior services provided in Finnish seaports, goods can be unloaded from ships (e.g. under Asian flags) with all border formalities within 1–2 days. Afterward, goods are sent to Moscow and Central regions of Russia in one-week time. For that reason, roughly 1/3 of handling amounts of these seaports are transiting to Russia. In practice, the figure of the transit volumes, which forwarded to Russia, is even higher. The explanation for that fact can be based on the allowance for the imported cargo that continues to Russia after logistics operations at the storage yards in Finland (Hilmola, 2011).

Therein lies the reason that Finland, like other European countries, is actively involved in the trade of transport services. In Russia, the volume of export of transport logistics services is lower by 2.3–2.6 times if compared with the leading European countries, such as Germany, France, and Denmark, which, in turn, are among the five leading countries with a the developed export of transport service, according to the statistics of 2013 (i.e. USA, Germany, France, Singapore, and Denmark with an indicators of 87.27; 60.5; 49.2; 44.8, 42.9 billion USD, respectively; Figure 2). In relative figures, the share of export of transport service in
countries’ GDP (e.g., USA, Germany, France, Singapore, Denmark, and Russia; The World Bank, 2014) would be as follows: 0.5%, 1.6%, 1.7%, 14.8%, 12.8%, and 1%.

Taking into account the leading role of sea transport in the international trade, the issue of scarce revenues from operations with maritime containers in Russia can be rooted in the insufficient quality of logistics services. Consequently, only less than 20% of container flows are processed at the marine terminals of the largest Russian container seaport of St. Petersburg. Meanwhile, the remaining cargo leaves the seaport without additional services (Gov.spb.ru, 2010). At the same time, world experience shows that the growth of value-added services (VAS), such as stuffing, packaging, consolidation, weighing, and labelling of cargo, increases the budget income, because the earnings derived from each container become two or three-fold higher.

The insufficient offer of high-quality services at the container seaports of Russia that potentially have a favourable transit location between Asia and Europe deprives budget of the country from the additional revenues. This problem also stems from the lack of lands required for the construction of warehouses or stacking yards at sea container terminals to perform VAS. The extensional development of the seaports, which includes the main marine container terminals, is restricted due to various reasons. For example, the seaport of Novorossiysk is surrounded by the mountains of the North Caucus. The seaports of St. Petersburg and Vladivostok are located within the urban infrastructure, which hinders their future development at the site, likewise.
Along with this issue, more and more experts show their concerns about undeveloped land access to the seaports that lead to the traffic jams (Abdikerimov et al. 2013; Hämäläinen and Korovyakovsky, 2007; Korol’, 2015; Maksimov, 2013; Rezer and Kuzin, 2011; Trepte and Rice, 2014; Wan et al., 2014). The maritime operating companies may be able to cope with the expected increase in container flows on the sea transport. However, the same cannot be said in the connotation of land transport that is used for carrying containers between seaports and hinterlands. As such, there are high risks of congesting the network infrastructure, leading to the ports.

Some academics stress that this critical transport situation on the approaches to the seaports is generated by the increase of the sizes of containerships (Vega, 2010). The marine transport generates almost proportional growth of material or cargo flows at the hinterland (Roso, 2009; Trepte and Rice, 2014; Wan et al., 2014). That is why the processing of large containerships leads to overloading of throughput at the seaports, as well as adding the burden to transport nets involved in servicing ports. Accordingly, the high throughput within maritime terminals of the seaport cannot be a guarantee for the exceptional performance. In other words, without the appropriate development of the hinterland infrastructure, such as roads, railways, and container terminals, it is impossible to deliver to/from the seaports the vast amount of goods.

1.1.4 Implications of Underfinanced Intermodalism in Russian Hinterland

Hinterland infrastructure of today can be positioned as a key component of the marine supply chains or so-called chief means of access to the seaports. Worth note taking that in import flows of seaports, the road component predominates (63.6 %), while the volume of cargo transported by railways does not exceed 21.6% (Figure 3).

Figure 3. The arrival and departure of dry cargo flow of seaports by mode of transport, in thousand tonnes (Russia’s Merchant Seaports Association, 2006–2014).

As can be seen from Figure 3, the fraction of the road in the transportation of dry import cargo of seaports tends to increase. This tendency is determined by the bulk and non-bulk split of cargo in export and in import directions. The high relevance of rail is down to the product structure in exports, particularly the high volumes of bulk
in exports, such as oil, ore, metals, and other raw materials. On the contrary, in the import direction, the prevalence of road mode of transport is due to non-bulk cargo in containerised trade. As a result, from 2009 until 2013, the road volume grew by 70%. Conversely, the proportion of the rail component has grown by only 16%. In the 1Q of 2014, the railways share in delivering dry cargo to the seaports (rail export) equaled 87.5%, while road transport accounted for 11.2%, provided that the proportion of the sea and inland waterways transport, respectively is 1.2% and less than 0.1%. Meanwhile, in delivering imported dry cargo, the modal split of transport is as follows: rail share 26.5% (rail import), road 68.1%, and maritime 5.4%.

If to look at the railways’ share in handling import seaport’s container flows, the figures are more dramatic. Railways accounts only for 17.8%, while the road transport share achieves 74.5%, provided that the share of the sea transport is 7.7% (Federal Agency of Marine and River Transport, 2014). The disproportions of bulk and a non-bulk split of cargo and present modal split issues in Russia resemble the market in Australia (Ghaderi et al., 2015), where the non-bulk freight is one of the few freight markets with the significant modal competition between road and rail.

In Australia, the over-shifting to the road of non-bulk cargo brought the reduction of the rail’s share in some directions (North-South corridor) from 35% in 1972 to 12% in 2007. The reasons for the low market proportion of rails were poor transit time and reliability levels, as well as the absence of a solution to the rail’s logistic difficulties (Ghaderi et al., 2015). In the U.S., the needed port/rail connections development is addressed to the governments in order to increase the efficiency of the seaport (Wan et al., 2014). Thus, the current situation in the national transport market demonstrates the potential interest of railways to increase their presence in serving the Russian container seaports and other sectors of the economy.

These trends are common in European countries, as well. For instance, in the White Paper of the EU, by 2030 around 30% of freight traffic is planned to shift from road routes of over 300 km towards railways and inland waterways. By 2050, the targeted figure is 50% (European Commission, 2011). In many countries, the idea of shifting relatively large goods flow, which is generated by the seaports, from roads in favour of railways is supported by the phenomenon of the dry port (Bergqvist and Monios, 2014). The term means ‘an inland terminal that has the direct connection with a seaport by high-capacity transport modes, preferably railways’ (Roso, 2009). Owning to the implementation of dry ports, the share of railways in the volume of cargo transportation, for example, in cooperation with leading port in Sweden, Gothenburg, is rapidly increased. That is, from 28%, in 2005 (Roso et al., 2006) to 49%, in 2014 (Port of Gothenburg, 2015).

According to Roso (2009), the dry port that is characterized by rail infrastructure, buildings’ equipment, and customs offices, allows to provide services to clients as if at the seaport. In the world practice, most of the dry ports are developed to serve major seaports that cannot be extended at the site. The other reasons for the dry port development were likewise the peculiarities of the regulations on railways. For example, in Sweden, new rail operators had challenges to get access to existing
terminals, because they were controlled by the main rail operator and had no open access. As a result, due to the liberalisation of railways, the favourable environment was created for the expansion of the competitive inland terminal business (Bergqvist and Monious, 2014). However, in many instances, the development of dry ports is stimulated from a public and landlord perspective, that aims, mainly to reach a modal shift and reduction of congestion, along with the growth of employment and the competitiveness of local and regional businesses.

Already ten years ago, the U.S. accounted for 570 inland ports (Elin, 2010). By 2009, the number of dry ports developed in India reached as many as 200 (Ng and Gujar, 2009). Three years later, there were more than 50 dry ports in China (Chang and Notteboom, 2012). In 2012, ten European countries represented 60 dry ports. These countries are Denmark, France, Germany, Greece, Hungary, Italy, Luxembourg, Portugal, Spain, and Ukraine (Haralambides and Gujar, 2011).

The utilization of inland terminals or so-called dry ports improves the productivity of the seaports. That is to say, the unloaded containers from the ship do not stay idle at the seaport, which suffers from insufficient storage areas. Instead, containers are directly transferred to the dry port by the trains where the additional logistics operations are provided. At the same time, the land of the seaport is released for the next containership to process. Therefore, the seaport can receive and process in the same area, without any technology upgrade, at the better turnover more containers, bringing revenues to the maritime companies (Abdikerimov et al., 2013). Additionally, the location of the dry port at the hinterland reduces the cost of logistics services and increases an attraction of shippers. Furthermore, the dry port mitigates the traffic jams at the approaches to the seaports, reducing the negative influence on the environment.

Normally, the dry ports, are located along the transport corridors (Hanaoka and Regmi, 2011; Monios and Lambert, 2013). Apparently, the similar approach is taken, in Russia, to build the required terminal and warehousing infrastructure. Specifically, these facilities can be erected on the adjacent to the St. Petersburg, Ust-Luga, Novorossiysk, and Vladivostok seaports, connected by the central railway backbone of Trans-Sib (JSC ‘RZD’, 2011a; Panova, 2011). By the development of the dry ports, the railways can underpin the access to the seaports, as well as to become the preferred mode of transport over long distances across Eurasia. The ability of smooth and rapid transportation of goods to/from the seaports by the use of railways may stimulate and determine the location and development of new enterprises in Russia. To a greater extent, the additional transit flows via the country can be attracted due to a higher quality of the logistics services.

The key role in providing foreign trade relations of Russia with all over the world is to play by St. Petersburg. The port has a favourable location on the Baltic coast in proximity to the countries of the European Union and the largest ports in Europe. As a matter of fact, St. Petersburg became the ‘gateway’ to Russia, supplying over 51% of all imported goods and 52% of total exports of goods transported by shipping in Russia. Export and import goods are gravitated to the St. Petersburg seaport not only
from the adjacent regions, but also from distant regions, such as Central, Ural, Volga, and Siberian Federal Districts.

Nevertheless, the potential benefits that can be derived from the implementation of dry ports for the further development of the St. Petersburg area and other container seaports of Russia have to be used yet. Most of the inland terminals, approx. 10, are congregated near the largest container seaport of St. Petersburg. However, only three of the researched inland terminals can be named as dry ports. The state of services of others does not entirely match with the definition given by the Economic Commission for Europe and Roso (2009) due to peculiarities of Russian regulations (e.g. Customs Code). In particular, customs clearance is available only within the territory of the seaport, if the inland terminal is under the jurisdiction of the three customs differed from Baltic, which is related to the seaport of St. Petersburg. In the case of dry port development, seaport and inland terminals have to be under the jurisdiction of one customs station or customs (Baltic) that allows making documents for internal customs transit (ICT) automatically and extending the sea to dry port. Thus, the customs inspection is carried out directly at the dry port, and all the necessary documents are processed without the need for re-registration of cargo in the seaport. In this regard, in St. Petersburg region only Logistika-Terminal, Logistic Park Yanino and Modul can be categorized as the dry ports of St. Petersburg seaport.

These modest tendencies in the development of the dry ports also stem from the history that told the following facts. The terminal and warehouse infrastructure has always been treated as secondary facilities for the industry, transportation, construction, and for all other sectors of the Russian economy (Abdikerimov et al., 2013). It appears that the port authority is mostly interested in the construction of inland terminals rather than land transport operators. For instance, JSC ‘Russian Railways’ do not set the priority in the investment policy to modernize the terminal and warehousing infrastructure (JSC ‘RZD’, 2011a).

On the whole, the lack of funding for the infrastructure projects drags the economy, leading to a reduction of budget revenues from the transport business (Straube et al., 2008; Roso et al., 2015). In contrast, trading or export of transport services, in the logistically-advanced countries, became the significant contributor to the gross domestic product (Castillo-Manzano et al., 2013; Chen et al., 2014; Ng and Gujar, 2009; Ng et al., 2013). For the facilitation of the trade relations across the borders, the mitigation of deficit in the logistics transportation systems, which naturally depends on capital investments, namely in long-term projects, is required (OECD, 2011). Thus, governments in developing countries are advised to increase investments in infrastructure to stimulate international trade and economic growth (Dang and Pheng, 2015).

The financial burden, which impedes the dry ports’ construction in Russia, can be mitigated by the application of the public-private partnerships (Bentzen et al., 2003; Bergqvist et al., 2010; Haralambides and Gujar, 2011; Korol’, 2015; Rodrigue et al., 2010; Van den Berg and Langen, 2011; Wilmsmeier et al., 2011). One of the viable options could also be the revitalisation of the terminal and warehousing
assets of JSC ‘RZD’. Around 95% of railway assets have low quality (Stupachenko, 2009). Meanwhile, the principles of PPP for the railway industry are not set in stone yet. The rules have still to be developed at the federal and regional level in Russia. Therefore, the problem should be addressed adequately with the allowance of the Russian economic conditions that are not deprived of uncertainties and risks (Goriaev and Zabotkin, 2006; Hilmola et al. 2008; Saleem and Vaihekoski, 2008), especially in the economic crisis. At the same time, the economic environment in Russia should be considered as an opportunity for the development.

This statement is clearly justified when referring to the word ‘crisis’. In the Chinese language, a crisis can be translated into 危機 and 危机 with former, as traditional Chinese character(s), and later simplified Chinese character(s). The first character (危) means danger and the second one (机) defines the opportunities. Therefore, one can ensure that, where the largest danger lives, there are the greatest opportunities for development (Lintner, 1965; Mossin, 1966; Sharper, 1964). The mood of optimism is also supported by the investment climate in Russia that has improved, according to United Nations (2014b). Russia is classified as the third most attractive country for investors after U.S. and China. This situation advocates for the research ‘Public-private partnership investments in dry ports – Russian logistics markets and risks’. It tends to show the full advantage from the opportunities that are stored for the entrepreneurs and the state in the untapped resource of the economic growth.

1.2 Purpose

The transportation of goods always has to begin and end at special facilities for cargo handling. They are called maritime terminals at the seaport or dry ports, if located inland (Abdikerimov et al., 2011; Malikov, 2008). The terminals and warehousing infrastructure are inevitable outlets to provide the indirect transfer of goods, which are natural in most times (75–80% cases) of intermodal transportations. As a result, participants in the container supply chains can capitalise on the implementation of dry ports.

First and foremost, transport companies will benefit from the dry port utilisation. That is why the bigger alliances that are formed in the Eurasian market tend to include firms that operate the maritime and inland terminals (Worldcargonews.com, 2014a; Chiu et al., 2015). By doing so, the alliances take advantage at managing these facilities for a better performance of their supply chains. From this point of view, terminal and warehousing infrastructure is an integral part of any logistics process of goods delivering. Overall, the supply chain can be represented as a combination of transportation (T) and warehousing operations (W). These activities are provided by shipping, road transport, railways, maritime terminals, dry ports, logistics centers, etc. Transport companies that don’t have terminal and warehousing infrastructure can only participate in the separate parts of the complex process of delivery of goods (Figure 4).
As can be seen from Figure 4, the forwarding companies or service providers (SP) can only transport goods between somebody else’s terminals and warehouses of the logistics supply chain. As a result, operations are fragmented between warehouses of the consignee (2) and the retail terminal (5), which located along the route of the main line traffic (4), or between an operator of terminal (4) and warehouse of manufacture (1), etc. (Abdikerimov et al., 2013). The negative aspect of such a kind of supply chain organisation can be explicit, if bottlenecks appear. For instance, due to the low technological level or insufficient capacity/operational productivity of these somebody else’s or ‘alien’ warehouses, the efficiency of the total delivery may be weak. However, the freight forwarder or any transport company cannot control the interruptions, since they do not own these warehouses. As such, providers are not able to improve the overall process of the supply chain, because it is only involved in some local parts of the goods forwarding (Abdikerimov et al., 2013).

Therefore, the aim of the research is to justify and facilitate the investment process of building dry ports in Russia with the allowance for the peculiarities of the Russian market and existing risks. Among different types of businesses, terminal and warehousing operations generate major revenues derived from the cargo flows that always begin and end in these facilities. As a matter of fact, their development becomes the priority for the transport companies, forwarding firms, and logistics providers, let alone the operators of maritime and inland terminals or seaport authorities, and the state (Monios and Bergqvist, 2015). Consequently, by owning warehouses and freight terminals, interested parties receive for the transportation larger cargo flows (Abdikerimov et al., 2013). The growth of traffic of transport companies can be explained by their ability to provide additional value-added services during handling of cargo and transformation of their parameters within the warehousing and terminal infrastructure. As such, with the implemented own
warehouses, transportation companies receive more contracts to provide the transportation services for clients, who choose the most efficient supply chains.

1.3 Research Questions

The main research question of “How the development of dry ports can be facilitated, knowing peculiarities of Russian logistics markets and risks?” is approached through the use of the systems point of view (Gammelgaard, 2004; Lindskog, 2012). This logistics position can be a basis for the design of the transparent management of material flows through Russian transport system that is a must for the complex supply chains of today.

The expected results set an incentive for the sequence of stages that imply the gradual conduction of the research. Firstly, on the macro level, i.e. mutual connections with an environment are established, aiming to explore the global nature of the supply chains, in which the dry port project can evolve. Secondly, on the micro level, interactive relations within an intermodal transport system are analysed. The important connections between different actors, which are potentially interested in dry ports setting, are examined. The outlined objectives were facilitated by the three sub-research questions:

1. What stimuli initiate the investments in the dry port projects within Eurasian supply chains?

The theoretical aim of this sub-research question is to present the current stimuli (e.g., market demands, business requirements, legal, social, and technological needs) for the investments in dry port within the Eurasian logistics environment. The empirical contribution encapsulates the reasoning of dry ports’ development that permits the elimination of ‘bottlenecks’, deteriorating the services for the clients, using Trans-Siberian Railway.

2. Which types of principles and factors define the alternative variants of dry port project realization in support of strategic plans to increase national logistics markets agility?

This sub-research question develops the analyses of alternatives for the dry ports projects realization, depending on the strategic views at national subsystems (e.g., seaports, customs, transport companies, marine terminals, and their owners). Additionally, the prerequisites for the progression of the dry ports, providing the desired logistics performance of Russian markets are discussed.

3. What project selection criteria and methods are used to specify public and private concerns about the contextual environment of the dry ports implementation?

The answer to the sub-research question considers the development of railways, seaports, and inland terminals based on the concept of dry port project realisation via a public-private partnership. The research question looks into the principles of the synthesis of the most prominent set of the interested parties, especially the inclusion...
of JSC ‘Russian Railways’ in the investing. Additionally, the surrounding environment at micro and macro levels is taken into account. On the micro level, that is the establishment of free rail market, appearing after its deregulation and opening possibilities along with the shortcomings for new undertakings, i.e. warehousing and terminal businesses. On the macro level, the existing uncertainties and risks, which attributed to the whole investment climate in Russia, are addressed. The internal and external risks’ evaluation required the consideration on the multiple capital budgeting approaches. To measure the attractiveness of the investments in dry ports to the proposed public-private partnerships project owners, several decision models were used.

The need for the assessment of different risks that adhere to PPPs projects and the establishment of transport businesses in the developing Russian ‘service’ economy, as well as the selection of the alternatives ways of project realization, has resulted in the design of the advanced project selection criteria. In turn, their application required a sophisticated decision model that was created in addition to the individual publications.

1.4 The Scope and Delimitations

The problem of the dry port development scenarios is a broad, spread and compound that implies multiple tasks to be solved. In turn, different functions can lie within several levels. For that reason, the study was approached on many levels and put into the focus of triangular perspective (Figure 5).

Figure 5. The framework of the thesis.
First and foremost, the dry ports are studied as the phenomenon of logistics and supply chain management domain. The operational role is prescribed to logistics, which offer the methods and models to design systems that mimic reality. This approach in defining the term is exhibiting positivist epistemology and objectivist ontology (Bridget and Jackson, 1997).

By limiting functional responsibility for logistics, supply chain management provides the strategic role and systematic nature. From this point of view, the meaning of the phenomenon may subscribe, on the contrary, to a subjectivism and constructivism approach. Hence, the subjective role of individuals in the coordination, optimization and integration of the remote sub-sections can be stressed. Therefore, the limits of one sphere, logistics, fostered to resort to the area of SCM in order to improve the understanding of the researched phenomenon.

In addition, it should be noted that the agreed consensus on the disciplinary scopes of logistics and supply chain management is viable only from the ‘plural’ connotation. According to Rolin (2011), ‘plural’ consensus means an agreement to give a right to a hypothesis just to present among the others proposed theories. This approach is opposed to the ‘summative’ consensus. The ‘summative’ account of a consensus can be made only, when many members of the community accept the hypothesis. The latter consensus may lead to the theoretical tyranny. That is why the ‘plural’ subject sense was applied herein, bringing the epistemic value to the diversity and dissent. In this regard, it is worth mentioning the diverse relations between both terms (logistics and supply chain management) within their more than 50-years history of development (Figure 6).

![Figure 6. Evolution of logistical integration (Hesse and Rodrigue, 2004).](image-url)
The associations between phenomena of logistics and supply chain management, however, more often than not, vary in studies, which have been undertaken (Figure 7).

![Diagram showing different approaches to logistics and SCM]

**Figure 7. View on logistics and SCM (Arlbjørn and Halldorsson, 2002; Klaus, 2009; Larson and Halldorsson, 2004).**

The cluster analysis, which was made on the grounds of the experts’ perceptions, by Larson and Halldorsson (2004) opened the broader issue of logistics and SCM – relabelling, traditionalist, unionist, and inter-sectionist. According to Rushton (2010) and Wall et al. (2009), the term ‘supply chain management’ has been used alternatively with ‘logistics’, covering the entire functions within an organization’s own boundaries and also the functions that contribute towards the provision of raw materials through manufacture and assembly to a product distribution to the final customer. In the context of this research, the dry ports are learned from the internal and external points of view that supports the perspective of unionist approach and Council of Supply Chain Management Professionals (CSCMP, 2010), i.e. where the logistics is a part of SCM.

To learn the phenomenon thoroughly, the thesis resorts to the second domain, the theory of systems thinking (or systems theory in logistics and SCM). It is a framework for seeing interrelation and at the same time the whole picture, as well as patterns of change rather than static ‘snapshots’ (Gammelgaard, 2004; Lindskog, 2012). Being a larger school, system thinking covers systems dynamics, which is ‘a computer-aided approach to policy analysis and design’ (System dynamics.org, 2014). The policies imply the rules and factors that govern or influence decision making. As a rule, decisions are based on mental models. However, the complex tasks (e.g., concerning the development of dry ports) require simulation that allows to test psychological assumptions on integrated separate parts of real systems through computer models (Figure 5).
The decision making is not free of risks. That is why the research utilises the third domain; the risks based approach that belongs to portfolio theory. This approach considers the trade-off between the measurement of risk and return on the investments (Markowitz, 2011; see also Ho, 2014; Black et al., 2012; Law, 2008). It was taken into account in order to close the niche that exists in the context of scenarios of dry port development. Up to the present, the dry port phenomenon was studied, in many instances, from the regionalization point of view. The choice of dry port optimal location was considered by the scientific society of different countries. With the growth of the environmental issues, the dry ports have been examined in favour of the mitigation of negative influence (namely, leaving no carbon monoxide behind) in the ecosystems.

However, little attention was paid to the technical, operational, and ecological factors of dry port implementation in Russia (Korol’, 2015). For this reason, the research touches these issues. However, the scope of this thesis mostly covers the financial aspects of dry ports’ development. Particular, methods and models of risk management processes of dry port implementation, which is based on the public-private partnerships. Therefore, this work joins to the theoretical discussion on financial models and theories, i.e. capital asset pricing model (Lintner, 1965; Mossin, 1966; Sharper, 1964), discounted cash flow technique, real option theory, and adds scientific contribution to the portfolio theory (Chang, 2005; Gao and Driouchi, 2013; Karttunen, 2009; Michailidis and Mattas, 2007).

Starting from the use of the capital asset pricing model (CAPM) and discounted cash flow technique to determine whether the investment in dry ports is financially sensible, the author found limitation in their applicability because of the inadequate value of the management ability to react to the sharp changes in the economy. Due to this fact, the author resorted to the theory of real options for the proper decision making, which is based on the valuable flexibility of management, reacting to the ‘shocks’ in the operational environment to minimise losses from risks. However, this theory is also not free of limitations: it implies instant execution of the option, which is not always true for the real alternatives (e.g., the exercise of the option may include the construction of the additional terminal or the container yard that is not instantaneous). As a result, the third – portfolio theory, was additionally employed to the research through the mediator – system dynamics simulation approach.

The reason for choosing the system dynamics approach was in nature of the challenged tasks. As a rule, the subject of the system dynamics programming is the complicated processes. A so-called multi-step process generally implies the developments over time that are divided into several ‘steps’ or ‘stages’ for the simplicity of the calculations or the other explicit requirements (e.g., planning of economic activity on a time interval, consisting of several years). Many processes can be divided into stages artificially. Therefore, this method received a broad coverage, including the sphere of risk management processes (Armstrong, 1976; Siegmann and Lucas, 1999; Wijnen, 2003). In the current study, the process of dry port development with the allowance for the uncertainties and risks of the surrounding environment is
proposed in the form of the multi-step strategy for the project implementation. The consensus on the same principle of continual investment was gained by the seaport management, considering that this method allows improving the port resilience to risks (Trepte and Rice, 2014).

From the point of view that risks are generally classified into two groups of systematic and specific, the latter risks of dry ports development can be reduced through diversification, according to portfolio theory. Meanwhile, this theory also has controversies under the attempt of practical implementation (Mao, 1970). For example, in many instances, this theory regards net present value or internal rate of return as better criteria of decision appraisals (Harrington, 1987; Magni, 2009; Pereira et al., 2005). However, if to relax the assumptions of portfolio theory, the discounted payback period, which is widespread in business practice, cannot be fewer relevant criteria for the investment selection and risk measure (Bhandari, 2009; Bowen, 1984). The viability of this idea for the obtaining of more precise results in the appraisal of investments risks of the dry port project was tested in the simulation program Vensim, allowing the combination of Monte Carlo method and the discounted cash flow technique. By doing so, the statistical mean is used for the explication of the expected value of the DPP and NPV, while the standard deviation is proposed as a characteristic of risks.

Since the probabilistic measure of DPP was employed in the appraisal of return on investments, the project investments failure and guaranteed recoupment of capital investment can be also found (Esipova, 2011) to complement the accepted measure of risk in the unitized risk value (Nowak et al., 2015). Additionally, the uncertainty and risks are subjects of measure by the elasticity principle (Coto-Millán et al., 2013; Ricker et al., 1999). By knowing the elasticity of NPV and DPP to the uncertainty of the environment, in which dry ports evolve, ratings of factors of risks have been provided.

In order to accomplish all stages of risk management processes of dry port development, meaning risk identification, risk evaluation, risk mitigation, and risk monitoring and control phases (Kirilmaz and Erol, 2015), the systems dynamics approach was underpinned by portfolio theory and real option theory. In particular, these theories helped to allocate risk mitigation strategies. Meanwhile, at the stage of risk monitoring and control phases, their limitations have been overtaken by the developed system dynamics model. It allowed making managerial changes and identifying the most stable parameters that contribute to the optimal alternative scenarios of the project realisation in the uncertain and risky environment.

As a rule, the comparison of alternative scenarios, which are used for the mitigation of risks of project investments, is based on portfolio theory, providing a trade-off between the measurement of risk and return on the investments (Markowitz, 2011; see also Ho, 2014). The set of all portfolios is plotted as a risk-indifference curves that allow to find an optimal portfolio, which is the one that provides satisfaction for the investor, depending on the tolerance of the investor to the risks, i.e. greatest return for the risk that the investor is willing to accept. However, the investors have
different risk preference, and therefore, the selection of portfolio should be complemented by more commensurable values. In this regard, the given research proposes a so-called commensurable indicator of marginal utility of investment, permitting to find the efficient portfolio. It is based on the algebraic calculation of elasticity coefficients and utility theory (Black et al., 2012; Law, 2008; Pereira et al., 2005).

In conclusion, it is worth to note that with the help of the systems dynamics model, it is possible to find more accurate results and make proposals for the improvement of the efficiency of the investments. However, due to the reason that the research is conducted with the allowance for the Russian business climate, some dissertation outcomes can be delimited from the generalization to the European and other markets.

1.5 Structure of the Research

The thesis is comprised of two parts: 1) outline of the research and 2) five publications, on which the study is based. The overview of the thesis can be presented through the natural growth and development of the plant (apple tree; Figure 8).

The soil is believed to represent the environment that needs changes. Correspondingly, Chapter 1 includes the background information (the motivation behind the research). Additionally, Chapter 1 establishes a crater (scope and delimitations of the research). It also sets an explicit goal (research purpose), in other words, the direction to grow the planning tree coupled with steps (concrete research questions), underpinning the trunk. The root is supposed to a problem that is identified in the environment at macro and micro levels. Respectively, these issues

Figure 8. The process of research conduction corresponded to the thesis structure.
are presented in Chapter 2 (Potential of Advanced Supply Chains in Eurasian Logistics) and Chapter 3 (Russian Logistics Market: Problems and Prospects of Intermodal Transport Development).

Next, in Chapter 4, the answer to the question: ‘By what methodology the research tasks are solved?’ was found, reflecting the crown of the tree. Ultimately, it enabled to see the flower of the tree (Chapter 5), which is the Summary of the Appended Papers. Based on the summary of the results of the publications, the comprehensive analysis of the main research question was completed, proposing the final decision to the problem. Thus, the fruit of the research was obtained in Chapter 6 (i.e., Sophisticated Decision Model for Research Problem) that brought some changes in the environment (Chapter 7), explicating Conclusions. In all, the process of the research was conducted, pursuing the following statement ‘Good fruit gives its roots’.
2 POTENTIAL OF ADVANCED SUPPLY CHAINS IN EURASIAN LOGISTICS

2.1 Geographical Structure of Economic Relations in Eurasia

The development of transportation systems in Eurasia is stimulated by natural production and world trade of the manufactured goods. The main countries that account for 90% of the global trade are Europe–North America–Asia (The International Trade Centre, 2014). In 2006, the so-called ‘triad’ accounted for 80% of exports and 83% of imports (Verny and Grigentin, 2009). America and Japan produce cars and make shipments of their value-added products to countries from around the world. China provides a supply of electronics and perishable goods to customers over long distances, likewise. These examples represent a minor segment of the international trade cooperation that takes place every day (VOA-news, 2014).

Nowadays, the interdependence of nations increases and shows no end in this process. Regional economic integration becomes a way of formation of new, economically stronger and more competitive in the global market units that are called integration blocs. These blocks are believed to be the main representatives of the world economic relations. In this regard, in the Eurasian logistics, it is appropriate to consider integrative blocks rather than countries alone. Examples would be the European Union (EU) and Asia-Pacific Economic Cooperation (APEC). According to the estimations, by 2020 the trade turnover between EU and APEC may reach 1.8 trillion USD, increasing annually by 3% (Perepelitsa, 2013a).

In 2004, the turnover (export and import) of the Russian economy with APEC accounted for 43.2 billion USD (Bl USD). That is 26.9 billion USD of Russian Federation’s exports to Asia-Pacific Economic Cooperation (or APEC’s imports from Russia) plus 16.3 Bl USD Russian Federation’s imports from APEC (or APEC’s exports to Russia), as Figure 9 represents.

![Figure 9. Trade turnover of the Russian Federation with EU and APEC, in thousand USD (The International Trade Centre, 2014).](image-url)
According to Figure 9, the turnover with EU in 2004 amounted to 129.3 billion USD. This volume encapsulated 94.9 billion USD of Russian Federation’s exports to European Union (EU 28), i.e. EU (28)’s imports from Russia, and 34.4 Bl USD of Russian Federation’s imports from European Union (EU 28), i.e. EU (28)’s exports to Russia.

Thus, a trade balance of the Russian Federation with both integrated economic blocks was positive. The situation has changed, starting from 2006. Trade balance of the Russian Federation with APEC became negative, because Russia’s export to APEC has reduced compared to imports from APEC by 9% (35.8 Bl USD vs. 39.3 Bl USD). In turn, the growth of imports to Russia from APEC contributed to the increase of the APEC’s share in Russia’s economy in the following years.

To depict the restructuring of trade flows of Russia with EU and APEC during 2004–2014, the absolute numbers were converted into percentages. In other words, integrated blocks trade volumes in Russian economy were calculated as percentages from Russian trade with the world (Figure 10).

Figure 10 shows that starting from 2004, the turnover of the Russian economy with APEC as the percentage of the Russian trade with the world equalled 16.8% (43.2 Bl USD/257.2 Bl USD×100%). At the same time, the EU’s share in the Russian turnover with the world was 50.3% (129.3 Bl USD/257.2 Bl USD×100%).

Noticeable changes in Russian turnover with integrated economic blocks took place before and after the crisis. That is to say, for a one-year period (2006–2007), the share
of Russian trade volume with EU from Russian trade with the world calculated in percentage decreased by 8.1% (from 54.5% to 46.4%). Respectively, the share of APEC in Russian turnover, which is also calculated as a percentage of Russian trade with the world, has increased by 1.8% (from 17.1% to 18.9%).

By 2010, other shifts in trade turnover took place. Compared to 2009, the proportion of turnover with APEC in the trade volume of Russia with the world has since grown by another 2.1% from 20.5% to 22.6% (Figure 10). In absolute figures, by 2010 the Russian turnover with APEC increased to 141.6 billion USD (i.e. 65.2 billion USD exports to APEC and 74.4 billion USD imports from APEC, as Figure 9 shows). On the contrary, the EU’s share in the Russian trade turnover with the world reduced by 6% from 50.4% to 44.4%. In absolute numbers, the volume lessened to 278.1 Bl USD, which includes 93.4 billion USD of EU (28)’s exports to Russia and 184.7 Bl USD of EU (28)’s imports from Russia (Figure 9).

On the whole, Figure 10 shows that in 2014, the Russian turnover with EU as a percentage of Russian trade with the world decreased by 2% compared to 2004. The volume reduced from 50.3% to 48.3% that were calculated based on absolute numbers (in 2004, 129.3 billion USD/257.2 billion USD×100% and 374.5 billion USD/774.7 billion USD×100% in 2014). At the same time, the share of trade with APEC in the Russian turnover as a percentage of Russian trade with the world has grown by 10.1%, reaching 26.9% (or 208.2 Bl USD/774.7 Bl USD××100%).

According to the Centre for International Economic Research, by 2025 there will be a dramatic change in the geographical structure of foreign economic relations of Russia. Trade with the EU will be reduced to 36%, while the share of APEC economies will increase to 35%. The forecast is based on the expected enhance in supplies of raw materials and energy resources to China, Korea and Japan, as well as machinery and technical products of dual purpose to Southeast Asian countries (Troekurova, 2008).

In the light of current circumstances, the rapidly developing APEC can be called the most promising economic association of the world nowadays. In this regard, in 2010, the foreign direct investments in Asia reached 86.8 billion USD or 29% of total FDI in 245 countries of 302.5 Bl USD (The International Trade Centre, 2014). The members of the forum economies account for more than 48% of total world trade in 2013 (17.9 trillion USD of the global trade, 36.8 trillion USD). The growth in 10 years’ time is 2.6% from the volumes of 2004 (8.5 trillion USD of 18.5 trillion USD world’s turnover).

The GDP of Asian emerging and developing economies has grown even faster (International Monetary Fund, 2015). Since 2004 until 2014, the increase of GDP of these countries was equalled to 10.4%. At the same time, the European countries and the United States GDPs as a percentage of world GDP based on purchasing-power-parity (PPP) showed the slow negative tendency (-5.2% and -3.9%, respectively) (Figure 11).
Figure 11. Gross domestic product based on purchasing-power-parity (PPP), in the percentage of world GDP (International Monetary Fund, 2015).

To complete, the processes of globalization and the integration of the market economies in the Eurasian scale require the formation of a new high quality and powerful transcontinental transport systems with an appropriate amount and the level of transport services. Considering infrastructure as the essential background for other economic activities in the modern economies, the lack of investments in it handicaps the development of the countries.

2.2 Characteristics of Supply Chains within Russian Part of Eurasian Land Routes

Increasingly, the transportation distances are stretching and hence the cost of raw materials to put into the places of production and finished products to places of consumption is also growing. Therefore, the logistics approach, concerning minimization of the costs and provision of the high quality of the services becomes critical.

In many countries, logistics costs are calculated as a percentage of GDP, however, in some countries they are evaluated as a percentage of sales or turnover (Rantasila, 2013). Reportedly, it is useful to compare logistics costs in commensurable values (e.g., as a percentage of GDP). According to the study, the level of logistics costs range from 6–10% of GDP in developed countries (USA, Canada, Japan, Europe, mainly in Sweden, and Finland) to 20% of GDP and higher in developing countries (Ukraine – 18–20%, Thailand – 18.6%, Albania – 19.2%, Morocco – 20%, Colombia – 21%, Lithuania – 22.2%, Brazil – 24.5%, and Tajikistan – 27.2%).

Despite the variety of measures as well as the level of breakdown of logistics cost components, the transportation cost is present in everywhere. Moreover, it is the largest individual cost component, followed by warehousing costs. As a result, the logistics costs on the Eurasian market depend heavily on the location of a consumer
and a supplier (i.e. local markets of cargo departing and arrival). The transportation costs in transit territories also determined the total level of logistics costs.

Nowadays, in Eurasian logistics, the sea transport and air transport hold inarguable leadership in the transported cargo value (billion Euros) with the sea freight having the far largest share (95–96%) in regard to transport volume calculated in million tonnes (Rodemann and Templar, 2014; Wang and Meng, 2011). The landbridge transport in transcontinental container delivery accounts only for 3–4% of the share in container transport market despite the fact it has prominent lead time (Wang and Meng, 2011). It is generally accepted that air freight provides short lead time, while the primary advantage of the sea transportation over other modes of transport (e.g., Trans-Siberian Railway) is its lower shipping costs (Ivanova et al., 2006). For this reason, the shipping through the Suez Canal is still considered the least expensive option, compared to Northern Sea Route (NSR) and Trans-Siberian Railway (TSR) that appear to be roughly equivalent second-tier alternatives (Verny and Grigentin, 2009). However, it can be true only for the landed cost, without taking into account the other logistics cost components, such as warehousing, inventory carrying costs, administration costs, etc.

For example, in comparisons between TSR and NSR, the relatively high operational cost of the NSR should be taken into account, no matter the fact that the cost of conveying a container along this line is not prohibitive. Moreover, the specificity and rarity of container ships that are capable of taking this route contribute heavily to expenses, and, thus, increase the logistics cost per one TEU (Verny and Grigentin, 2009).

Similarly, in the research of Ivanova et al. (2006), the additional costs, like price erosion, has been considered as the negative impact on shipping costs. The study compares the route via Suez Canal and railway transport through Eurasia for delivering different products between Europe and Asia in containers. According to findings of authors, the mobile phones prices reduce on average by 20–30% per year. If the price erosion is considered as 24% and the transportation by sea and by railways from Europe to China accounts for 0.8 months and 0.5 months, respectively (Rodemann and Templar, 2014), then the decrease in cell phone value delivered in containerised form in both cases will be calculated as follows:

<table>
<thead>
<tr>
<th>Sea transportation</th>
<th>Railway transportation</th>
</tr>
</thead>
<tbody>
<tr>
<td>The value during the trip can reduce by 1.6% (24%/12×0.8 months=1.6%). To consider the erosion cost per one container, several parameters are adopted. The value for a mid-range mobile phone is 125 USD. The container encapsulates 10 000 phones (100% use of the capacity theoretically). Therefore, the erosion cost per one container will add 1 250 000×0.016= 20 000 USD.</td>
<td>The use of railways to deliver the same products is less harmful to the cost erosion 24/12×0.5=1%. That is why the erosion cost by railways per container will be 12 500 USD (125×10 000×0.01=12 500), which is by 38% lower than the transportation by sea (7 500/20 000×100=38).</td>
</tr>
</tbody>
</table>
The positive effect of using faster than sea transport railways is even higher when considering more expensive mobile phones (125 USD vs. 548 USD) that are neatly packed, e.g. iPhones. The elegant boxes allow to use better the capacity of the container, and, therefore, adding to the value of one container. For example, in one container, 54,704 units of iPhones (model 2012), 30 771 iPhones (model 2008) or 12 193 units (Nokia E7) can be loaded. For that reason, the value of the full container with iPhone of 2012 model is approaching 30 million USD (548×54,704=29 977 722 USD) with the erosion cost of 480 000 USD per one container delivered by sea (30 000 000×0.016=480 000). Therefore, the transportation of the full container by railways would minimise the erosion cost from sea route by 180 000 USD to 300 000 USD (30 000 000×0.01=300 000). Rodemann and Templar (2014) also acknowledge the idea of the existing strategic niche for rail freight in the Eurasian market. According to the authors, rail transport allows to reduce lead time compared to sea freight at a lower cost than, for example, air or sea-air freight transportation.

Another factor that advocates for the railway utilization via the Eurasian landbridge for the delivering of the value-added cargo is the inventory holding costs. The long delivery time brings a higher level of stocks that are required to perform the same level of services (Ivanova et al., 2006; Rantasila, 2013). The larger stocks inevitably increase the inventory holding costs. Wan et al. (2014) additionally point out the road congestion at the seaports that negatively impact the cost of delay and hence the total delivery cost on the relevant maritime transport chains. Due to this facts, the calculation results are the evidence that the transportation by sea is less competitive in the price from the point of view of the hidden logistics cost (Ivanova et al., 2006).

These effects of hidden costs fostered approximately 100 companies to have ‘reshored’ manufacturing to America (Economist, 2013). Examples range from the large organization, such as General Electric, to the Small and Medium Enterprises, such as ET Water Systems. The latter company found that California was only about 10% more expensive than China due to discovered hidden costs (Gray et al., 2013). So as to decrease the logistics cost, companies have started to practice inshoring activities and retaining local production long ago (Theyel, 2012).

Erosion cost and inventory holding cost had the adverse effect on Tandy Corporation in 80’s when the company decided to move production of its latest computer to South Korea. Then rising shipping costs, long lead times for the sea transportation to the USA, high inventory holding costs, the changing value of the dollar, encouraged them to reconsider their location. In 1987, they moved back to FortWorth, Texas and reduced logistics costs by 7.5%. Even Apple announces its proposals to produce one of the Mac assortments in the U.S. (Theyel, 2012).

Thus, it makes little sense for a high-technology company to move away from its main markets and work in a low-wage economy, when wages accounts only for 2% of total logistics costs of the enterprise. The problem with moving to areas with low-cost operations (developing countries) is that they might give lower production cost, but higher logistics costs of distribution. Finally, there are higher total logistics costs
than expected. Due to this fact, for instance, South Africa does not export excellent beer made by national breweries to Europe, because of the transportation costs (Waters, 2003). The above-mentioned examples determine the necessity to minimize logistics costs by choosing the right supplier, the route for the delivering of the cargo, and the suitable transport modes included in the supply chain.

To a greater extent, the formation of effective SCs across Eurasia requires analysing all supply chains of deliveries; defining through what countries the routes lie, what level of service is provided in the transit countries. The Russian logistics markets are an inevitable part of Eurasian supply chains. Therefore, it is important to know about specifics of its transportation system, principles of cooperation between modes of transport, level of logistics costs, and provided services.

To estimate the transport services of the transit country at a glance, several logistics indexes can be utilized. An example could be Logistics Performance Index, Global Competitiveness Index, Index of Globalization, and DHL Global Connectedness Index. Accordingly, Russia is in 90th place from 155 possible countries by the Logistics Performance Index (LPI). The fundament of the Russian logistics is its transportation system (Figure 12).

![Transportation system](image)

**Figure 12. Transportation system (CSCMP, 2010; Lättilä, 2012; Rantasila, 2013).**

Russian transport network interfaces with a network of 17 border countries. The network has more than 4,000 railway stations; 102,000 km of inland waterways, more than 2,000 river quays; and 63 seaports. Approximately, 34 seaports serve international traffic and 28 the cabotage trade and cargo delivery to the Extreme North of Russia with the turnover of 589.2 Ml tonnes in 2013 (by 2030, more than 1 billion tonnes). The number of airports equals 1218, of which 594 and 624 with the paved and unpaved runs, respectively (Perepelitsa, 2012a; Russia’s Merchant Seaports Association, 2014; Siparo, 2014; The World Factbook, 2014; YE.com, 2014).

The transportation system of Russia can be characterized, for instance, by the following quantitative indicators:

- Length of transport networks,
Volume of cargo transported,

Cargo turnover.

According to the World Factbook (2014), Russia is ranked as a second by the length of the railway network and the 5th by the roads’ length. The third place in the road and railway networks’ length is occupied by China, while the longest networks of roads and railways could be found from U.S. At the same time, the length of Russia’s rail network as a percentage of road length is higher than, for example, the same fraction in China and the U.S. (Laisi, 2010).

During the last decade, the transportation of goods by road in Russia remained higher than the by other modes of carriage (68% of all transport modes in 2014, Federal State Statistics Service, 2015a). Road is dominant on the market of the carriage. The reason behind is that it used as the ‘last mile’ of the supply chain for delivery of goods to the consumer (Figure 13). In Europe, the share of road transport accounted for 75.4% in 2013, exceeding the rail transport share of 17.8% (European statistics, 2015).

Figure 13. The volume of transported goods by mode of transport, in million tonnes (Federal State Statistics Service, 2015a).

The road transport is highly involved in the national and international traffic. The import cargo is mainly transported by roads through Moscow and Moscow region – 52.8%, Kaliningrad region – 19.7%, and St. Petersburg and Leningrad region – 12.5% (Ermolenko, 2014). Moscow and Moscow’s region traditionally remain the main area of imports of cargo, receiving around half of all Russian imports. Concerning the ways of crossing the border, in general in 2013, the share of imports via the Russian border crossing points was 93% and 7% via seaports. In 2002, this proportion was 85% and 15%. Through the seaports, the metal ore is mainly imported – 27.5%, while via border crossing points are mineral construction materials – 36.6% (Ermolenko, 2014).
On the regional level, in the period of January-April 2014, the volume of cargo transported by road in the import direction to Russia from the EU reached 59.36%, seaports – 28.43%, while railways only 11.92% (Ermolenko, 2014). The share of cargo imported by sea transport from EU seaports, including Finland and the Baltic States could be increased via St. Petersburg. Further on, the goods could be delivered to other regions of Russia by railways. This alternative is viable, if there were enough multi and intermodal facilities in the area. Potentially, the import via this route can be enlarged by 10, or 100 times (Simonova, 2014). To increase the throughput of St. Petersburg seaport, it is planned to extend its quay wall so as to build new piers (Simonova, 2014).

Unless the changes are not made, instead of sea transport, the road is more popular in delivering the cargo between St. Petersburg and EU countries (47.4%). One of the reasons for such disproportion may stem from the absence of the terminal and warehousing infrastructure that is technologically required for the railway transport and, overall not well developed in Russia (Simonova, 2014). The transportation of goods by road is carried out in more than 40 countries provided by more than 5.5 thousand Russian transport companies (Auto-business, 2012). In the international traffic, the share of foreign companies is higher than the proportion of national enterprises (Figure 14). Meanwhile, by 2030 the share of national enterprises is expected to grow to 50% (Investinrussia.com, 2015).

Figure 14. The volume of international traffic provided by national and foreign companies, in percent (Kholopov and Zaboev, 2014; Ushenin, 2011a).

In Russia (North-West region), the largest volume of international freight traffic was carried out in the direction of Russia – Finland (51%; Gorshkova, 2012), as Figure 15 shows.
According to National Board of Customs Finland, in 2013 cargo (2,409 thousand tonnes) was exported to Russia from Finland by the following transport modes: 76% (1,830 thousand tonnes) by road, 16% by railway, and 7% by sea. In the import direction, approximately 27,442 thousand tonnes from Russia was transported to Finland. The proportion of road in transportations was lower (8%) than railway (24%) and sea (57%).

In Russia, the vital role of railways in the domestic and international market should not be underestimated. This situation can be explained by the scale of the country, and, therefore, by the competitiveness of the railways compared to roads over longer distances. JSC ‘Russian Railways’ carries 45.3% of freight turnover (tonne-kilometers, tkm) of total turnover provided by other modes of transport (or even 86.6%, if to exclude the pipe from the total turnover, in 2014). In the global scale, by the performed work (turnover) measured in tkm, Russia is in the third place after the U.S. and China (Figure 16).

By 2020, it is expected that the growth of the freight turnover of the Russian Railways...
will be 40%. At the same time, via BAM the turnover will increase by 2.5 times and at the approaches to the seaports of the Vanino-Sovgavansky transport hub will be even higher (by 3–4 times; Yakunin, 2012). The current growth of the turnover at railways brings the sufficient revenues to the company ‘Russian Railways’. The income, in 2010, was 1 196 billion RUB that is higher than the outcome of 2009 by 13.9% (Gurev, 2011). The profit of the JSC ‘RZD’ was 70 billion RUB. The income from the freight traffic alone, in 2010, was 937.5 Bl RUB (19.7% growth compared to 2009).

Meanwhile, the railways are not sufficiently involved in transporting the cargo between hinterland and seaports. Instead, road transport is extensively used in connections with the seaports. At the same time, the infrastructure of both is inadequate to the seaports’ demand (Perepelitsa, 2012b). In future, the unbalanced development of the seaport and land infrastructure can be even more noticeable since freight turnover at the seaports will significantly increase. By 2030, the turnover of the seaports will rise from 589.2 million tonnes (2013) to 1 billion tonnes. Within this figure, 60% is dry cargo, mainly coal and containers. Meanwhile, crude and crude products are accountable for 40% (Ermolenko, 2014).

Currently, the split of railway share traffic in connection with the seaports shows different levels of railways utilization. For instance, in the North-West region railways’ share is 39%, while in the Far East and the Southern region is 32% and 29%, respectively. In the North-West region, the service of the seaport of St. Petersburg is provided by one of the 16 branches of Russian Railways. The branch is called October Railway, which has a unique geographical location, allowing to serve the ‘seaport gateways’ and ‘border crossing points’ simultaneously. The railway provides services to St. Petersburg and other six Russian seaports (Figure 17). Rail freight traffic is predominantly used in connection with Ust-Luga (30%) and St. Petersburg seaport (29%).

![Figure 17. Railway’s share in maritime basins and North-West region seaports, in percent (Lobko, 2012).](image)

The volume of cargo sent by October Railway to the seaports has grown in 2012 by 12.7% to 94.3 Ml tonnes compared with 2011. The increase of the traffic is determined by the development of Ust-Luga seaport. The number of the trains sent by the regular schedule amounted to 1 637, bringing the additional profit of 78.2 million RUB.
However, without the creation of railway terminals and inland warehousing infrastructure, the volume of traffic by rail in communication with the seaports is unlikely to improve (Abdikerimov et al., 2013). This situation may stem from the advanced development of the warehousing and terminal infrastructure at seaports, rather than in the inland territories. The maritime infrastructure of seaports becomes a much more significant factor as shipping lines consolidate the volume on bigger ships (Ivanova et al., 2006; Rodemann and Templar, 2014; Roso et al., 2015; Trepte and Rice, 2014; Verny and Grigentin, 2009; Wang and Meng, 2011). Because the efficient operations at the maritime terminals of the seaports are at the high request, it is worth noting about key companies, which manage containers’ processing at the Russian seaports. These are Global Ports Investments (GPI) and Summa Group Terminals operating companies.

Global Ports Investments (GPI) is the Russo-Danish port’s operator. The press releases of Interfax.ru (2013) and Worldcargonews.com (2014a) informed that GPI has recently (December, 2013) taken over the Russian operations of National Container Company. As a consequence, nowadays, the company operates five terminals in Russia. These terminals are Petrolepsport, First Container Terminal, and Moby Dick in St. Petersburg seaport, a container terminal in Ust-Luga seaport, and Eastern Stevedoring Company in Vostochny seaport. Additional assets of the company include two container terminals in Finland (e.g., Multi-Link Helsinki and Multi-Link Kotka). The Group also owns 75% of the dry port Logistic Park Yanino and 100% of the dry port Logistika-Terminal, which both are located near to St. Petersburg.

The stevedoring operations at leading seaports in container handling, such as St. Petersburg, Vostochny, are provided by the Global Ports Investment. Meanwhile, the Summa Group Terminals are located in Novorossiysk, Vladivostok, Primorsk, Baltiysk, and in Zarubino seaport, which is enlarging nowadays. Summa Group also stimulates the project of the free port (porto franco) in Vladivostok, advocating for this idea by citing excellent examples of the fast cargo base growth in Shenzhen and Singapore.

It is worth stressing that these operating companies can cope with the expected increase in container flows in the sea. However, the same cannot be said in relation to the land transport that is used to carry containers between seaports and hinterlands. There are high risks of congesting the road network leading to the ports, as well as the insufficient carrying capacity of railways proceeding to the seaports. That is why, it is critical that the Government takes the necessary steps. Particularly, in terms of hinterland infrastructure, land access to seaports requires improvements. For example, the advancement can be in the development of the appropriate rail links, terminal and warehousing infrastructure, as well as the promotion of intermodal interaction between land and water modes of transport.

In Russia, the cooperation of modes of transport is based on the desire to implement
the direct transfer. This concept implies the transfer of cargo from sea to rail/road and vice versa without the use of temporary storage (Abdikerimov et al., 2013). The direct transfer reduces the logistics cost related to the warehousing and inventory holding costs due to the absent need for the large warehousing capacities. However, this method of cooperation is difficult to provide due to different schedules of transport modes and other factors.

As a result, the direct transfer may lead to increased downtime of vehicles. The seaport may not have a vessel for direct cargo handling. Consequently, the seaport may not accept the loaded trains or trucks (due to lack of available storage). Empty wagons or trucks or loaded vehicles are idle sometimes for many days (7–10 days or more) in anticipation of the arrival of the vessel.

Railways in such cases decide to accumulate and store goods directly in the trains (in wagons as a stock on wheels) in the expectation of the arrival of the ship at the seaport. These trains called ‘abandoned’ trains that cause so-called traffic jams at railways. The insufficient development of the adjacent rail approaches to the seaports (St. Petersburg, Novorossiysk, and Murmansk) deteriorates the situation (Maksimov, 2013) at railways systems. According to Abdikerimov et al. (2013), the cost of storage time of cargo in warehouses is around ten times lower than the storage of cargo in rail cars in the expectation of vessel arrival. The costs in both alternatives are 7–8 RUB/t-days vs. 70–80 RUB/t-days.

The insufficient capacity of the seaports approaches, especially those that are situated in the urban infrastructure, causes the overloading of adjacent roads and city streets. For instance, in St. Petersburg seaport, which is located within the city infrastructure, most of the cargo is transported by road (up to 90%). As a result, the traffic jams are evident not only in the daytime, but also at night. An example would be the Kupchino district of St. Petersburg, where the trucks are parking in the residential neighbourhoods. The truck drivers are naturally present in their freight cars, blocking the city streets (Aleksandrova, 2012a).

In these circumstances, the quality of the air reduces. On the whole, in Russia, transport accounted for 41% of emissions in 2000 (Federal State Statistics Service, 2015b). In 2014, the emission from transport increased to 44%. In the EU, transport causes approximately 19.7% of CO₂ emissions with the road transport amounting to 71.9% of all national inland transport in 2012 (European statistics, 2014). In Russia, transport sector emissions account for 30% in the overall CO₂ emissions from fossil fuels combustions (Internationaltransportforum.org, 2010). It should be noted that the CO₂ intensity of the Russian economy is in the highest category of countries with the largest volume of carbon dioxide emissions generated by the energy sector (Ministry of Natural Resources and Ecology of the Russian Federation, 2015; Co2scorecard.org, 2011). In 2011, Russia released 1,710 million tonnes of CO₂, and was ranked 3rd after the U.S. and China out of 216 countries (Co2scorecard.org, 2011). The difference of emissions’ levels in Russia and the EU members can be explained by the serious attention to the environmental management, which is progressed in the transport and logistics sector of the developed countries
and on the global level through the cap-and-trade mechanism (Liu et al., 2015; Oberhofer and Dieplinger, 2014; Yang, 2015).

The implementation of this approach in Russia may change the current stance to the organisation of the transportation within the supply chains to more efficient cooperation. Moreover, the situation reportedly will be improved, especially in 2017, being the Year of Ecology in Russia (Ria.ru, 2016). First and foremost, the issues from traffic jams at road and railways can be diminished. Like in the Austria, where the emission is below an average European level, powerful enterprises need to be more cautious about their brand. In this regard, they ought to avoid negative connotations with it, including those that may arise from the insufficient level of their supply chain management (Liu et al., 2015; Oberhofer and Dieplinger, 2014).

Through the efficient strategic management, rather than the desire to provide immense profits during the transport modes cooperation without proper considerations, the problem of traffic congestions and subsequent high emissions issue can be eliminated (Bergqvist and Monios, 2014; Bisen et al., 2013; Tang et al., 2014). The studies of Moscow Transport University, for example, showed that the direct transshipments of goods from rail to road transport can be applicable in a few cases. Without unnecessary postponement of vehicles, the implementation of direct transfer is possible in only 20–25% instances. In the remaining 75–80%, the transfer between modes of transports is better to provide by the indirect transfer with the use of the freight terminals and warehouses, where cargo can be accumulated (Abdikerimov et al., 2013).

Currently, the deficit of the technological infrastructure of the terminal and warehousing infrastructure is compounded by the implementation of new schemes of intermodal traffic in Russia, e.g. piggyback traffic that requires higher standard and new technologies’ creation. In general, the piggyback services that considered as new for Russia are already a long-time favourite in Europe. By nowadays, more than 300 intermodal terminals in 29 countries are organized. The first trial trips with the use piggyback technologies in Europe have started in the 1960s. The initial regular Route Cologne (Germany) – Verona (Italy) was put into operation in 1972. Nowadays, on the territory of the European Union, there are about 21.5 thousand piggyback trains per year. In most cases, the application of this technology assumes a so-called ‘the ferry decision’. That is, to overcome mountain passes, nature protection zones, restrictions on the traffic and so forth. In this regard, a small part of the intermodal traffic is provided by rail (around 300 km or 15–30% of the whole intermodal route). This technology is also favourable for the environment.

By contrast to EU, the current implementation of the piggyback traffic in Russia is related to the difficulties with the passage of the customs’ procedures. The association European Intermodal Transportations recognized a piggyback train ‘Viking’ as the best European project of 2009 for passage of the Belarus – Lithuanian border (within 30 minutes). At the level of forwarding associations of Lithuania, Belarus, Ukraine, and Turkey, there is an arrangement on expanding of a route of ‘Viking’. It is planned, in a context of EU-TEN Corridor 9 (Baltic Sea – Black Sea), to broaden the
way to Turkey. There is a possibility of prolongation of the connection to Uzbekistan with the participation of ferries.

By nowadays, the JSC ‘RZD’ developed a Concept of the Organisation of Piggyback on the ‘1520’. The concept aims to justify piggyback development in Russia. In the near future, the piggyback trains will be started in a direction of Helsinki – Moscow. (JSC ‘RZD’, 2011b). It is supposed that piggyback transportations will be organized on the additional directions. At the first phase, this technology is prescribed on the nine routes, which nowadays are characterised by the most intensive automobile traffic. The use of this form of transportation stimulates the upgrading of the terminal infrastructure. The proposed modernisation of Russian transportation system, considering its critical importance for the Eurasian supply chains, is expected to change the peculiarities, which concern the management of freight flows and the total costs of goods processing in the country and beyond its borders.

2.3 Challenge of Logistics Costs

To a greater extent, if to consider Eurasian continent as a ‘landridge’ for the cargo delivery, goods are passing developed and developing economies, involving different levels of logistics costs. Among the continents and regions, logistics costs vary from 10% in North America, around 13% in Europe, to 14% in the Pacific Rim and almost 16% in South America. As such, the improvement and facilitation of transportation processes between states and regions may lead to significantly lower logistics costs, higher quality of services, and growth of the economy, as a whole. For example, the world economic growth can be boosted by the increase of the performance logistics index. According to Coto-Millán et al. (2013), the elasticity of the global economy to the logistics performance correspond to the ratio, which shows that global growth between 0.011% and 0.034% results from the one-percent change of the LPI and its most important sub-indexes. In Russia, the growth of the economy can be attained by the reduction of logistics costs (8900 Bl Roubles), which take on the average about 20% of GDP. In particular, the decline of logistics cost by 1% translates to a saving of 445 billion Roubles/year (8900/0.20×0.01=445) (Sergeev, 2011).

According to the survey made by Boston Consulting Group together with the Committee on Commerce and Logistics Industry of the Russian Federation, the vast majority of respondents, Russian and foreign entrepreneurs (81%) indicate the cost of transportation of the manufactured products as the primary component of the logistics cost. More specifically, around 34% of these respondents estimated the share of costs of the company for transport and logistics services as 10% of the products cost. An even higher value of these costs (30%) within the products price is considered by 26 percent of the respondents (Volkov et al., 2014).

Meanwhile, Alesinskaya (2005) estimates the reduction of the logistics costs related to inventory management of the critical importance. The author states that in the overall costs of logistics, the expenses of the inventory carrying make up about 50%, including the administration costs, as well as losses from damage to goods.
Rybnikova (2008) hypotheses that funds invested in stocks occupy a large proportion of the cost structure. That is why inventory management of the enterprises, is in the focus for economic consideration. Smirichinsky and Perov (2010) also note that an analysis of the structure of the logistics costs of the developed capitalist countries shows that the largest shares of the costs are:

- inventory management – 20–40%;
- transportation costs – 15–35%;
- costs of administrative and managerial functions – 9–14%.

Smekhov (1993) pointed out that, if the cost of logistics is taken as 100%, the shares of individual components are as follows:

- transportation to the main transport – 28–40%;
- storage, handling and cargo processing –25–46%;
- packaging –15–25%;
- administration costs – 5–15%;
- other (including order processing) – 5–17%.

Thus, the analysis of logistics costs in Russia suggests that transportation, warehousing, handling and storage of goods, and their management comprise the main individual cost components. Warehousing and transportation could all add to more than 80% of total logistics cost.

Among the adverse factors of high logistics costs are the lack of progression in the development of the existing transport infrastructure, coupled by the low level of availability of logistics services to the public. Transport Minister Mr. Sokolov notes that the loss of the country’s insufficient transport infrastructure development is estimated at 3% of GDP, annually (Pletnev, 2013). The lack of funding for the infrastructure projects in Russia drags the economy, leading to a reduction of budget revenues. Experts have calculated that the needs of the industry are such that just to bring infrastructure to the standard level; it is required to invest 1.2 trillion USD. The sum is more than any state can provide (Pletnev, 2013).

The stance of the railway industry in Russia is deteriorated by its clear underfunding; despite the fact that railways historically have been the backbone of the Russian economy, helping to develop the economy itself and equality in society (Andreeva and Svyatkina, 2011a; Ermolenko, 2013a; Maksimov, 2013). If compared to a global scale, the investment to the railway sector is more prioritised by Organisation for Economic Co-operation and Development (OECD). For example, the investments into the rail infrastructure are 5 trillion USD, which is higher than in airport and seaports in total (3.3 trillion USD; Table 2).
Table 2. Global infrastructure investment needs 2009–2030, in billion USD (OECD, 2011).

<table>
<thead>
<tr>
<th>Global Infrastructure facilities</th>
<th>Annual Average Investment</th>
<th>Aggregate Investment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airports capital expenditure</td>
<td>70</td>
<td>120</td>
</tr>
<tr>
<td>Port infrastructure facilities capital expenditure</td>
<td>33</td>
<td>40</td>
</tr>
<tr>
<td>Rail 'new construction' (incl. maintenance)</td>
<td>130</td>
<td>270</td>
</tr>
<tr>
<td>Oil and gas – transport and distribution</td>
<td>155</td>
<td>155</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>388</strong></td>
<td><strong>585</strong></td>
</tr>
</tbody>
</table>

In Russia, the cost of the railways’ infrastructure projects is impressive likewise. The projects geared towards delimitation of ‘bottlenecks’, the developments of transport nodes and junctions, are included in the federal target programme ‘Development of transport system in Russia (2010–2020)’. The programme is approved by the Federal Government from 28.12.2012 No. 2600-р. The costs of the infrastructure projects are as follows (Ermolenko, 2013a; Kashirina, 2013):

- High-Speed Railway Moscow – Kazan (927 Bl RUB),
- BAM and Trans-Sib (562 Bl RUB),
- Central Ring Road in Moscow (300 Bl RUB),
- Line of high-speed traffic between St. Petersburg and Helsinki, including the cost of shifting the cargo traffic to the new directions (52.7 billion RUB for the period 2006–2012).

However, in the latest version of the investments’ documents, the sum required for the reconstruction of Trans-Sib and BAM increased to 1 RUB trillion. The finances mentioned before (562 billion RUB) can only provide the growth of traffic to 50 million tonnes per year. According to the Strategy, the traffic should be enhanced to 100 million tonnes/year. Due to this fact, the additional investments were announced. The financing will be for the construction of 87.3 km of the third lines in Trans-Sib, 25 train stations and transport, and logistics centres (Aleksandrova, 2014).

In general, the cost deviations of 50–100% are an often an issue of mega infrastructure developments in different countries. A similar pattern follows transport infrastructure projects in Asia, where the investment activity is boosting (Park and Papadopoulou, 2012). The same situation characterises the costs of the 2018 World
Cup, which will be in Russia. The budget has grown gradually (Baumann and Matheson, 2013). The next project is Western High-Speed Diameter that is a toll motorway in St. Petersburg. The funds allocated by the budget of the city increased by 61% from 33.5 to 54.1 billion RUB. The financial inflows from the investor have been slightly enlarged by 1 Bl RUB to 107.86 Bl RUB (Gaiduk, 2012). Another project is Orlovsky toll tunnel under Neva River with cost overruns of 23% (from 56 to 69 billion RUB). Reportedly, the reason behind the growth of the value of the project is that the first price did take into account only the cost of the tunnel. Meanwhile, the road infrastructure was not summed with the total project cost despite the fact that it was required for the connection of the tunnel with the embankments (the complication of junctions on the left and the right bank of the Neva; Gaiduk, 2012).

Some authors elaborate that the tight deadlines due to rushed schedules determined the rise of the costs. A notification should be also made to the risk analysis, because, in reality, the world of project development is a non-linear and non-deterministic. Instead, the events are significantly stochastic. The pricing risks in Great Belt, Öresund, and Channel Tunnel projects were insufficient (Bruzelius et al., 2002). Their consideration in other projects likewise might be the same.

Therefore, in the current economic environment, especially in Russia, the transport projects require the attraction of the additional investments, as well as a proper estimation of different factors of risks. The evaluation of risks can benefit the process of meeting the overall goal of the facilitation of projects realization (Bergqvist and Monios, 2014), and, in the long term, provide the mitigation of high logistics cost.

2.4 Internalization of Logistics Systems in Russia

In general, the issues mentioned above received more publicity in recent years, because the role of the transport infrastructure progression, notably transport corridors, is ever increased with the sharp development of the world container market. Intermodal transport corridors across Russia are a natural extension of European highways (road and railways) in the direction of South and Southeast Asia (Shabarova, 2002). These are the extensions of the following European corridors:

— EU-TEN Corridor 9 (from the border with Finland to St. Petersburg and Moscow, and then through Kiev continuing to Astrakhan and Novorossiysk seaport);

— EU-TEN Corridor 2 (from the border with Belarus to Moscow and then to Nizhny Novgorod followed by coupling with the Trans-Siberian railway in Yekaterinburg);

— EU-TEN Corridor 1 (border with Latvia from Riga – Kaliningrad – border with Poland, Gdansk; European Commission, 2014).

In the Baltic Sea region, the corridor of Klaipeda–Moscow, which connects Baltic Sea through Lithuania and Belarus with Moscow; as well as Barents corridor, linking
Kem’ (Russia) with Salla (Finland) and Russian seaports of Murmansk (Barents Sea) and Kandalaksha (White Sea), play a critical role for the organisation of transportation processes in the region.

Nowadays, more and more European operators are interested in the extension of their supply chains to Russia (Straube et al., 2008). By cooperating with the Russian railways, the businesses provide the Third Party Logistics (3PL) services under the demand in the rail industry (Lasarev, 2011a). Russian Railways influence the domestic economy and to Eurasian, likewise. Almost 84% of intermodal transport corridor East-West or so-called Northern Corridor (NC) lies in the Russian territory (Hilletofth et al., 2007; Rodemann and Templar, 2014; Figure 18).

![Figure 18. Eurasian transport corridors (Tonkova, 2014).](image)

In connotation to NC, the Trans-Siberian Railway is also used. It goes from Europe to China directly or through the territory of Kazakhstan. The Northern Corridor, totalling about 11 thousand km runs from the port of Lianyungang (China) to Rotterdam (Netherlands). Approximately 9 200 km of the route is covered with long Trans-Siberian Railway. In Russia, the importance of railways is determined not only by the necessity to transport goods over long distances, but also by the formation of the country’s GDP. More than 2% of Russia’s GDP is derived from the railway industry alone (Yakunin, 2011a). According to the estimations of the RBC Information Systems, the volume of the Russian container market equals to 2 700 million USD. The cost includes the services provided by the Russian operators, expeditors, and stevedoring companies. From this sum, around 810 million USD
accounts for the stevedoring services and 950 billion USD is the transportation of containers by the railways (Rezer, 2009).

It is supposed that JSC ‘RZD’ can be a base for the formation of the 3PL and even 4PL or 5PL services. The favourable impulse for the development provides companies from other countries that are interested in the optimising distribution of their goods in Russia. The increase of interest from foreign investors was noticeable in the sphere of terminal and warehousing business (Tsygankova and Shmeleva, 2009). Generally, the volume of operations of foreign logistics companies on the Russian market increased to 1 Bl USD in 2007. The growth compared to 2006 was 30% (Tsygankova and Shmeleva, 2009). In this regard, Russian railway companies, e.g. JSC ‘RZD-Logistics’, also appeared to meet this demand (Lasarev, 2011a).

On the whole, Russian transport and logistics market employ around 3 800 companies that offer transport and freight forwarding services. The companies, which are registered in Russia, including their subsidiaries, are 2 800 shipping companies and 1 000 freight forwarders (Van Eynde and Bilkova, 2014). According to Kravchenko and Bereka (2014), more than 6 000 companies offer transport and logistics services of 1PL and 2PL services in Russia. Regardless the development of logistics companies, the level of outsourcing of services is rather small. If, on a global scale, the level of outsourcing (2PL, 3PL, and 4PL services) reaches 60–63% of the world transport and logistics market, the Russian share of the global market was only 4% in 2009 (Tsygankova and Shmeleva, 2009).

The latest research addresses that the outsourcing share of transport and logistics services in Russia is estimated at only 20%, while world average value is 40–50% (Volkov et al., 2014). The market size, in general, is relatively small. Only basic transportation services have a higher share, while 3PL/4PL services can be considerably expanded under certain conditions (Kravchenko and Bereka, 2014; Volkov et al., 2014). For example, the development of dry ports may contribute to the supply of qualitative services. Since the operating of dry port implies the warehousing and transportation, as well as value-added services, it can be attributed to the contracted logistics, e.g., comprehensive 3PL services, or even integrated logistics, i.e. 4PL services that lack of supply from logistics companies in Russia (Figure 19).
As can be seen from Figure 19, the 3PL services are under development, while 4PL are only in its infancy. The market of 3PL services (1.9%) in Russia is represented by the courier services (4.5%), warehousing operators (10.8%), and transport and freight forwarding companies that provide international traffic (82.8%). The freight forwarding segment growing was the fastest, contributing to transport and logistics market increase by more than 19% p.a. It should be noted that the services, which are aimed at outsourced providers, are limited to inbound and outbound logistics. Meanwhile, on the global market, there is an increase in outsourced internal logistics and inventory management that comprise about 12–14%. This segment in Russia has a share of 3–4% and holds a significant growth potential (Van Eynde and Bilkova, 2014; Volkov et al., 2014).

In the next ten years, according to Volkov et al. (2014), an average annual growth of transport and logistics services will be about 15%, despite the peculiarities of the logistics market in the Russian Federation, i.e. a domination of the integrated model of logistics companies. A classic example would be JSC ‘Russian Railways’. The company is responsible for the rail infrastructure and provides 3PL-services with the help of JSC ‘Transcontainer’ and JSC ‘RZD-Logistics’. By the purchase of GEFCO, the largest Russian company came into the 4PL service segment and strengthened its presence in the 3PL service market (Volkov et al., 2014).

In conclusion, for Russia, intermodal transport can be a way to integrate better into the world market. Given the fact that all contemporary routes cross Russian territory, it can be considered as a current key country for a successful landbridge. However, the contemplation of Russia on its heavy infrastructure investments may provide China to take the advantage in the future (Rodemann and Templar, 2014). To avoid blurred expectations, the promotion of intermodal transport is required, allowing for the deeper level of integration, i.e. beyond the raw materials' exports. The desired way of cooperation could be attained through the export of the logistics services.
during the carriage of goods in transit. Meanwhile, the latter form of the successful trade relations is only possible, if the transport systems are organized at the European level. Especially, railway links, terminal and warehousing infrastructure placed inland and on the approaches to the seaports along the international transport corridors, are to play critical significance.
3 RUSSIAN LOGISTICS MARKET: PROBLEMS AND PROSPECTS OF INTERMODAL TRANSPORT DEVELOPMENT

3.1 Consideration on Railway Links

The development of intermodal transport in Russia can be one of the most promising alternatives for the enhancement of the land traffic in connections Europe–Asia. The intermodal freight traffic between Asia and Europe can be realised by the leverage of economic, political, technical, social, legal, and environmental enablers (Rodemann and Templar, 2014). In support of this idea, the agreement signed by the International Union of Railways (UIC) and the Coordinating Council on Trans-Siberian Transportation (CCTT), plans to facilitate the cargo attraction to the East–West International Transport Corridor. For this to happen, the Trans-Siberian Railway will be promoted for the use (Worldcargonews.com, 2012).

Nowadays, the term of Trans-Sib is less frequently used in the sense of a local route, connecting the Centre of Russia and the Pacific Ocean, Moscow, and Vladivostok. Trans-Siberian Railway, as part of the East-West corridor in Russia or Northern corridor in Eurasia, is more often used as a geopolitical concept. In a broader sense, the term of Trans-Sib refers to the route, which connects the Russian western, northern and southern ports with the ports of the East and the rail outputs in Asia.

In previous years, the main contributor to the transit traffic via Trans-Sib was Finland that transited via Russia the largest volumes of goods during 2003–2005 (Hilmola, 2011; Rezer, 2010). The most significant increase of container traffic via Trans-Siberian Railway (Finland–Asia connection) was spotted since the 2000s. In 2004, the record number of containers (124,473 TEU) was transported (VR Cargo, 2004–2010) in connection Finland–Asia with maximum transit traffic via Trans-Sib, 174,000 TEU in 2004 (Ponomareva, 2014). Timetables and safety of goods were provided. Trains had a departure three times a day from Kouvola (Finland) to Vostochny seaport (Russia) and further. The delivery time was 21–24 days (Hämäläinen and Simonen, 2007). Critical points were in the Far East, when the container was moved from the ship to rails at Vostochny seaport, and the border crossing at the western end of the Trans-Siberian–Buslovskaya–Vainikkala. The border crossing with Finland gave a competitive advantage, as it belongs to the part of the European rail network (EU-TEN Corridor 9). Meanwhile, at the Eastern part, in Vostochny seaport, delays could occur due to selective customs’ control or because of the shortage of rolling stock. However, the positive trends of traffic between Finland and Asia via land route were undermined.

The volume at Trans-Siberian Railway was sharply reduced due to the growth of tariffs (Ollus and Simola, 2007; Tsuji, 2003; Ushkova, 2013b). Since the 1st of January 2006, the increase of tariffs on transit transportation via Trans-Siberian Railway on average was 30% for loaded containers and 3–4 times higher for empty containers. Meanwhile, the import tariffs for the carriage of containers were increased by 32.9% due to the indexation and value-added tax (VAT) growth. According to
Germanova (2006), the reason behind the tariffs’ increase was the preceding small tariffs that did not cover the cost of shipping, and, therefore, was subsidised by the profits from the transportation of other goods. After a sudden increase in tariffs, transit container flows in the Russian Railways collapsed in a few months during 2006 (Hämäläinen and Korovyakovsky, 2007).

According to other sources, the transit sharply reduced due to inadequate and exaggerates in customs’ controls. For example, the ‘Samsung’ customs liability had to incur in Finland at the time of sale of the goods, while over Russia ‘Samsung’ just had to transit cargo. Instead, Russian customs extended the professional responsibility, concerning transit. Hence, in order to avoid a lengthy one hundred percent inspection, it was necessary to eliminate transit container traffic with consumer goods (Parshina, 2006).

Some author considers that factors behind the volume decrease of transit traffic via Trans-Sib were the delays. Primarily, they occurred at Vostochny seaport due to the lack of wagons. The second reason is the decrease of Deep Sea Route tariffs that had a downward tendency since 2005 (Tsuji and Sergachev, 2006).

Meanwhile, the growth of tariffs was the central reason for the sharp reduce of transit traffic of containerized cargo via Trans-Sib (Ivanova and Hilmola, 2009; Sutela, 2010). If to look into the nomenclature of export and import traffic of Trans-Sib, the goods suitable for containers also were represented by non-consumer cargo. In export direction, the first and foremost goods were the production of pulp and paper mills (35.4%), chemical and mineral fertilizers (18.5%), timber (11.2%), and non-ferrous metals (11.2%). In the structure of imports were refractory materials (24.4%), construction materials (18.2%), and chemicals and soda (14.6%).

Concerning the transit, in January 2006, the volume of shipments of cargo from the port of Vostochny by railway fell by 82%, because of their shift to the sea route via Suez Canal. In the first two weeks of 2006, the containers were shipped mainly on the contracts of the previous year. However, the bookings of transit goods on the main Trans-Siberian route have been suspended by the key forwarders (Germanova, 2006). As a result, the traffic via Trans-Siberian Railway, i.e. in the area from the Russian border to Kouvola, reduced for the first two months of 2006 by 70%. In 2006, the decline was by 92% (VR Cargo, 2004–2010).

Freight that used to be moved to Kouvola by TSR from the seaport of Vostochny was shifted to the sea transports. The containers began to be delivered from Vostochny by sea to HaminaKotka seaport. From this seaport, they were sent either directly to the Russia by road transport or to logistics centres of Kouvola. The situation was deteriorated in transporting of paper products via Trans-Sib. The reason is that Chinese companies did not need to import paper products from Finland. Numerous new paper factories were built and located in China.

In 2009, the volume traffic in connection Finland–Russia–Asia via TSR was 1 459 TEU, while the total transit container traffic via Trans-Sib declined to the level of 1990, reaching only 18 000 TEU in 2009 (Ponomareva, 2014). Since 2006, traffic
has improved, but the volume remained lower 2,000 TEU (Hilmola, 2011). The clients have been forced to use sea transport, despite the fact that railways did provide transportation of large volumes of goods at regular services with a short travel time and flexibility. Rising tariffs brought to the distrust of the pricing policy of Russian railways among customers. This effect will persist for some time in the future, because to regain the trust of clients is not easy (Hilmola and Lorentz, 2012).

The confidence in Trans-Siberian Railway is still not recovered from the side of the Japanese companies. Earlier, Japanese manufacturers have refused services via Trans-Sib, because of problems related to cargo safety. Nowadays, the security of goods considerably improves and is high, but the Japanese customers are hardly attracted back to Trans-Sib from the sea route via Suez Canal (Ollus and Simola, 2007).

Meanwhile, the participants of the UIC pay a considerable attention to the development of Trans-Siberian Railway and, on the whole, railway cooperation in major global transport corridors. The problems of transit traffic via Russia became under the central focus since 2012, when the first Russian resident Mr. Yakunin was appointed as the president in 90-year history of UIC. Overall, the container traffic via TSR is on the stable rise since 2007, excluding 2009. The export-import traffic has a trend of yearly growth (e.g., 657 thousand TEUs in 2008, 373 thousand TEUs in 2009, and 527 thousand TEUs in 2010; Merkusheva, 2011). In 2010, transit traffic via Trans-Sib increased by 1.5 times in connection China–Russia (52%) and Korea–Russia (54%). The growth of traffic is associated with the undertakings on both sides of the corridor East-West.

East part:

1) The restoration of Trans-Korean Railway, which starts in Pusan further via Seoul and then through North Korea (Kason–Pesan–Vonsan) to join up with the TSR (Hantsevich, 2011; Ushkova, 2013a). 2) The project of the railway crossing Continent-Sakhalin (bridge, tunnel or dam to the bypass line), and 42 km long bridge/tunnel from Sakhalin to Japanese island of Hokkaido. 3) The reconstruction of the BAM, which is likely to attract a significant part of the bulk cargo from the Trans-Siberian Railway, e.g., coal that has a negative impact on the success of containerized cargo forwarded through TSR (Lozovaya, 2013; Seaports, 2012).

West part:

1) The ‘Belkomur’ project, which connects the Scandinavian countries via the seaport Arkhangelsk and North-West Russia with Asia by the shortest route, and has the goals similar to BAM. 2) The extension of the railway tracks with Russian standard gauge (1520 mm) from Kosice (Slovakia) to Vienna (Austria). 3) The development of the rail-ferry service from Ust-Luga–Baltiysk (Russia) to Sassnitz/Mukran in Germany (Perepelitsa, 2012a; Yakunin, 2012). Some experts predict that Ust-Luga will rise from the 4th place at the list of the Russian seaport to the first one by 2020, surpassing the current leaders of 1) Novorossiysk, 2) Primorsk, and 3) St. Petersburg (Russia’s Merchant Seaports Association, 2014; Simonova, 2014; Yakunin, 2012).
The improvements are also include 1) A large-scale project ‘Trans-Eurasian zone ‘Razvitie’ that implies the creation of a transport corridor from the Pacific to the Atlantic Ocean (Gudok.ru, 2015). 2) A programme of ‘Trans-Sib up to 7 days’ that helped to decrease journey time compared with the sea route via Suez Canal approximately fourfold (Yakunin, 2011a). Since the start of the project, more than 260 trains have been sent with the routing speed of 1051 km/day (Ushkova, 2014b).

In the perspective, the number of trains, running on the rigid schedule, and called as the shuttle trains will be increased. On the whole, during the last ten years, the number of trains sent on schedule increased by four times to over 9 thousand trains per the year of 2013. Over 50% of these trains were sent via Trans-Sib (Krasnoschek, 2014). The trains along the Trans-Sib go with the slots between trains equal to 8 minutes. In future, by 2020, the slots between all trains will be reduced to 5 minutes (Ushkova, 2014a). With the expected threefold increase in the container throughput of Russian seaports and implementation of dry ports, the number of these shuttle trains may grow even more.

To build the supply chain confidence (SCC) of Trans-Sib, the government of Russia also launched a new method of the regulating the tariffs at railways. This method is predictable, transparent, and understandable to all participants of supply chains. The application of Regulatory Asset Base (RAB), the system of long-term tariff design, guarantees at JSC ‘Russian Railways’ stable rates of tariffs for 5–10 years. These actions make TSR more competitive, especially in light of current events in the Deep Sea Route. For example, tariffs via Suez Canal were under yearly’ increase: in 2012 – 3% and 2013 – 2.5–5%.

Meanwhile, the tariffs on Trans-Sib are two times higher of the tariffs via Suez Canal. For instance, if the cost of shipping TEU container via sea route was roughly 2000 USD, by Trans-Sib the cost equalled 4000 USD. In the future, the difference will not exceed 1000 USD. The time of delivery will be within 17–20 days in case of block train use, says Mr. Yakunin, the former president of JSC ‘Russian Railways’. Therefore, the Suez Canal will become less reliable in terms of tariffs, let alone pirate risks. In 2008, the number of attacks on the ships reached 293 cases, which was higher of the level of 2007 by 11% (Nezhinskaya, 2009).

Additionally, Verny and Grigentin (2009) underline that the capacity of the Suez Canal will be constrained, because the granted access to larger and heavier ships take longer processing time. As a result, the number of vessels in each convoy could be diminished and waiting time will be increased, reducing the offer of frequent services to the clients. In this regard, the transportation of cargo from Asia via Trans-Sib will be more feasible. Another thing to note is the restrictions on the sulphur content of marine fuel in 2015 in the Baltic Sea region, North Sea, and English Channel (RZD-partner.com, 2014b; Notteboom, 2011; Lättilä et al., 2013), but also globally after the year 2020 in more strict form (IMO, 2015). Due to these facts, the shipping fare via Baltic Sea could grow by 25% (Solntsev, 2013a).

However, so far the Eurasian rail freight is still involved insufficiently in the rapidly
developing areas of the Russian and international transport business, e.g., container market (Rodemann and Templar, 2014). On the contrary, North American landbridge is much more popular than transporting containers through Panama Canal (Hilletofth et al., 2007; Wang and Meng, 2011). Railway companies in USA and Canada are showing extremely excellent profits and revenue growth (Hilmola and Laisi, 2015). Thus, Eurasian landbridge realization has a high potential, even if it might sound not so convincing nowadays. Moreover, in a long-term perspective, the prospering of TSR traffic would mean declining volumes for the most of the seaports (Wang and Meng, 2011).

Currently, the significant share of container traffic at Trans-Sib is comprised by domestic container flows (34% of total container flows of Trans-Sib in 2010; Merkushева, 2011). However, the membership of Russia in the WTO since August 22nd, 2012 was expected to increase import flows. These flows are mainly represented by containerized cargo, such as agricultural products, textile, chemicals, and fertilizers (Intacen.org, 2014; Karamysheva et al., 2013).

The proposed growth was met. In 2012, through the railway network of JSC ‘Russian Railways’ almost 3 Ml of containers were carried, which were up to 9.4% over the previous year (Yakunin, 2013a). The significant increase in transit traffic via Trans-Sib was also identified (102 thousand TEUs or 124% if compared to 2011; Ushkova, 2013a; Ponomareva, 2014). In 2013, the container traffic at Russian Railways increased by 5% from the level of 2012 to 3.097 million TEUs (Ushkova, 2014a).

Another fact to note is that around 70% of transit traffic is provided in container trains. In the railway net of Russia, the number of trains with containers increased by 20% to 7.5 thousand (Yakunin, 2013b). The outcome of the Trans-Siberian Railway for the first half of 2013 likewise notified the growth of transportation of container trains (Figure 20).

![Figure 20. The volume of traffic via TSR, in TEU (Ushkova, 2013a).](image)

As Figure 20 presents, the growth of container flows, in the 10 months of 2013 compared to the same period of 2012, is provided by the international traffic. The same tendency was in the previous years, too, when the maximum volume of
Container traffic was achieved in the 80s (31 Mt tonnes) mainly due to export and import traffic. In 2005, there were around 21 Mt tonnes transported in containers by railways (67% of the level of 1988). However, the growth of domestic container traffic was not identified (Osminin, 2009).

The container trains are considered as the easiest mode of transportation to integrate into the market of transit. Meanwhile, so far the share of the Russian transport corridor of Trans-Sib in the transit container traffic in the direction of Asia–Europe–Asia is minor, and could be calculated as follows. In 2013, the volumes of traffic carried on major East-West container trade routes, i.e. Trans-Pacific (21 million TEUs), Europe–Asia–Europe (20 million TEUs), and Transatlantic (7 million TEU), contribute to the total volume of 48.3 million TEUs (United Nations, 2014). Assuming that empty containers return to Asia, the containers traffic on East-West connections would be 25 million TEUs. Since the number of trucks between Asia and Europe is small, it could be neglected.

The transit container traffic via Trans-Siberian Railway amounted to 116 thousand TEUs, while, via the whole Russian Railways, of which TSR is a part, the figure is higher (236.8 thousand TEUs) in 2013 (Simonova, 2015). Therefore, Trans-Sib accounts for only 0.5% (0.116/25×100%=0.464%) in the direction of Asia–Europe–Asia. Meanwhile, the whole system of Russian Railways has a larger share in transit container traffic between Asia and Europe (0.236/25×100%=0.947%).

However, this statement is true, if Europe only concerns the European Union, since most of the volume ends to or starts from Russia. Instead, when Europe concerns all regions/countries after the Ural in the West direction (these countries of EU include Central and Eastern Europe, i.e. Belarus, Ukraine, Bulgaria, etc.), then potentially the proportion is considerably larger. In other words, if the total volume of containers (export, import, transit, and domestic traffic) transported by JSC ‘RZD’ is considered as 3 099.4 thousand TEUs in 2013, then transit potential of Russian Railways to service international trade channels is much higher (by 6%).

It should be noted that the growth of container traffic on the Trans-Siberian Railway was dramatic in the recent years. From the level of 2000 until the crisis in 2008, the growth was 4.6 times, which is higher than the pace of growth in the Suez Canal (by 2.6 times). After the economic downturn (2008–2012), the international container traffic also has grown faster on Trans-Sib than through Suez Canal (3.4 times vs. 1.1 times, respectively; Figure 21).
a) Trans-Sib

![Graph showing the pace of international traffic growth, in million TEUs.](image)

b) Suez Canal

![Graph showing the pace of international traffic growth, in million TEUs.](image)

**Figure 21.** The pace of international traffic growth, in million TEUs (Coordinating Council on Trans-Siberian Transportation, 2015; Suez Canal Traffic Statistics, 2015).

By 2020, it is planned to carry 1 MI TEU via Trans-Sib in transit alone (Investinrussia.com, 2015; Ushkova, 2013b). For that to happen, most experts considered the requirement in synchronized development of railways and seaports (Ushkova, 2013c). The reason is that the pace of traffic is higher than the pace of the infrastructure development, and not only on the railways, but also at seaports and warehousing business. These shortcomings can be the main barrier to increasing the transit traffic via Trans-Sib in the future, according to the lead manager of the ‘Finnam Management’ Mr. Baranov (Perepelitsa, 2013a).

That is why JSC ‘Russian Railways’ is focused on the questions of the development of transport corridors, as well as on the unification of the law framework. The
Company cooperates actively with the UIC, the Organization for Cooperation of Railways (OSJD), the Asia Economic and Social Commission for Asia and the Pacific (ESCAP), and other international organisations. In 2010, JSC ‘RZD’ has joined to International Rail Transport Committee, CIM (Yakunin, 2011b). Moreover, the JSC ‘RZD’ improves the services, simplifies the cooperation between clients, subsidiaries and the parent company, as well as actively partners with the foreign companies. An example would be the company Trans Eurasia Logistics GmbH (TEL) that has been created in 2008. The business is the joint venture of Germany and Russia by Deutsche Bahn AG and JSC ‘Russian Railways’ with the 50% shares of each company. Headquarter of the enterprise is located in Germany, Berlin. There are also offices in Russia, Moscow and in China, Beijing.

The primary objective of the company is the organization of the freight transportation between Europe, the CIS and Asia. The Trans Eurasia Logistics GmbH represents itself as the organizer and the operator of the international freight traffic (Trans-eurasia-logistics.com, 2014). Under the trademark ‘East Western Trains’, the Trans Eurasia Logistics GmbH has united all intermodal communications, preferably with the use of railway between Europe, Russia, the Central Asia, and China. On this basis, the company offers the clients daily railway trains, running from terminal to the terminal. Since the establishment of the enterprise, several trans-continental train connections were developed (Trans-eurasia-logistics.com, 2014):

Europe – Russia/the Central Asia

– ‘Moscowit’ is the regular container train between Duisburg and Moscow that launched since June, 2010. The continuous, reliable, and fast railway transportation connects German port Duisburg with the capital of Russia. The delivery time is seven days from Duisburg to Moscow. The frequency is five departures per week (two from Duisburg and three from Grossbeeren).

– ‘Tyubeteyka’ is a railway communication between economically developed regions of Europe and fast-growing central Asian markets. From the beginning of 2012, the company offers a daily railway connection between 13 European railway terminals and 20 terminals of the Central Asia through the transport node Malasheviche/Brest.

– ‘Nested doll’ or ‘Matreshka’ is a railway communication between economically developed regions of Europe and the Russian industrial centres. From the middle of 2012, the company offers the daily trains between 13 European railway terminals and stations of Russia through the transport node Malasheviche/Brest.

Europe – China

– ‘Tiger’ is the regular container train following a route Germany (Duisburg) – China (Beijing) through the Trans-Siberian Railway of weekly frequency. Delivery time is from 14 till 26 days.
‘New Silk Way’ is the regular container train following a route Germany (Duisburg) – China (Chongqing). As can be noticed, the Port of Duisburg is the starting and finishing point for several trans-continental rail links to China. However, it is necessary to pay special attention to this route, as TEL is the first company, which has revived the ‘Great Silk Way’ on a network of railways. The new transport route from Southeast Asia to Europe originates in Chungking (Central China). At a border crossing point, Alashankow (Peoples Republic of China) the direction is connected to the Kazakhstan railway. Then, it passes further into the territory of Kazakhstan, Russia, Belarus, and Poland and comes to the end in German Duisburg. Delivery time is 17 days with the frequency of once a week.

The joint company for providing container traffic from China (Chongqing) to Europe (Duisburg) was created by Russia, China, Kazakhstan, and Germany. By 2015, the company planned to increase the container traffic to 50 thousand containers. Chinese companies receive in the joint venture of 51.1%, while the rests of the investors get 16.3% shares.

The railway route from Chongqing – Xinjiang to Europe reduces the delivery time by 20 days, if compared with other alternatives. First one is the way, which includes the Chongqing – Shenzhen distance by rail and Shenzhen – Europe by the sea. The second route is comprised of river and sea modes of transport (Yangtze River – Shanghai and Shanghai – Europe, respectively).

Previously, the number of trains from China to Duisburg was more than in the opposite direction. However, since 11.08.2014, a train with containerized cars bound for Chongqing began loading at Duisburg Intermodal Terminal (DIT). It is the first ever consignment of finished products from top German manufacturers at the Duisburg Intermodal Terminal. DIT has made a considerable effort in developing this rail link. There will thus now be no fewer than four trains leaving Duisburg for China every week (Worldcargonews, 2014b).

In the late August 2014, this route has been used to forward the cargo to Latin America (Worldcargonews.com, 2014b). From Chongqing to Duisburg, through Kazakhstan, Russia, Belarus, and Poland, approximately 21 tonnes of cell phone electronics were delivered by railway. Afterwards, the goods were forwarded by trucks to Frankfurt airport. From the airdrome, DB Schenker provides the cargo to Brazil by air transport. The combination of rail, road, and air transportation allowed to reduce the lead time by almost four weeks compared with using ocean freight from Asia to South America. The sea route alone takes between 50 and 55 days. The rail trip equaled 17 days, covering 10,124 kilometers to Duisburg. In total, the goods are on the route for 24 days before reaching their destination in Brazil. This first successful combining of three modes of transport has exemplified the growth potential of intermodal logistics.

**Russia/the Central Asia – China**

‘Multynet’ is a container railway communication between China and Russia.
The service accesses more than 40 terminals in China and Russia. The company also provides the free return of containers. Frequency is up to five departures in a week.

— ‘The Central – Asian express train’ is a container railway communication between China and the Central Asia. The frequency is five departures per week.

In the next year, so as to promote trains in the ‘New Silk Way’ from the one per week to two, the simplification of the passage of borders crossing points is expected. These changes will also allow decreasing time along the line from 17 to 16 days. The additional important task of the company is a constant perfection of security measures. For that reason, it organises transportations with the use of a GSM-seal. The GSM-seal ideally protects cargo from plunder, as at the opening of the container immediately gives an announcing signal. The Trans Eurasia Logistics GmbH also pays particular attention to the safety of the environment. The calculations of Ecological centre DB show that emission CO\textsubscript{2} from trains are 95\% below this indicator of air transport.

Apart from TEL, the Trans-Siberian Railway is utilised by other companies. An example would be CEVA Logistics, which is a leading company that provides freight forwarding, contract logistics, management in transportation and distribution. The company includes more than 49,000 personnel and runs a global network of the facilities in more than 160 countries. CEVA Logistics proposed the beginning of train connections on the daily basis from China to Europe with the delivery time of 28 days. The train connects Suzhou, which is located in the west of Shanghai, with the Netherlands through the route (11,000 km) via Russia (Worldcargonews.com, 2013).

The company CEVA Logistics, as well as other undertakings, which will be discussed further, develop logistics services in accordance with the existing trends in globalisation. For example, Baltic States in order to facilitate transit traffic introduced container trains into Eastern directions. These trains have higher potential than road transport with problematic border-crossing formalities (Hilmola and Henttu, 2015). For instance, intermodal train Klaipeda (Lithuania) – Chongqing (China) with the delivery time of 12–13 days was launched in 2011. However, later the development of the project has been suspended for some time due to customs and other formalities at borders. The next one is DB Schenker China Express, which connects Leipzig to Shenyang. It takes 23 days to cover a distance of 11,000 km. Commodities transported by this train are: chemicals and auto parts from the BMW. However, the border crossing issue also caused the more or less the failure of this route.

Apart the companies specified before, it is necessary to note the activity of the Russian Railways. JSC ‘RZD’ plans to develop transport and logistical business from 2PL to 4 or 5PL services by 2030. These changes imply the designing of a multimodal logistics company with the focus on the Eurasian space (Yakunin, 2014b). Already now the company actively works towards this direction (JSC ‘RZD’, 2013). Firstly, within the corridor East-West with the use of Trans-
Siberian Railway, Mr. Yakunin has suggested creating the uniform logistics operator, the Integrated Transport Logistics Company (ITLC). The creation of the ITLC has been supported in 2012, and, in 2013, the national railway companies of Russia, Kazakhstan and Belarus have made the agreement on the establishment of this company.

The competitive idea on the development of the integrated company for the international traffic organisation via the territory of Russia was persuaded by the Summa Group company (Losovaya, 2012). In order to become the largest service provider in the country, the company acquired 56% of shares of FESCO (one billion USD). Due to the inclusion of FESCO, the actives of the Summa Group were extended by the Vladivostok seaport, sea fleet, as well as the wagons of rail operators, including Transcontainer. By buying the shares in FESCO, Summa Group planned to increase its shares in Transcontainer by 70% from current 20% that belonged to FESCO. The strategy of the company was disrupted by the plans of JSC ‘RZD’, which also owns the shares in Transcontainer Company. Russian Railways intend to increase the presence in transit traffic between Europe and Asia by improving the service through created ITLC (JSC ‘RZD’, 2013).

The purpose of ITLC is also in the development of the transport infrastructure of the three countries. Additionally, the company is geared towards implementation of the uniform principles of a price policy, mutual use of the rolling stock, and other assets of the integrated company. By 2015, the operators of these businesses will receive access to the national infrastructure (Yakunin, 2011b).

According to Boston Consulting Group, the ITLC assets are as follows: border terminals Dostyk and Horgos (Kazakhstan), Brest (Belarus), and Zabaykalsk (Russia); dry ports in Moscow, Nizhny Novgorod, Yekaterinburg, Novosibirsk, Almaty, Astana, and Minsk; rolling stock (platforms) of 5.4 billion USD and the container fleet of 589 million USD.

The integrated transport and logistics company benefited from the Customs Union of Russia, Kazakhstan and Belarus (Eurasian Customs Union), as well as from the Eurasian Economic Community. It originated from the Commonwealth of Independent States (CIS) and was transformed into the Eurasian Economic Union (EAEU) since the 1st of January 2015, with the member states of Armenia, Belarus, Kazakhstan, Tajikistan, Kyrgyzstan, and Russia. Nowadays, in the Eurasian Economic Union, the Russian Railways represents 79.7% of all railway routes (Figure 22).
It is planned to simplify customs’ operations with China, Mongolia, and Kazakhstan by the inclusion of these countries in the project of utilising CIM/SMGS (Perepelitsa, 2013b). The application of CIM/SMGS in Kazakhstan, Belarus, and Russia for the forwarding container trains China–Europe was started since 2012. The option allowed to increase the speed of traffic, because the documents were not restated when passing border crossing points of the country with the different rules of law (Yakunin, 2013c). The utilisation of CIM/SMGS in other Asian countries will provide harmonization of the railway traffic in Eurasia. Moreover, the delay of trains at the borders will decrease by 2–3 hours, reducing the logistics costs by 26% (Perepelitsa, 2013a).

Secondly, with the reference to the development of the comprehensive services at Russian Railways, in December, 2012 JSC ‘RZD’ has acquired 75% shares of company GEFCO (JSC ‘RZD’, 2013). Company GEFCO is a group Peugeot-Citroen affiliated company. The enterprise is included in ten largest logistical companies of Europe. GEFCO has provided the logistics services for a motor industry since 1949. Therefore, the company is a leader in this area and an outstanding 4PL provider of high-quality services to the automobile industry and other branches.

For the Group GEFCO, to become a logistical branch of the Russian Railways means the set of commercial possibilities. It opens for the GEFCO the access to a large network of railways, which is stretched to China. Nowadays, GEFCO covers all services within the supply chain: warehousing and reusable packaging; overland; finished vehicles’ logistics; overseas; as well as customs, and tax representation. To a greater extent, the enterprise is considered as the 4PL provider of ITLC.

In March of 2014, Russian Railways joined with Belarus and Kazakhstan’s railways under the company called ‘Project office ITLC’. This company, in turn, has signed the memorandum of mutual understanding with DHL Global Forwarding (a leader in the sector of air, sea, and overland transportations). The members became strategic partners for the joint development of railway routes in a direction China –
Europe – China. The ‘Project office ITLC’ will bear responsibility for services within
a rail communication from station to station, including the rolling stock provision.
Moreover, the company will handle the transit customs registration cargo and other
accompanying services on a route. In contrast, DHL is responsible for providing
sophisticated services and formation of cargo base both in China, and in Europe.

The final approval from the governments of Russia, Kazakhstan, and Belarus on the
creation of ITLC will bring deeper integration. All rights and duties within the limits
of this agreement will be passed from the company ‘Project office ITLC’ to the main
company ITLC. Consequently, the company will operate the border crossing
terminals in Belarus and Kazakhstan, as well as the dry ports and logistics centres in
Russia (Ushkova, 2013c). The company additionally will invest 6.2 billion USD in
the rolling stock, terminal, and IT infrastructure by 2020. The plans for the
development of the ITLC foresee the growth of the freight traffic by railways
between China and EU. In the optimistic scenario, the growth is 35–40 times, which
will bring 800 million USD with the total turnover of 4 MI TEU by 2020
(Babaev et al., 2013). The first container train within the limits of strategic
cooperation between open company ‘Project office ITLC’ and DHL Global Forwarding delivered cargo from Suzhou (a province of Jiangsu) to Warsaw for 13
days. Nowadays, the company is working on the task of providing the container trains
China – Europe once a week.

To complete, the abovementioned examples suggest that overland transportation;
mainly by railways is more than twice faster than by sea. As a rule, market wins the
operator who provides a shorter delivery time. From this point of view, this route
offers a competitive advantage for the sectors of businesses that are involved in the
international supply chains. However, despite the existing supply chains and
companies that aim to provide better services to the clients, there is still a room for
the improvements. Some ‘bottlenecks’ in the supply chains negatively influence the
material flow from one country to another, increasing the overall cost of the entire
delivery. Therefore, further development of the overland supply chains implies the
eliminations of constraints that lie in the undeveloped technical and technological
infrastructure of intermodal transport. One of the untapped resources for Russian
logistics on this way could be mitigation of deficit of terminal and warehousing
facilities that will be discussed further more specifically.

3.2 Analysis of the Current Stance of Development of Transport Nodes

As was mentioned in Chapter 1, in Russia, the terminal and warehousing
infrastructure has always been treated as secondary facilities. The priority was given
to the industry, transportation, and construction, and in all to other sectors of the
economy (Abdikerimov et al., 2013). Albeit, terminal and warehousing infrastructure
is an integral part of any logistics process of goods delivering; especially, it is
technologically required for the railway transport. In the rail sphere, in 2002, there
were 725 train stations opened for the handling of the containers, including 120 to
work with the private industrial enterprises. About 85 train stations were tailored to work with intermediate bulk containers of 3 and 5 tonnes capacity, which, however, were eliminated from the network in 2013. The processing of containers at railways was provided by 614 freight yards.

Despite the small level of containerization at railways (1%) at that time, the development of the terminal and warehousing infrastructure was fast among the private sector (e.g. TransContainer). The same cannot be said about the rail terminal system of JSC ‘RZD’. The fully recognition of the lucrative warehousing business for railways could come in the aftermath. This tendency was favourable for the private companies that switched to the profitable business, and, by contrast, negatively influenced the parent company (Osminin, 2009). The reluctant approach towards the development of the warehousing business in the sector of the railway industry has changed since 2009, which is evidenced by the arrangement within the JSC ‘Russian Railways’ several structures. Firstly, it was the Centre for the Development of the Freight Terminals. Secondly, in 2010, the Central Directory for the Operating of Terminal and Warehousing Facilities was opened. This infrastructure included 577 freight yards; over 6000 of the immovable property, i.e. warehouses, administrative buildings, and freight sites; 2.6 thousand of handling equipment. Finally, in 2012, the Central Directory of the Infrastructure was created (Dyachenko, 2011; Gapanovich, 2010; JSC ‘RZD’, 2011a).

Nowadays, more and more experts show concerns about the necessity to expand the terminal net at Russian Railways and develop the warehousing business (Ushkova, 2012). The market accumulated deficient of the terminal and warehousing infrastructure (Perepelitsa, 2013c). The adverse effect had the previous state of mind, regarding the warehousing business within the railways and other sectors of the Russian economy, as a whole. At the beginning of 2008, the demand for warehouses in Moscow was 1.5 higher than the supply (Svyatkina, 2011a), despite the highest dynamics of the development of this business in 2007. The segment of logistics services oriented to the storage and distribution of cargo in Russian increased by 76.6% in 2007. At the market of the warehousing services, the network projects of the warehouse constructions were realised. The interest in this business was shown by Russian and foreign investors (Tsygankova and Shmeleva, 2009).

Recently, the logistics centres were oriented on the central scheme of the cargo delivery via Moscow and St. Petersburg. The services were limited by the base assortment: storing, loading, and unloading, while the infrastructure was mainly presented by the warehouses of the class B and C (Perepelitsa, 2013d). To date, the market is geared towards diversification in other regions and the increase of the quality of class A. In 2008, in Moscow region, there was 8 Ml sq.m. of warehouses. By 2010, it was planned to increase this figure nearly twofold (+6 Ml sq.m.). The same plans were in other large distributing centres of Russia, such as St. Petersburg and Leningrad region. The investment in the warehousing assets had to grow by 4 Bl USD by 2010 from 10 Bl USD investments during 2007–2008 (Shevchenko, 2009; Svyatkina, 2011a). However, the crisis in 2008–2009 has
changed the plans of many developers.

A half year before the crisis of 2009, the demand was higher than the offer by 1.5 times. Leases were signed long before the completion of construction and commissioning of the objects. For example, among 8 Ml sq.m. of warehouses in Moscow, there were only on average 1–3% of the vacant spaces. The empty spaces at the warehouse of class A were 0.5%, and B less than 3%. The profit of the warehousing business was twofold than the European level of 15% (Shevchenko, 2009).

However, already at the end of 2008, an average level of vacant warehouses of class A increased to 25%. According to the European normative, it had to be 10% (Svyatkina, 2011a). Of class B, the vacant space was at the level of 4% (Shevchenko, 2009). The reason for such a situation was rooted at the decrease of the traffic flows in Russia, and, as a result, the reduction in the occupancy of the warehouses. Meanwhile, already in 2009, in Moscow, it was commissioned 720–770 ths. sq.m. of warehouses. However, in 2010, this figure reduced twice to 370–405 ths. sq.m. (Aleksandrova, 2011).

The decrease in the construction of warehouses was even higher in St. Petersburg than in Moscow. In 2008, there were commissioned 527 ths. sq.m., in 2009 – 186 ths. sq.m., in 2010 only 100 ths. sq.m. (Svyatkina, 2011a). Therefore, due to the crisis, the ‘warehousing boom’, attempting to create the regional infrastructure in 2009, according to the developers, did not happen. Further on, potential expectations for the warehousing business development were shifted to 2010, after the accomplishment of the pilot projects at St. Petersburg and Moscow (Tsygankova and Shmeleva, 2009).

However, even by 2011, the deficit of warehouses was not eliminated. According to the experts, the volume of new warehouses’ construction was expected in 2011 at the volume of 350 ths. sq.m., the lowest indicator since 2003. That is why, the demand for the warehouses was high (Aleksandrova, 2011). In the second half of 2011, in Moscow, there was the maximum volume of the absorption of warehouse space since 2007: 360 ths. sq.m. were rented or bought, from which 300 ths. sq.m. are the warehouses of class A. The vacant place of class A was 3%, while of type B was 6%.

Due to the decrease of the vacant warehousing spaces the rates of rent increased by 17% in Moscow. The rents for the warehousing fluctuated from 125–135 USD for class A per sq.m./year. Meanwhile, for class B the cost was 95–115 USD per sq.m./year. At the same time, in St. Petersburg, the rates were lower: 95–115 USD/m²/year for class A, and 80–110 USD/m²/year for class B (Aleksandrova, 2011).

According to analysts, it was expected that the deficit of warehouses that was keen in 2011 should be eliminated in 2012. Considering Moscow, the deficit had to be covered with the created 700 ths. sq.m. of warehouses of class A and B (Aleksandrova, 2011). However, the expectations were not met, again. As a matter of fact, the number of vacant storages reduced, and the rates of rent were going to stay
at the high level (Aleksandrova, 2012b). Moreover, there was a deficit of high-quality warehouses that, to a greater extent, are an indicator of the developed logistics in foreign countries. In general, at the market of warehouses in St. Petersburg and Moscow in 2010, around 60–70% of the warehouses were related to the class C and D. In other regions, this figure reached 80–90% (Yakunin, 2010a).

The insatiable warehousing market in Russia determined the pace of growth of warehousing construction. The growth remains high in Moscow on the scale of Russia, as well as among foreign countries (e.g., EU, Middle East, and Africa; Aleksandrova, 2011). According to analytic agency Knight Frank, in Moscow region, around 523 ths. sq.m. were built within nine months of 2012, which was higher than in 2011, by 43% (Aleksandrova, 2012b). Despite such a high pace of growth, there was still a shortage of vacant warehouses. For example, the share of vacant warehouses of class A equalled 1–2% in Moscow (Aleksandrova, 2012b).

Taking into account the deficit of the warehousing infrastructure and the lands costs, especially in Moscow and St. Petersburg, in perspective, the warehousing development may be expanded to other regions, e.g. Kazan (Perepelitsa, 2013d). Additionally, the expansion could be prolonged to other largest distribution centres of Russia, such as Yekaterinburg, Novosibirsk, Nizhniy Novgorod, Samara, Voronezh, and Rostov-on-Don. All of them in total represent 18.8 million sq.m. of warehousing infrastructure in 2010 (Table 3).

Table 3. The volume of warehousing infrastructure at the main ‘distributing city-centres’, in ths. sq. m. (Shavzis, 2014; Svyatkina, 2011a).

<table>
<thead>
<tr>
<th>City</th>
<th>Class A</th>
<th>Class B</th>
<th>Class C</th>
<th>Total (2010)</th>
<th>Total class A+B (2014)</th>
<th>Price, USD/m²/year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moscow</td>
<td>4240</td>
<td>1880</td>
<td>6120</td>
<td>12 240</td>
<td>8 000</td>
<td>135–145</td>
</tr>
<tr>
<td>St. Petersburg</td>
<td>367.1</td>
<td>1172.2</td>
<td>1539.3</td>
<td>3078.6</td>
<td>2 200</td>
<td>125–135</td>
</tr>
<tr>
<td>Yekaterinburg</td>
<td>230</td>
<td>115</td>
<td>345</td>
<td>690</td>
<td>750</td>
<td>115–125</td>
</tr>
<tr>
<td>Novosibirsk</td>
<td>263</td>
<td>73.5</td>
<td>336.5</td>
<td>673</td>
<td>630</td>
<td>110–120</td>
</tr>
<tr>
<td>Kazan</td>
<td>390</td>
<td>10</td>
<td>300</td>
<td>600</td>
<td>320</td>
<td>90–100</td>
</tr>
<tr>
<td>Samara</td>
<td>143</td>
<td>100</td>
<td>243</td>
<td>486</td>
<td>220</td>
<td>90–115</td>
</tr>
<tr>
<td>Rostov-on-Don</td>
<td>96</td>
<td>116</td>
<td>212</td>
<td>424</td>
<td>210</td>
<td>110–120</td>
</tr>
<tr>
<td>Nizhniy Novgorod</td>
<td>86</td>
<td>99.4</td>
<td>185.4</td>
<td>370.8</td>
<td>292</td>
<td>115–120</td>
</tr>
<tr>
<td>Voronezh</td>
<td>101</td>
<td>43</td>
<td>144</td>
<td>288</td>
<td>143</td>
<td>90–110</td>
</tr>
<tr>
<td>Total</td>
<td>5816.1</td>
<td>3609.1</td>
<td>9425.2</td>
<td>18850.4</td>
<td>12765</td>
<td>-</td>
</tr>
</tbody>
</table>

The number of business deals related to the warehousing infrastructure in regions in the first half of 2013 equaled 61 ths. sq.m., including 42 ths. sq.m. in Novorossiysk. In St. Petersburg, 80 ths. sq.m. of deals were made, while in Moscow 550 ths. sq.m. According to expectations, annual absorption of warehousing infrastructure in Moscow may reach 1–1.5 Ml sq.m. (Ermolenko, 2013b). That is why the regional markets represent only 10% of warehousing deals and trade (Figure 23).
This scheme of distribution (Figure 23) is determined by the nature of cargo flow that is still centered via Moscow. Therefore, high-quality warehouses in Moscow equal to almost 8 Ml sq.m., on the other hand, in St. Petersburg, this figure is only 2.87 Ml sq.m. For that reason, the prices for rent are also higher in Moscow region. In other regions, the prices are lower by 20%. Overall, the rates are increased in all regions of Russia by 7–10% in 2012, due to the increased demand for the warehousing infrastructure (Ermolenko, 2013b). The distribution of the total number of transactions in the agent profile is diverse among regions (Figure 24).

The warehousing infrastructure is bought or rent by the logistics operators. Similarly to the distribution of the total number of transactions in the agent profile, the pace of growth of the facilities is also faster in Central regions of Russia. According to Jones Lang LaSalle, the warehousing market in Moscow, in 2013, increased by 10%, compared to 2012, and reached 9.7 Ml sq.m. In St. Petersburg, the same measurements were as follows 3.8% and 1.5 Ml sq.m.
The developers are more interested in the construction of the warehouses in Moscow, because the cargo will be there even during the crisis. The location of the warehouses in other regions can be risky, since the containerized cargo is transported via the North-West region or south maritime terminals (Solntsev, 2014a). Therefore, in the case of the construction of the warehouses in Moscow, the risks of the developers are minor, while the warehousing development in the other regions implies the danger of the buyers, likewise.

According to experts, the situation in the market will change positively when the logistics projects of the warehouse construction are done not only million-populated cities like Moscow, but also engulf the other regions of Russia. The creation of the broad network of the warehouses in Russia will stabilise the warehousing market, and, similarly, the cargo flows will be distributing more evenly through the country.

In 2013, the positive changes were outlined. In particular, high-quality warehouses of 80 ths. sq.m. of class A and B begun to appear in the cities with the population of 150 ths. persons (Solntsev, 2014a). These tendencies can be also connected to the difficulties in developing the infrastructure in the central regions. For example, the construction of the freight terminals at Moscow is complicated due to the specification of the work with the passenger flows.

Additionally, there are other specifics of warehousing business in Moscow. It should be noted that the existing terminal and warehousing infrastructure is mainly located in the north and north-west of Moscow. Moreover, these facilities do not have the connections with the railways. As the result, the transport services are reduced, and the clients shift to the road transport (Perepelitsa, 2013d). The shift of the cargo to the road transport also increased due to the elimination of the small size containers (three to five tonnes) from the Russian Railways (Osminin, 2009).

Overall, the terminal and warehousing infrastructure of Russian Railways represent 28–33% of the total warehousing infrastructure of the national market. At the same time, the level of the profit does not exceed 5%. The total land occupied by the warehousing infrastructure of JSC ‘RZD’ is 5.6 Ml sq.m. (Gapanovich, 2010). In order to estimate the warehousing and storage assets of the JSC ‘RZD’, it is better to mention the amount of the warehousing spaces in Russia. That is, approximately 17 Ml sq.m. (Stupachenko, 2009). Therefore, the company can be considered as the most powerful participant in the warehousing market in Russia, if its warehousing infrastructure, which has a beneficial location, is upgraded to time. So far, almost 50% of the containerised cargo is handled by only 5% of the terminal and warehousing assets of JSC ‘RZD’, because the rest of 95% has low quality (Stupachenko, 2009).

The level of the used property (5%) at Railways is a guarantee for their potential growth and demand. The reason for that, as was above mentioned, is the existence of warehouse infrastructure that has deficit of railroad sidings. For example, out of 1 Ml sq.m. of warehousing space in Yekaterinburg, only 150 ths sq.m. has those railway approaches (Shavzis, 2014). Hence, the warehousing business has yet to be
developed within the rail industry, posing the necessity for the standards for providing the services and the strategy for the managing of the terminal and warehousing infrastructure.

The warehousing infrastructure at railway sphere is mainly represented by the open storage yards (95%), while the warehouses comprise only 5–11% of the total square (Gapanovich, 2010; Stupachenko, 2009). Almost all (95%) of the open storage yards are not utilised. The rest 5% of the warehouses are considered as the class B. The warehouses of class A are absent within the net of JSC ‘RZD’ (Stupachenko, 2009). The depreciation of the main warehousing and terminal infrastructure achieves 43–71% (Gapanovich, 2010; Stupachenko, 2009). It is believed that the converting of these underused warehousing and terminal infrastructure in the inland terminals or dry ports would be a viable investment.

It should be noted that even 5% of the operated warehouses of the company brought, in 2008, 2.3 billion RUB incomes, handling 110.6 MI tonnes of cargo. Most of the load is represented by containers (47%) and bulk cargo (37%). It was planned that the proportion of the warehousing business of JSC ‘RZD’ had to increase from 5% to 10% by 2015, while the level of transhipment services had to grow from 1.5% to 1.9% (Stupachenko, 2009). So far, the terminal and warehousing infrastructure is of inferior quality. Especially, in St. Petersburg and Moscow, there is an incredible amount of storage of wooden barracks (Stupachenko, 2009).

It was decided that the old infrastructure of JSC ‘RZD’, which is located in the centre of St. Petersburg will not be shifted to its outskirts unless the new infrastructure is developed. This location causes busy freight traffic on the central streets. In this regard, the Transport strategy of the government of St. Petersburg envisages the elimination of freight traffic from the city centre street. One of the options is by the development of the technology of the shuttle trains that are backed by the projects of dry ports (Gapanovich, 2010; Lasarev, 2011a; Perepelitsa, 2011). Since 2012, this technology is used by all dry ports located within the area of St. Petersburg. Moreover, in 2013, the number of shuttle trains increased by 6% to 61 trains per month (Stepov, 2014).

In accord with the concept, regarding the development of the terminal infrastructure at railways, the new transport and logistics centres will be built. This infrastructure could be constructed on the basis of the existing old freight yards at the train stations. The examples would be Shushary-transport and logistics centre, TLC, called Baltiyskiy, at the train station Navalochnaya – TLC Moskovskiy, and at the train station St. Petersburg-Finlyandskiy – TLC Finlyandskiy. The previous alternative of shifting freight yards from the station St.Petersburg-Finlyandskiy to the station Parnas or Kapitolovo was rejected, as being not optimistic (Ushkova, 2014c).

On the whole, according to the new general scheme of the development of the railway junction of the transport system of St. Petersburg and Leningrad region, by 2025 it will be required 744.7 billion RUB. However, only 16% of this sum is provided by the financing (118 billion RUB). This figure includes the investments
from JSC ‘RZD’ (9.5% or 70.7 Bl RUB), federal budget (1.2% or RUB 8.6 billion), and off-budget sources (5.2% or 38.7 Bl RUB). Therefore, the investment needs are estimated at 626.7 billion RUB. So as to provide the resources, JSC ‘RZD’ had plans to address this problem in the interdepartmental working group of the development of the transport (Ushkova, 2014b).

3.3 Outline of Austerity Measures

The insufficient amount of the terminals with the high standards for handling containers in the railway systems can be the factor, restricting the growth of container traffic in Russia. Nowadays, the level of containerisation is low: 42 containers per capita, if compared to the global average level or emerging market like Turkey. In Europe and North America, the levels are 135 and 134 containers per capita, respectively (Figure 25). Meanwhile, regardless difficult conditions in Russia at the current time, in the long-term perspective, a positive endorsement of the future of the container market is high (Global Ports, 2014).

Figure 25. The level of containerisation, in TEU per capita (Global Ports, 2013).

Due to the fact that container market in Russia has a significant growth potential, the postponed demand after the economic turmoil requires from rail operators a readiness to cope with the expected clients’ ambitions. According to Federal State Statistics Service (2015a), the share of containerized cargo in the total volume of goods transported by railways equaled 2.1% in 2013. Presumably, the comparison is made based on tkm (Figure 26).
Without the development of freight terminals and train stations, the service of the container trains at railways will be complicated and at a reduced quality. As a result, the competitiveness of rail is deprived. The situation is also deteriorated by the growth of cargo, on one hand, and an increase of the rail fleet, on the contrary (to 1.2 M1 wagons, in 2014), because this growth, in turn, was not supported by the railways’ development (Ushkova, 2014a). The unfinished reforms of Russian Railways sharpened the problems of the deficit of infrastructure, as well as the deficit of locomotives. In particular, the wagon market was fully deregulated, bringing the significant enlargement of the wagon fleet over the last ten years, coupled with the increase of the volume of cargo transported at better quality of the services. These positive changes cannot be noticed in other spheres of railways, such as traction and infrastructure, since they have yet to be liberalised (Khusainov, 2011).

Consequently, with the liberalisation of the railways, the surplus in the wagons became the highest level ever needed, implying the necessity for active support of infrastructure development and maintenance by the government (Retynin, 2014). Generally, the infrastructure has to be developed in the advanced pace compared to other sectors of the economy. According to Mr. Yakunin, by 2030 it is planned to build 35–40 modern terminal centres at railways that will be located at the most important transport junctions and industrial zones of Russia. The company will seek the cooperation with Russian and foreign partners to develop these projects in the regions of Moscow, Samara, Leningrad, and Sverdlovsk (Stupachenko, 2009).

The shortage of terminal and warehousing infrastructure is sharpening due to the deficit of financial sources. As a result, the participant of transport processes meets with the significant restrictions of the infrastructure, as a whole. In a perspective, the
The railway network will have more difficulties at most problematic zones – Far East, Kuzbass, Moscow transport node, and North-West of Russia (Ushkova, 2011a). The approaches to the seaports of the North-West, South, and the Far East regions are considered as the significant ‘bottlenecks’ (Gorbunova, 2011).

To develop railway infrastructure, an estimated 1.5% of GDP, according to Mr. Yakunin, is required instead of current 0.7% (Yakunin, 2012). By 2015, in accordance with Mr. Morosov, the needs to renovate and maintain the infrastructure are assumed to 600 billion RUB (Hantsevich, 2011). At the same time, only 200 billion RUB could be subsidised by the company itself, the rest (400 billion RUB) allegedly could be attracted from other sources (Hantsevich, 2011). In the longer perspective, it will be required 2 trillion 240 billion RUB by 2020 to develop the infrastructure only in the principal directions of cargo flows (Gurev, 2011). In more details, the investment programme of the railways’ development until 2020 presumes that the investment needs reach 411.4 billion RUB in 2013. In 2014, the requirements equal to 360 Bl RUB, and 346 Bl RUB, in 2015 (Maksimov, 2013).

Some experts mention that the estimated investments may fluctuate from 2 to 5.2 trillion RUB, depending on the scenario of their development (Kraskovsky and Zhukov, 2014). For example, unexpectedly, due to the crisis, most of the target programmes of Russia were sequestrated by 15% (Andreeva, 2009). In these circumstances, the experts complain that the existing programmes are not supported by the sufficient number of the sources of funding. The particular programmes concern the railway transport development until 2030 and ‘The Development of the transport system in the period of 2010–2015’ (Perepelitsa, 2012c). In the later agenda, the expected investments provided by the private sector outlined to 8 trillion RUB of total 13.5 trillion RUB in the rail transport system of Russia (Andreeva, 2009; Stepov, 2010).

The lack of investment handicaps the development of the low stance of the lifting machinery, as well as auxiliary infrastructure that deteriorates the outcome of railways, increasing the delays in transhipment and postponements in curricular of the trains. In the case of the providing of the sufficient investments by the state, the additional financial inflow of the budget by 2021 may be 500 billion RUB (Gorbunova, 2011, 7). Since the creation of the company, Russian Railways invested 1.6 trillion RUB in the infrastructure during seven years (Andreeva and Svyatkina, 2011). Approximately, 1 trillion RUB was allocated for the last four years (Lasarev, 2011b). In total, for the ten years, JSC ‘RZD’ invested 4.3 trillion RUB (Yakunin, 2014a).

However, the priority of the investments was in the renovation of the locomotives. In particular, in 2013 the JSC ‘RZD’ planned to buy 770 locomotives (Yakunin, 2013b). In total, it was pledged to renovate the fleet of locomotives comprised of 20, 000 locos, in which 13% of electric locos, 20% of mainline locos, and 30% of shunting, were rundown. For these purposes, it was required to buy 800 locos annually. However, only 300 locos were obtained (Perepelitsa, 2012c), albeit, in
2013, a record number of locos (804) were bought (Retyunin, 2014). By 2020, it is required 901.2 billion RUB to renovate the fleet of locomotives (Gurev, 2011).

At the same time, it is evident that for the reconstruction of the railway infrastructure that will be worn by 58% up to 2030, the higher investments are required (Maksimov, 2013). According to Ministry of Transport assessments, in 2011, around 49% of infrastructure was already depreciated. If the sufficient investments are not provided, then the length of the heavy-traffic line will rise by 7.5 ths. kilometres from 14 ths. km that present nowadays, including the heavy-traffic approaches to the seaports at North-West, South, and the Far East regions (Shevchenko, 2011).

Despite the blatant financial needs for the railway infrastructure developments, in the programmes, the highest restraints concerned railways and roads. In accord with the socio-economic development of Russia, their financing has been reduced by 6% and 5% to 5.8 trillion RUB and 4.1 trillion RUB, respectively. The deficit of the budget also influenced the inland waterways – their assignations reduced by 2%. Meanwhile, the expenses for aviation and development of transport corridors have been untouched. Conversely, the investments into the infrastructure of the seaports have been increased by 8% (Svyatkina, 2011b).

As a consequence, the share of the programmes are as follows: ‘Civil Aviation’ is 1.2 trillion RUB, the programme ‘Export of transport services’ 753 billion RUB, and ‘Sea’ and ‘Inland Waterways’ respectively of 635 and 200 billion RUB (Svyatkina, 2011b). These sequestrations, which stem from the financial crises, may lead to delay until 2019 of the commissioning of the programme ‘The development of transport system until 2015’ (Svyatkina, 2011b).

It should be noted that the central correction of the budget was made in 2009 and 2010. In 2009, the crises resulted in the reduction of the investment plans from 433 Bl RUB to 257 Bl RUB (Yakunin, 2009). In 2010, assignation for the railways development reduced by three times (from 718 to 218 billion RUB). For roads, the reductions were by two times, from 495 to 172 Bl RUB (Svyatkina, 2011b). The approximate investment programme of JSC ‘RZD’ is presented in Figure 27.

![Figure 27](image_url)  

Figure 27. The size of the investment programme of JSC ‘RZD’, in billion RUB (Gorbunova, 2011; Lebedev, 2015; Yakunin, 2014a, 2015).
The crisis phenomena in the Russian economy, which was projected for 2015, resulted in the sequestration of the investment programme of JSC ‘RZD’ by 20%. The main subject of the austerity became the acquisition of the new locomotives and the construction of the high-speed railways. For example, the allocated finances for high-speed railway Moscow – Kazan reduced in 2015 from 150 billion RUB to 6 billion RUB (Lebedev, 2015).

The tendency of reducing the investment remains one of the main problems at Russian Railways. It negatively influences the economy as the whole, because the investment in the infrastructure and rail fleet is the base for the growth of the national budget (Yakunin, 2009). By 2016, the reductions in the investment programme of Russian Railways may equal 74 billion RUB (Maksimov, 2013). At the same time, according to Mr. Yakunin, the target of the company is to reduce expenses in the next three years by 24–25 Bl RUB, annually (Yakunin, 2013b). Meanwhile, JSC ‘RZD’ does not have internal reserves to finance investment programme, in particular, from the sale of the shares of its subsidiaries (Perepelitsa, 2012c). In light of current circumstances, to mitigate the situation, the long-term government has approached to the field of tariffs that assures a guaranteed return on investment.

3.4 Review of Subsequent Impacts on Transport Services

In the budget restraints, the required extra-budgetary resources are fluctuated from 156.2 Bl RUB to 405.9 Bl RUB (Maksimov, 2013). The shortcomings in financial inflow may reduce the railway traffic. As a result, the total losses of GDP by 2020 will be assumed 5.5–6.4 trillion RUB, while the budget losses will amount to 1.3–1.5 trillion RUB (Yakunin, 2013b). The annual losses of GDP will be 250 billion RUB (Gurev, 2011). Hence, by 2020, the Russian Railways will not be able to take 300 Ml tonnes (Gurev, 2011), partly due to the delayed of the planned construction of the terminal and warehousing infrastructure. In particular, this concerns the expected construction of the ‘backbone’ net that included ten multimodal logistics centres of federal level, tending to be the nodes of origin of cargo traffic. The terminals were proposed to attract 120 Ml tonnes of cargo additionally. Reportedly, the leading role in such strategy had to provide three dry ports situated in the Far East, Baltic, and Azov–Black Sea regions (Gapanovich, 2010; Perepelitsa, 2013c; Figure 28).
Overall, it was planned to build 20 multimodal transport and logistics centres of regional level and over 50 of the territorial level (Tsygankova and Shmeleva, 2009). The proposed capacity of all 50 Terminal-Logistic Centres by 2015 was 3.5 million TEUs with the facilities erected on the territory of 4.5 million sq.m. (JSC ‘RZD’, 2011a). Moreover, around 60 large freight yards should be put under reconstruction, while, in approximately 400 freight yards, the handling and lifting equipment should be upgraded (Gapanovich, 2010; Yakunin, 2010a).

In Germany, similarly to the logistics centres of federal level, around 33 freight villages provide the base for German logistics (Lasarev, 2011a). After the realisation of projects in the freight villages in Germany, they are further connected with the German seaports and another freight centres primarily by railways (Lasarev, 2011a). The same projects have been planned in Moscow and St. Petersburg. However, in Russia, the German experience is hardly applied. The reason is that investors and providers cannot cooperate properly. Each of them builds their warehouse and then tries to find their goods and transport for delivery.

Meanwhile, despite the financial administration difficulties, the construction of the first terminal or transport and logistics centre called Beliy Rast is almost finished in Moscow region (Yakunin, 2013b). The centre is deployed on the territory of 100 ha, which is occupied by the container yard of 290 ths. TEU capacity, customs office, warehouses (68.8 ths. sq.m.), etc., providing the total turnover of 18 million tonnes (Gapanovich, 2010). The capital investment is 500 million Euros, with the payback period of 11 years. Similar centres will be built in North-West and Ural regions with
the summed capacity of three projects of 500 ths. TEU.

By the development of these projects the parent company JSC ‘RZD’, showed intentions to enter the market of logistics services. Additionally, the creation of the structures mentioned above, including the subsidiary company JSC ‘RZD-Logistics’, symbolise the intentions of JSC ‘RZD’ (Svyatkina, 2011a). However, JSC ‘RZD’ is rather focused on the elimination of ‘bottlenecks’ in mainline railway infrastructure. Therefore, the private sector finances will be under the demand for the renovation of terminals and warehouses (Perepelitsa, 2013c). On the whole, by 2030 it is planned to develop over 100 transport and logistics centres within the system of Russian railways with the involvement of interested national and foreign investors (Lasarev, 2011a). It is assumed that the lands for freight terminals’ development will be allocated by the administrations of districts and towns, with whom the private investments will be in cooperation. The following changes accompanied almost all of the contacts related to the development of multimodality at the network of railways. That is, the appearance of the new transport and logistics centres or plugging the railways to the existing terminals (Lasarev, 2011a).

In the meantime, the insufficient financing has deteriorated the pace of the construction of the terminal and warehousing infrastructure, which is accompanied by the reformation of the railways sector. It led to the growth of the ‘abandoned’ trains at the national rail system. According to Hämäläinen and Korovyakovsky (2007), ‘abandoned’ trains mean ‘trains that are directed to the port, but due to the fact that all the tracks at the port–station area are engaged, they cannot be accepted by the port’. As a result, they are stopped at the nearby stations, causing ‘traffic jams’ (Korol’, 2015).

There have been many instances of the ‘abandoned’ trains in recent years. For example, in 2005, the average daily number of the abandon trains was 69. This figure, however, reduced to 47 ‘abandoned’ trains at the approaches to the seaports in 2006 (Denisenko, 2007). In 2007, the unloading of wagons at the main Russian seaports was at the level of 70% of the use of their capacity. As a matter of fact, the losses of the unloaded cargo amounted to 500 ths. wagons. Daily, at the network of Russian Railways, there were 32–35 trains as ‘abandoned’ (Rezer and Kuzin, 2011; Ovcharova, 2009).

In order to reduce the delay of wagons at the approaches to the seaports, JSC ‘RZD’ announced 93 conventional restrictions on loading the cargo, directing to the seaports in 2007. In 2006, the number of the conventional restrictions was more by three times from 2007 level. Due to these reasons, the railways were deprived of the transportation, and seaports from the handling of 20 million tonnes. The profit was also lost from these operations (Rezer and Kuzin, 2011).

In 2008, the number of the ‘abandoned’ wagons with export cargo at the approaches to the seaports increased by 311 wagons per day, amounting to 17.6 ths. of wagons a year. Consequently, 1 426 days of the conventional restrictions on loading the cargo in wagons, forwarded towards the seaports were announced in 2008. From this
number, there were 603, regarding the seaports of Russia, 778 – seaports of Ukraine, 45 days – to the seaports of Baltic. In comparison with 2007, the number of the conventional restrictions reduced by 34%, including on loading of cargo to the seaports of Russian – by 2.5 times, Baltic countries – by 3.6 times. Instead, to seaports of Ukraine the conventional restrictions increased by 1.5 times (Ovcharova, 2009).

At the beginning of January 2009, at the railways, more than 200 trains have been ‘abandoned’. In this sum, there were 150 trains with coal among different sections of Russian Railways. For instance, at the Far Eastern railway – 120 trains, October Railway – 20, and North-Caucasus Railway – 18 trains. At that time, on the railways, approaching the seaports, there were around 25 ths. wagons with the export cargo as ‘abandoned’. The critical situation was in the seaports of Vostochny, Posiet, Nakhodka, Temryuk, and Novorossiysk (Ovcharova, 2009).

At the end of the January 2009, the ‘abandoned’ trains did not disappear. The loss in the unloading of wagons at the seaports reached 1500 rail cars. Moreover, for a long time, 100 trains had been staying ‘abandoned’ at railways. At the North-Caucasus Railway, losses achieved 1000 wagons. The same problems were identified in the approaches to the Novorossiysk seaport, where more than 1.5 ths. wagons with the ore have been abandoned. At the approaches to Murmansk seaport, there were 7 ths. of wagons with the coal abandoned. At the approaches to the seaports, served by the October Railway the number of ‘abandoned’ wagons was 4 ths. Therefore, 50% conventional restrictions on loading the cargo (coal) towards the rail station Nakhodka have been introduced since 25th until 26th of January 2009 (Ovcharova, 2009).

Another example is net of Sverdlovskaya railway, which is one of the branches of Russian Railways. The peak load of the rail lines was in the direction Tobolsk-Surgut, where due to the growth of cargo (extraction of gas and oil) the capacity was deficient (Ushenin, 2011b). In July 2011, there was 20 pair of trains daily, which load the capacity of the line by 91%. This pressure has been higher than normative of 87%, since 13% should be the extra capacity to provide the maintenance of the rail lines (Ushenin, 2011b).

In the second half of February 2014, ‘abandoned’ trains again appeared at the approaches to the Russian seaports. Moreover, their number increased by 1.4 times from 2013 (Solntsev, 2014b). Special attention should be paid to the ‘abandoned’ trains on the approaches to the seaport of St. Petersburg. The reason behind this is that the seaport is located in the North-West region. It can be considered as litmus paper, since the situation in the national market is always judged by the most significant parts of the country. The North-West region of Russia is the ‘gateway’ for the international traffic. Therefore, the cooperation between the seaport of St. Petersburg and October Railway should represent an active form of communications in the Russian logistics markets.

On the contrary, at the end of December 2010, approximately 20 ‘abandoned’ trains
were detected on the adjacent railways, leading to the seaport of St. Petersburg. More than half of the ‘abandoned’ trains accounted for the container trains. The primary cause of the ‘abandoned’ trains at the train station Avtovo was a declined productivity of the First Container Terminal, which is situated at the 3rd harbour section of the seaport. The FCT is the leading maritime terminal of St. Petersburg seaport among other 30 maritime terminals located at the site of the port. It provides almost 50% of container handling of all maritime terminals of the St. Petersburg seaport. The second one on the list of the major terminals is Petrolesport that handles over 20% of the seaport container throughput. These terminals are the biggest Russian seaport container terminals. However, their capacity is insufficient, especially in winter times, resulting in a number of ‘abandoned’ trains.

In 2014, the situation on the railway approaches to the seaport of St. Petersburg deteriorated again. The capacity of the maritime container terminal (FCT) was overloaded, resulting in ‘abandoned’ container trains at the adjacent to the seaport train station Avtovo. The ‘abandoned’ trains blocked the St. Petersburg railway junction overall. The situation, in turn, brought difficulties in organising the rail traffic towards the other maritime terminals of St. Petersburg seaport (Solntsev, 2014b). A straightforward solution to the shortage of coastal lands could be concept of dry port, providing a maximum seaports’ capacity enlargement and the reduction of the lead time.

The construction of dry ports will allow to relieve the freight rail stations for the main operations, related to cargo processing, marshalling of wagons, and maintenance of rolling stock. The execution of value-added services (e.g., packaging, labeling, assembly, customs’ operations), as well as stuffing and unloading of containers/transport modes, storage, and the accumulations of containers and rail flat cars for the full trains, will be provided by dry ports. It is envisaged that the capacity and layout of dry ports should be sufficient to ensure safe and unhindered movement of containers, cargo and vehicles, providing the possibility of increasing capacity, depending on serviced modes of transport and future volumes of containers and cargo (Egorshev, 2014).

The overseas experience shows that, in countries, where the terminal and warehousing logistics are well developed, the ‘abandoned’ trains do not exist (Perepelitsa, 2013c; Rezer and Kuzin, 2010; Roso, 2009). That is why to improve the productivity of the seaport in cooperation with the railway; it is required to develop inland terminal, if the maritime terminal is not possible to expand at the site. The utilization of inland terminals or so-called dry ports may improve the productivity of the seaport. Moreover, the use of the dry port reduces the number of the ‘traffic jams’ at the approaches to the seaport that create the favourable condition for the smooth container flows and fewer footprints on the environment.

The construction of dry ports has already being experienced in Russia and received rewarding, despite few difficulties (Gagarskiy et al., 2013). For example, nowadays, most of the dry ports are located far from the seaports’ lands at the free spaces on the outskirts of the cities. The facilities of dry ports, as a rule, are connected to the sorting
stations, different from the adjacent to the seaport railway station. Due to this fact, the use of the code of the adjacent to the seaport railway station is illegal. At the same time, consignees are interested in using this code in order to receive the discount of the VAT. The problem can be solved by the prescription of the unique codes to the dry ports by JSC ‘RZD’, once they are put into the operation (Gagarskiy et al., 2013).

The dry ports are, first and foremost, attractive for consolidated shipments (i.e. having freight to numerous customers in one container). In the seaports, it takes much time to dispatch such a container since it has to wait for the customs clearance of the cargo by all consignees (Gagarskiy et al., 2013). The recognized key role of the terminals and warehousing infrastructure (dry ports) can be essential, if taken into practice. The development of these facilities should become the priority not only for the operators (operator of maritime and inland terminals), but also for the transport companies, forwarding companies, and different providers. Broadly speaking, the interest can be from the parties geared to the improvements of the services of the clients. In the deficit financial situation, the dry port development requires the cooperation not only from maritime and land transport companies (e.g. JSC ‘Russian Railways’), but also from the state.

The timeless of dry ports development is stressed on the local level, as well as on the international scale by ESCAP. With the active participation of the Russian delegation, ESCAP created a draft of an intergovernmental agreement on dry ports (2012), signed by 14 countries in November 2013 in Thailand. The development of the agreement was conducted since December 2009 at the initiative of Russia, supported at the first session of the Forum of Asian Ministers of Transport. In 2012, the first session of the Forum of Asian Ministers of Transport was held, adopting the Regional Action Programme of the Busan Declaration to 2016 that involved the creation of a single international intermodal transport system in Asia and the Pacific region. The signing of the agreement on dry ports is a continuation of the trend for the development of Euro-Asian transport routes, which Russia has consistently pursued so as to create a sustainable transport system in the Asia-Pacific region (Egorshev, 2014). Thus, the role of dry ports is considered as being an important component of the efficient international integrated intermodal transportation systems. The dry ports can facilitate the efficient logistics, especially in providing the specific needs of the countries that are ‘landlocked’, coastal or transit (Government of Russia, 2012).

The agreement on dry ports shall enter into force on the 30th day from the day when at least eight states, included in ESCAP, have deposited documents of ratification, acceptance, approval or accession to the Agreement. It was expected that this agreement will be signed by the interested economies by 2013 and further ratified. The Ministry of Transport of the Russian Federation carries out the necessary steps to prepare for ratification of the Agreement by the Russian Federation (Egorshev, 2014). After the ratification of the Agreement, the dry ports definition will be fixed at the level of normative legal act. So far, the term dry port was mentioned only in the Concept of customs clearance and customs control of goods in the sites close to the state border of the Russian Federation approved at a meeting of the State Border
Commission June 9th, 2009. However, the definition of the dry port was not given. The dry port was considered only as one of the locations of the zone of border and customs control, along with sea and river ports, and airports (Egorshev, 2014).

The Agreement (Article 1) defines dry port as ‘the site located on the inland territory of the country, which include logistics centre connected to one or more modes of transport that intended for processing, temporary storage, and the law inspection of goods carried in the course of international trade for the fulfilment of applicable customs control functions and formalities’. According to the document, each country provided the list of the dry ports that can be used for handling of cargo. Russia offered 15 dry ports, including existing and projected, India – 18, and Kazakhstan – five. In total, 27 countries listed dry ports in the appendix of agreement. In future, the list of the dry ports presented in the appendix of the agreement will be extended. The parties intend to develop these dry ports in the framework of their national programmes, laws, and regulations.

Therefore, in current circumstances, the mechanism and scenarios for the rational dry port implementation had come into the highest focus ever. However, without precluding the fact that the dry port construction is the most capital intensive scenario for the seaport capacity increase, implying the need for the smooth coordination with railway transport, the financial barriers to progressive processes and technologies based on dry port implementation have to be mitigated. For that to happen, the government and private companies need to be hand-in-hand for such type of businesses set up.

To streamline their united actions towards the terminal and warehousing infrastructure development, the financial schemes for the feasibility studies that can be applied for dry port projects are required. For these reasons, Chapter 6 discusses the utilisation of the public-private framework for the realisation of the dry port undertakings. Additionally, it exemplifies the feasibility study (capital budgeting decision tool) that can increase the accuracy of the predictions and help analysts and planning managers on the dry ports’ budget decision-making.
4 METHODOLOGY

4.1 Research Strategy

The overall research strategy was developed based on the existing experience of research methodology in different fields of knowledge (Novikov and Novikov, 2010). As a rule, the strategy is represented by serial logical steps that include three basic phases: designing, technological, and reflective phases (Table 4).

Table 4. The phases, stages, and steps of scientific research (Novikov and Novikov, 2010)

<table>
<thead>
<tr>
<th>Phase</th>
<th>Stage</th>
<th>Steps</th>
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<tr>
<td>Designing</td>
<td>Concept development</td>
<td>1. Detection of contradictions</td>
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<td></td>
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<td>2. Formulation of problem</td>
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<td>3. Defining the goal of research</td>
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<td></td>
<td>Hypothesis building</td>
<td>Development of hypothesis</td>
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<td></td>
<td>Structuring of the research</td>
<td>1. Decomposition (definition of tasks of research)</td>
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<td></td>
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<td>2. Investigation of conditions (resource opportunities)</td>
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<td></td>
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<td>3. Development of the research programme</td>
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<tr>
<td>Technological</td>
<td>Conducting the research</td>
<td>Empirical step</td>
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<td></td>
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<td>Theoretical step</td>
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<tr>
<td>Registration and publication</td>
<td>Registration and publication</td>
<td>1. Testing results</td>
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<td>of the results</td>
<td>2. Making results</td>
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The first design phase that covers the stages from conceptualization to determination of the final objectives of the study and planning of the research was carried out through the following detailed research steps: intentions – revealing contradictions – formulation of the problem – definition of the object and the subject of the study – stating of the goal – building scientific hypotheses – defining the research objectives – planning resource opportunities and studies. The logic of the technological phase was build based on the developed studies and covering paper. It should be noted that reflective phase penetrated into several steps of the conducted research, despite its inclusion in the last line of Table 4.

Starting from the first stage of designing the research (Table 4), the initial step was considered. Meaning, the preliminary step or the intention of the study, which was determined by the background knowledge received at railway universities, as well as personal traits and biographical characteristics mentioned in the Acknowledgments. Already at this phase of the development of the research, it was defined that the conducted study will be more practically oriented than fundamental. The applied research became a logical continuation of fundamental research, existing in the
financial models and theories (e.g., capital asset pricing model and real option theory), providing the concretization and complementation of the portfolio theory.

Further on, the contradictions were identified in the theory and practice of the applied science. First and foremost contradiction is that the portfolio theory considers net present value as a better measure of return on investments. Meanwhile, in business practice, the discounted payback period is more popular. That is not to say that net present value is not profoundly important, but it would be desirable to relax the assumptions of portfolio theory. In other words, the latter appraisal approach of discounted payback period should be regarded as not fewer relevant for the assessment of the investment and risk measure.

On the ground of the fixed contradictions the problem was formulated. It rose as a continuation of the trade-off between the opportunities that the investors can gain from the development of terminal business in Russia (e.g., dry port implementation) and risks. As a rule, the higher the investment risk, the greater should be their expected return. However, investors have different tolerance to the risks. That is why it would be advisable to find an optimum. In the given study, the optimum relates to the search of the efficient portfolio, which can provide satisfaction to the investor, depending on its tolerance to the risks.

Afterward, the goal of the research was determined by the subject and object of the study. The object of the research is the dry ports that can be broadly implemented in Russia through the mechanism of public-private partnership investments. In this regard, it should be noted that the widespread practice of the public-private partnership investments is not gained popularity in Russia, especially in the sphere of dry ports development. The PPP's principles from the theoretical and normative points of view would be advisable to apply so as to minimize risks, existing on the domestic market.

As a matter of fact, the subject of the research became methods and models of dry ports development on the peculiar national market. Therefore, the goal of the research, represented in the main research question (Table 5), is in the designing of models and methods for the facilitation of dry port development on national market that implies the necessity to mitigate barriers, first and foremost, the shortage of the investments and presence of risks.

For the development of the theory, the hypothesis of the research was built, in the second stage of the designing phase (Table 4). It was supposed that the application of simulation modeling with the use of systems dynamics approach and Monte Carlo method can provide more accurate results for the feasibility studies of dry ports development via PPP mechanism that, in turn, can facilitate the process of their construction in Russia.

The third stage of the designing phase of research was formulated on the basis of the determined contradictions, specified goal, and a constructed hypothesis. Structuring and decomposing of the goal of the research into small steps helped to reach the expected results. The several tasks of the study, which were designed in the form of
the sub-research questions (Table 5), became private, relatively independent targets of the research in the particular conditions of testing the stated research hypothesis.

Table 5. Relation of the examined questions to the study.

<table>
<thead>
<tr>
<th>Research questions</th>
<th>Appended papers</th>
</tr>
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<tbody>
<tr>
<td>S-RQ1: What stimuli initiate the investments in the dry port projects within Eurasian supply chains?</td>
<td>X</td>
</tr>
<tr>
<td>S-RQ2: Which types of principles and factors define the alternative variants of dry port project realization in support of strategic plans to increase national logistics markets agility?</td>
<td>X X</td>
</tr>
<tr>
<td>S-RQ3: What project selection criteria and methods are used to specify public and private concerns about the contextual environment of the dry ports implementation?</td>
<td>X X</td>
</tr>
<tr>
<td>MQ: How the development of dry ports can be facilitated, knowing peculiarities of Russian logistics markets and risks?</td>
<td>X X X X X</td>
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Overall, in the designing phase of the research, the conditions or resource capacity was critically analyzed, because any soluble scientific problem can only be considered under certain circumstances. Examples of these operating conditions would be the existence of motivation, material, technical, scientific, financial, organizational, and informational resources. From the practical orientation, a stimulus for this study was the connection of the theme of the dry ports development with the railway sphere. To a greater extent, a further progression of the Russian distribution system is dependent on railways. As a rule, dry ports in Russia were evolved based on the existing rail infrastructure. In other words, the inland terminals have been adjoined to the current railway network, linking rail stations and seaports (i.e., without the additional construction of the main lines). In 2012, JSC ‘RZD’ issued the Concept of creating terminal and logistics centres in the Russian Federation that anticipated the development of dry ports, including the rail approaches to the leading container seaports. In the reasonably foreseeable future, rail operators will probably rent these facilities. However, the project investments in the Concept are not yet final. For the construction of the inland terminal and warehousing infrastructure, Russian Railways plan to attract investors and work out entirely the technology of implementation of the projects.

The questions, concerning the feasibility studies, improvement of management systems, traffic safety, development of regulatory documents, etc. are the subjects of relations between JSC ‘RZD’ and railway universities. Examples would be Far Eastern State Transport University, FESTU (the former place of studying of the author) and Petersburg State Transport University, PSTU (current working place).
Meanwhile, the location of the Petersburg State Transport University close to a pioneering affiliate of JSC ‘RZD’ (October Railway in the North-West region) makes the inclusion of the university in the different projects more frequent. The University has extensive experience in cooperation with the largest enterprises of rail sector from the federal and regional level. That is why, the research questions have been examined through Russian Railways perspective. It should be noted that both universities and another seven railway universities in Russia educate the personnel for the huge Russian rail industry (more than 1 million employees). The important role of the railways in Russia cannot be overestimated. On the whole, these facts influenced and shaped the choice of the post-graduate research, in which the subject of railways remained in the focus.

Continuing the steps mentioned above, the plan of doctoral study was gradually developed, concluding the design phase of the research. The fourth stage of the designing phase (Table 4) or so-called the technological preparation of the study was critical for the further development of the research. It implied the allocation of the supporting literature and guidance for the testing of the developed hypothesis, as well as the search for the required technological equipment and programs for the development of the models and conducting computer experiments. It was clear that simple mathematical formulas and techniques, such as MS Excel, could restrict the comprehensive and advanced scientific work. Knowing that LUT laboratory is equipped with the latest versions of the required programs and software (e.g., @RISK and Vensim Professional), as well as accumulate professional academia, the motivation letter for the residence permit on the ground of studies have been prepared for the Finnish Consulate in St. Petersburg, Russia.

The next phase of conducting the study, in turn, consisted of two stages, such as the theoretical: analysis and systematization of the literature, development of the conceptual apparatus, and building the logical structure of the theoretical part of the study, and empirical: interviews and conduction of the experiments. The pillars of this phase became activities on the writing of five research papers, which were published in the reviewed international journals and helped to reach the answers to the main question and three sub-research questions of the study. Most of the research papers rely on the literature reviews and empirical studies (Table 6). At the same time, the facts from analytical studies have been cross-checked and verified by the conducted interviews, forming the triangulation method.
Table 6. Summary of the research studies.

<table>
<thead>
<tr>
<th>Number of the Paper</th>
<th>Time of conducting the research (publication year)</th>
<th>Gathered data</th>
<th>Data collection methods</th>
<th>Technique for data analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper 1 – Potential of connecting Eurasia through Trans-Siberian Railway</td>
<td>End of 2009 – middle of 2010 (2011)</td>
<td>1. Existing and future volumes of transit cargo in containers through the system of JSC ‘RZD’ in connection with Finland, Baltic nations, Germany, Poland, China, Japan, Republic of Korea, Ukraine, Belarus, as well as countries of Central and Eastern Europe; volumes of container throughput in the Far Eastern seaports (e.g., Vladivostok, Nakhodka, Vanino, and Vostochny); 2. Reasons of absence transit traffic on the Trans-Sib; 3. Tariff indexation on freight internal and international railway traffic; 4. Maritime and hinterland infrastructure projects; 5. Current technology of cooperation between Far Eastern Railway and seaports; 6. Procedures of cargo transiting via Trans-Sib vs. Deep Sea Route; 7. Existing shortcomings; 8. Proposed supply chain for transiting containers via Far Eastern Railway (with the dry ports implementation); 9. Possible dry port locations in the Far East region (close to the Far Eastern Railway stations of Nadezgdinskaya, Hmylovsky, and Makhalino).</td>
<td>• Analyzing secondary documents and literature review (reports, concepts, trade journals, investment projects and programmes, internet, papers and files provided by JSC ‘RZD’, databases of Russian Central Bank and Federal Tariff Service of Russia). • Seminar discussions.</td>
<td>Analytical conceptual case study: concept of dry ports is investigated within the context of Trans-Siberian Railway (namely, its section Far Eastern Railway) that is regarded as a potential area for developing and investing from macro-level point of view.</td>
</tr>
<tr>
<td>Paper 2 – Dynamics of Russian maritime basins</td>
<td>June 2010 – December</td>
<td>1. Handling volumes of containerized cargo among the Russian maritime basins;</td>
<td>• Studying of secondary documents and literature review</td>
<td>Analytical mathematical and</td>
</tr>
<tr>
<td>Number of the Paper</td>
<td>Time of conducting the research (publication year)</td>
<td>Gathered data</td>
<td>Data collection methods</td>
<td>Technique for data analysis</td>
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<tr>
<td>Russian Dry ports</td>
<td>2010 (2011)</td>
<td>2. The proportion of containerized cargo in import and export volumes of Russian seaports; 3. Container throughput of the busiest maritime terminal of St. Petersburg seaport (First Container Terminal); 4. Volumes of cargo by mode of transport, amount of delivered, picked and defective containers within FCT, retention cycle of delivered and picked containers, proportion of the direct loading operations from ship to train, the height of container stacks in different zones of the terminal, the size of the territory occupied by office buildings, a service center and nonfunctional warehouses; 5. General information about Russian inland terminals (date of establishment, owners, capacity, size of the territory, existence of rail approaches, provided services, including storage, maintenance, forwarding, and customs clearance and customs jurisdiction); 6. Discrepancy of Russian inland terminals from the common term of ‘dry port’; 7. Existing dry ports in Russia; 8. Peculiarities of dry port implementation in the busiest North-West sea basin of Russia.</td>
<td>(preferably, consideration of statistics of the First Container Terminal, public reports, strategies and planning documents about the cities transport systems development, especially seaports, according to Russia’s Merchant Seaports Association) and first-hand data received by means of telephone interviews.</td>
<td>qualitative case study: design of the hierarchy of dry port implementation in the busiest North-West sea basin of Russia and analytical modelling of a competitive situation of the St. Petersburg seaport capacity increase: – Expansion at the site by the release of the territory occupied by office buildings, a service centre and non-functional warehouses. – Increasing the height of the stacking yards. – Implementation of a dry port.</td>
</tr>
<tr>
<td>Paper 3 – Perspective reserves of</td>
<td>July 2011 – June 2012 (2013)</td>
<td>1. The primary geographic region of Russian manufacturing locations (out of seven regions) and their primary industry (e.g., electrical and optical equipment</td>
<td>• Analyzing secondary documents (Federal State</td>
<td>Analytical mathematical and qualitative case</td>
</tr>
<tr>
<td>Time of conducting the research (publication year)</td>
<td>Gathered data</td>
<td>Data collection methods</td>
<td>Technique for data analysis</td>
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<tr>
<td>Russian seaport container terminals</td>
<td>production, machinery and equipment industries, Transportation equipment production, textiles and clothing manufacturing, etc.</td>
<td>Statistics Service – Rosstat, Eurostat, Governmental websites, State Committee Standards – GOSTs, and first-hand documents provided by the Russian research agency in Moscow and compiled from various sources, such as Federal State Statistics Service; Central National Bank; Ministry of Finance, as well as the Center for International Logistics and Supply Chain Management of Deutsche Bahn and Russian Railways (CIL) that helped to designed the survey.</td>
<td>study: classification of factors, determining dry ports implementation and simulation modeling, identifying the improvement potential of sea container terminal, working with the new dry port system vs. the current technology.</td>
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In general, a target sample size (n=875 manufacturers) was provided. One respondent was received per each of 600 firms, and two respondents per firm in 275 cases. The total number of enterprises equaled to 1535 companies. That is why the response rate was 875/1535×100%=57%.
<table>
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<tr>
<th>Number of the Paper</th>
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<th>Gathered data</th>
<th>Data collection methods</th>
<th>Technique for data analysis</th>
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<tbody>
<tr>
<td>Paper 4 – Deregulation of the Russian railway freight market – learning from empirical results</td>
<td>February – November 2012 (2013)</td>
<td>1. Company background (regulatory and operational bodies; infrastructure assets, enlargement of transport network); 2. Tasks, which were set for each period of reforms at Russian Railways; 3. Market entry barriers when entering the Russian railway market; 4. National peculiarities in Russian rail market; 5. Characteristics of target market model; 6. Legislative demands in different countries on the subject of liberalization of railway freight markets; 7. Results of the structural reforms on Russian Railways; 8. Liberalized spheres within the rail industry.</td>
<td>• Interviews (11) provided by co-author Ph.D. Milla Laisi; • Literature and documents reviews (Russian and international journals, Non-recurrent publications, companies websites, Council Directives, the sources from the Community of European Railway and Infrastructure Companies (CER) and the World Factbook).</td>
<td>Qualitative case study: market entry barriers and peculiarities of the liberalization processes on Russian Railways.</td>
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</table>
Some of the appended papers are based on the research ordered by the Finnish Transport Agency and international project ‘Rail Baltica Growth Corridor Russia’, which originated in 2012 from the mother project of RBGC (RBGC.EU, 2014).

The project partners are Aalto University School of Economics Small Business Centre; the city administration of Helsinki; Lappeenranta University of Technology, Kouvolan unit; Petersburg State Transport University; North-Western Russian Logistics Development and Information Centre ILOT; and Public Transport Authority Berlin-Brandenburg VBB. The project aimed to increase the competitiveness of St. Petersburg and Leningrad region, as well as the eastern part of the Baltic region. It geared towards the improvement of the availability of information about the transport system at the transnational and regional level. Additionally, the project proposals include the improvement of the transport infrastructure in the region. One of the objectives of the ‘RBGC Russia’ programme was the geographical expansion of the project beyond the EU. The involvement of the North-West region of Russia in the mutually beneficial development of the transport infrastructure in the Baltic region also was a project’s task.

In conclusion, it should be noted that writing and publishing the reports related to the projects, as well as other forms of scientific and literary production, such as scientific papers in the reviewed journals and conference proceedings have contributed profoundly to the final stage of technological phase, represented by consecutive steps of making and testing of the scientific results of the study (Table 4). Meanwhile, the technological phase of the conducted research cannot be regarded as final in the whole scientific strategy from the systems point of view. That is why the research strategy includes the reflective phase in conclusion of Table 4. It is placed at the end due to the reason that after the conducted study, the researcher can start a new cycle of the developments that will be on the higher level of quality due to the gained experience.

4.2 Approaches to Scientific Knowledge

In order to solve the research problem, it was required to utilize different research approaches, which complement each other (e.g., qualitative and quantitative methods) (Silverman, 2011). The choice in favour of both of them was made on the grounds of epistemological, ontological, and practical orientations that, in turn, relay on the link between theory and research.

The theory is latent in the literature review, according to Briman and Bell (2011). Moreover, in many instances, the relevant background literature acts as the equivalent of the theory. By knowing the theory, the reasoning for the data gathering in relation to the researched problem became explicit. In particular, the literature review allows to consider whether the theory should be built with the use of quantitative method or (and) tested by the qualitative approach.

The research data showed that the concept of dry ports’ development received a lot of international coverage (Ambrosino and Sciomachen, 2014; Henttu, 2015; Henttu and
Despite the fact, that most of the researchers shed the lights on technical, ecological, and technological aspects of the phenomena, there was still a niche to explore the problem from the economical point of view. That is, the economic justification of business and risk investments of JSC ‘Russian Railways’ and other interested parties in the construction of dry ports.

At the same time, the investments’ barriers to the construction of dry ports echoed in numerous research papers (Bergqvist et al., 2010; Henttu, 2015; Henttu and Hilmola, 2011; Henttu et al., 2010; Korol’, 2015; Liedtke and Garillo Murillo, 2012; Ng and Gujar, 2009; Rodrigue et al., 2010; Van den Berg and Langen, 2011). Roso (2009) stresses that respondents, representing dry ports, identified that more than 50% of them do not suffer difficulties during the implementation and operation of the dry port projects. However, the statement is correct only, if the problem of significant investment is neglected. As a matter of fact, the development of methods for economic evaluation of major dry port projects is timely.

Based on the afore-mentioned practical orientations, further philosophical understandings and justifications (e.g., the epistemological and ontological aspects) have been considered. According to Flyvbjerg (2011) and Yin (2009), the qualitative methods serve as a preliminary to the quantitative research. For this reason, the qualitative methods were applied as the first ones for theory-building through the inductive approach.

The inductive research strategy implies the interpretivism (as an epistemological position) and constructionism (as an ontological position). As known the epistemology considers the questions related to the acceptance of knowledge. That is why based on the interpretivism manifests; the knowledge was generated on the grounds of the experience of those who work within the researched area. To a greater extent, the social world or the trends of the railway industry were understood through the examination of the interpretation of the world by its participants (Briman and Bell, 2011).

Next, from the point of view of the ontological considerations, the researched phenomenon was studied regarding the nature of the social entities. In particular, its meaning was considered dependent on social actors (as constructionism perception), rather than a phenomenon ‘out there’. The research phenomenon of economic appraisal of risk investments in dry port development is a tangible object. However, the structure of the economic model is not pre-given. This position also coheres to the ontological position of constructionism. Continuing this idea, it was assumed that the dry ports can be developed through the public-private partnerships that are extensively implemented, in many countries, to mitigate the investment burden of the projects.

The ambiguous generalizations, which represent the inductive approach, on the possible application of PPP model for the dry port development in Russia was gained via analyses of the multiple case studies, e.g. Sweden, Spain, India, New Zealand, 104
Finland, Turkey, and Australia. The national market has yet to build its experience in
investments in dry ports via PPPs. In order to understand better the peculiarities of
the Russian market, in general, regarding PPP scheme utilization, the literature
review in the native language was conducted, and several interviews have been
organised.

Afterwards, the model of PPPs of the dry port project was conceptualized as the
‘negotiated order’, in which social actors have a role in fashioning. For that reason,
the scheme of the investments, implying the shares, which are held by each actor; the
percentage of risks shared among interested agents, etc., can be considered as an
outcome of the agreed-upon patterns of actions. In other words, a so-called ‘the
socially constructed product’ can be designed. This ‘product’ is, hereafter, created on
the basis of the negotiations of some interested parties, which are involved in the
project.

Having said that the phenomenon is influenced by the social actors, its understanding
requires personal perceptions. Regarding the fact that the dry port project implies the
inclusion of logistics centre (e.g., terminal and warehousing infrastructure) connected
to one or more modes of transport, preferably railways, one of the possible parties or
investors was prescribed to JSC ‘Russian Railways’. The project also could have a
potential interest for seaport agents, as well as the state. Therefore, the experience of
these actors was fundamental for the understanding of the phenomenon of the model
of PPP dry port project.

Hence, the contact with the experts from the field was provided. For gathering
reliable data, the semi-structured interview method was applied (Wilson, 2014).
Additionally, the interviewing helped to mitigate the criticism of the quantitative
research as a ‘quick fix’ of the problem. Meanwhile, due to the relatively small size
of the group of overseas case studies and Russian single case scenarios, the
qualitative research results were impossible to generalize to the entire market.
Therefore, the problem of the reliability of the qualitative research, which was
discussed by Silverman (2011), was subsequently solved via the other research
techniques. Particularly, quantitative methods allowed to explain the created
generalized theory via the deductive method.

The deduction process entails the theory testing, according to Briman and
Bell (2011). This approach provided, in turn, the consideration of the applicability of
the PPP scheme for the Russian market. Within the national environment,
the inclusion of the risk factor in the investing projects of dry port development was
under core attention. Generally, the quantitative research strategy, which was the
second applied approach, is considered as opposite to the qualitative approach. Most
obviously, quantitative research tends to be concerned with the numbers rather than
words, but other features are particular noteworthy: the ontological position is based
on the objectivism, while the epistemological position relies on the positivism.

From the ontological orientations of objectivism, the PPP model was considered as
the external reality to the interested parties. Specifically, the designed model of cash
flows, costs, and results, allowing for uncertainties and risks, was evaluated on the grounds of the main deterministic indicators. These indicators included net present value and the payback period. Importantly, the model was assessed separately from those who were involved in the construction of the economic scheme.

Then, the created model or researched phenomenon was studied by the utilisation of the methods of the natural science, according to the positivism. To obtain sufficiently reliable results the following scientific theories and mathematical methods have been applied: systems theory, probability theory and mathematical statistics, operations theory, mathematical optimisation, real option theory, portfolio theory, simulation modelling, and Monte Carlo method.

Thus, the theory testing, which was tailored to the natural science model, was performed, first and foremost, by experiments on the evaluation of capital investments in the dry port project based on the PPP. In other words, this procedure allowed to perform the revision of the theory. On the ground of the collected results from the scientific methods, the applicability of the public-private partnership investments in dry ports in Russia showed benefits for railway companies’ inclusion in the project. Additionally, the problem of dry ports implementation via PPP has been considered based on the information about the risks. Their identification and accurate assessment allowed to reduce the overruns in the typically long term and capital intensive investments, which are regarded as one of the factors, impeding the dry port projects realisation in Russia (Laisi et al., 2013).

By taking uncertainties and risks into account, the outcome of capital budgeting technique for PPP investment in dry ports, based on the net present value and discounted payback period was improved. The proposed procedure enables the proactive and reactive strategy applicability to mitigate the risks as to response to unexpected markets evolvement. Thus, the decision making, concerning dry port projects development via PPP in a dynamic and uncertain Russian environment, was facilitated due to the allowance for the managerial flexibility and accuracy of the results.

The validity of the results of the conducted experiments was confirmed by the outcome of the experiments of investment appraisal calculations, which were comparable to those that are obtained when similar problems in the transport sector are solved. The conclusions of the research were consistent with existing notions of economic efficiency of investments in the construction of terminal and warehousing infrastructure that was on the balance sheet of JSC ‘Russian Railways’.

4.3 Research Process and Design

In this sub-chapter, the process of approaching the purpose of the thesis and research design, following the detailed description of the conducted studies, is presented. The main question of the research is reached through the answers to the sub-research questions, analysed in appended publications of Part II. It should be noted that the researched issues and responses to them were formulated based on the clear
understanding of the alternatives for gaining new scientific results. According to Novikov and Novikov (2010), the new scientific results can be accumulated from the algorithm presented in Figure 29.

Figure 29. Variants for generating new scientific results (Novikov and Novikov, 2010).

Figure 29 shows the alternatives ways of research process that depend on the variants of gaining new scientific results:

1. A new previously not researched area of the subject (‘novelty’ is indicated by shading on figure) is studied (Figure 29a);
2. Alternatively, to the previously studied domain, a new technology, e.g. a method, mathematical models or means of knowledge are applied (Figure 29b);
3. Simultaneously, the new individual domains of the subject alone with the new technologies are explored (Figure 29c).
4. On the contrary, by considering the already existing study of the subject area and using known technologies, the fundamentally new results or broad generalizations are impossible to receive (Figure 29d).

Based on the above-mentioned alternatives, the research process can be categorised into two main groups: 1) ‘Turning away nuts’, i.e. exploring new subject areas and 2) ‘Picking up the new keys to loosen screws’, i.e. using new technologies of
knowledge (Novikov and Novikov, 2010). To unfold the research process, it was clearly defined that two options can be used for gaining the new scientific results (Figure 29 c), in the current study. The reasons for this proposal are as follows.

The idea of inland container terminals’ development, otherwise known as a dry port concept, is in high demand overseas, but has a little application in Russia. Therefore, it was supposed that the term can be an object of the research within the new content area, partly contributing to the option of ‘turning away nuts’. Moreover, it was found that the dry port concept has been studied by many sciences, each of which has its own special subjects of knowledge. The dry ports have been widely investigated within the logistics and supply chain management domain through the prism of technical, ecological, and technological specifics of the phenomena. Despite the fact that the issues related to the financial barriers to dry port development have been addressed by many authors, they did not receive critical attention from the special knowledge of economic sciences. From this point of view, economic methods and models were proposed to serve as ‘new keys to loosen screws’. As a result, the primary question of the current research did put under the focus preferably the financial methods and models that became a subject for the facilitation of the dry ports construction in Russia (MQ: How the development of dry ports can be facilitated, knowing peculiarities of Russian logistics markets and risks?).

Since dry ports became the main object of the research, it was important to learn properties, relations, the laws of development of this phenomenon in Russia by different scientific approaches and context levels. The first level, from which dry ports were analysed belongs to the domain of the supply chain management, and concerned the macro point of view. It was depicted in the Sub-Research Question 1 (S-RQ1: What stimuli initiate the investments in the dry port projects within Eurasian supply chains?). The answer to this question at this level did not require a clear distinguishing of the subject within the object. As a result, Paper 1 was only making the framework so as to continue the research of the object ahead.

Paper 1 consists of the intense literature study and background knowledge received at Far Eastern State Transport University, Khabarovsk. The purpose of the initial literature review and analysis of the secondary documents was to develop an understanding of how the commonly accepted dry port concept can be applied in the Russian market. Notably, the dry port idea was researched in the context of the supply chain, providing transit traffic of containers between Asia and Europe. Their implementation was argued in the vicinity of the eastern part of Trans-Siberian Railway on the approaches to the Far East seaports. By doing so, the logistical scheme of cooperation between railways and seaports can be excelled (the first sub-research question of the research). This study was originally presented at the Seminar ‘Future of transit logistics in the Gulf of Finland’, Maritime Centre Vellamo (Kotka, Finland, 2009). Seminar discussions enabled the conversations that provided additional knowledge and stimulated further development of the study into the journal article, in 2011. The results of this study and the next two papers were also presented and debated at the meetings of the Department of Logistics and
Commercial Operations in PSTU, while the findings from the last paper were discussed with the representatives of the railway sector.

On the second level, the analysis of the phenomenon of dry port development has been provided within the domain of logistics, i.e. more precisely. In other words, the subject of the research, which is mainly relates to the scientific knowledge of logistics, in this level, has helped to depict the most significant and profound features and properties of the object of the study – dry ports, and, thus, contributed to the Sub-Research Question 2 (S-RQ2: Which types of principles and factors define the alternative variants of dry port project realization in support of strategic plans to increase national logistics markets agility?). The answer to this sub-research question was generated via the next two papers.

In Paper 2, the focus was narrowed down from international supply chains that include dry ports, seaports and railways, in general, to peculiarities and characteristics of dry ports in Russia. The aim of the study was to identify common challenges in the dry port realisation that lead to the existing problems of seaports restricted in their infrastructure enlargement. Therefore, the framework for the analysis of dry ports developed in the previous paper structured the data collection in the current study, as well as determined the choice of the case study (St. Petersburg seaport). As a result, the principals for dry port implementation in the busiest North-West sea basin of Russia were created, partly answering to the second sub-question of the research. Due to the reason that the study concerned a thorough analysis of Russian container market, and dynamics of domestic dry ports, the access to the Russian databases was essential. In this regard, the literature review was the primary method of the data collection for the first part of the study. Meanwhile, in the second part, additionally first-hand data, which was received by means of telephone interviews, have been utilised in the mathematical method, providing the analytical modelling of a competitive option (dry port development) for the seaport capacity increase (Table 5).

By contrast to the Paper 1 and Paper 2, which were more theoretically oriented, the next three papers were derived from observations and practical experience. Paper 3 addressed different factors of dry port utilisation by the seaport terminal, completing the answer to the second sub-research question. Since the aim of the study was to analyse the effect of particular factors on dry port construction, the representation of the cause-effect relationships required analytical research. With the analytical study of the secondary and first-hand data, as well as through the semi-structured interviews, the propositions on the dry port implementation by the maritime container terminal of St. Petersburg seaport were developed. Further, one of the main reasons of dry port implementation, i.e. technical factors, were analysed based on simulation modelling. Finally, the model was designed, employing site-visits to the maritime and dry ports. Without precluding the fact that observations were not the data collection method on the own, they were used to complement a document and literature review analysis and interviews, helping to generate explanations and understandings.

The research in this phase was carried out in the project ‘Rail Baltica Growth
Corridor Russia’. Although the activity package number three covered all the logistics centres and freight terminals in the North-West of Russia, the article namely concerned the situation with the dry ports of St. Petersburg area. The author handled the empirical data collection at the St. Petersburg seaport, including its dry ports of Logistika-Terminal and Logistic Park Yanino. The paper was presented at ‘Innorail Forum Activities’, Kouvola, Finland, on the 25th of May 2012, and then revised and expanded for the international journal.

In the process of writing this paper, the author also participated in the research on the public sector opinions on RBGC. Two semi-structured interviews were conducted with colleague, Ph.D. Milla Laisi, and four by the author alone (three of them with the duration of 1.5–2 hours each and one via e-mail respond for the questionnaire). The actor groups included representatives of the St. Petersburg, Leningrad region administration, such as heads of departments within Committees on Transport Infrastructure Development, on Public Utilities and Transport of Leningrad region, Directorate for Development of Transport System of St. Petersburg and Leningrad region, including their decision makers, organisations, representing transport customers, freight forwarders, carriers, transport, architecture, and civil engineering institutes. During the interviews, the additional information was gained that provided inspiration for further research and helped in understanding the context of dry port development, e.g. the urban and outskirt transport system construction, projects, and investments decision-making. The author received a description of the public sector’s role in the St. Petersburg and Leningrad region transport development, including dry ports. Planning documents about the cities’ transport systems construction were reviewed to complement the interviews. Based on the collected data by all working group, the report, covering public transport related issues, has been published (Laisi et al., 2013).

On the third level of the research, the dry port phenomenon was put under the domain of economic sciences, allowing to find the answer to the Sub-Research Question 3 (S-RQ3: What project selection criteria and methods are used to specify public and private concerns about the contextual environment of the dry ports implementation?). Additionally, the technologies of computer sciences have been applied to the process of dry ports projects facilitation, providing a subsequent mediation object from knowledge in Paper 4 and Paper 5. As a result, the methods and models moved away more, abstracting from the object matter and contributing to the final steps towards the search of an answer to the main research question of the facilitation of the dry ports construction in Russia.

Paper 4 was based on the same research project as Paper 3, while the study addressed the third sub-research question, and was designed in regard to Finnish Transport Agency, which the author with the supervisor, Professor Olli-Pekka Hilmola, and co-author, Doctoral student Milla Laisi, visited in 2012. The author also participated in the collecting data via semi-structured interviews with Ph.D. student Milla Laisi. The interviews were held in Stockholm with the representatives from German and Swedish railway markets. These interviews encouraged the author to learn more
about Russian Railways from the angle of the experience, which has already been
gained by the European Railways. Therefore, it helped understanding better the
liberalisation processes that took place in the homeland and resulted in the creation of
new business, such as leasing of rolling stock and maintenance of the locomotives
and wagons. Despite the fact, that the paper concerned deregulation of the Russian
Railway freight market, the colleague, as an expert in global deregulation processes,
was capable of the main topic. That is the market entry barriers into the Russian
railway market, and its national peculiarities (e.g., acquiring the rolling stock, needed
investments, and bureaucracy). The conclusions from this study can be fully
applicable for the start-ups of the anticipated private activities, i.e. in the sphere of
terminal and warehousing undertakings, such as dry ports.

In order to complement the answer to the third sub-research question, Paper 5
analyses further the findings from previous papers about the potentially interested
actors in dry ports development (e.g., railways, seaports, and maritime terminals), as
well as problems of financing and risky investments. The goal of the paper was to
tackle the challenges in the dry ports implementation that lead to the existing
problems of seaports and railways cooperation within the international supply chains.
The analytical model, which was based on the interviews in the Russian Railway
sector and literature/documents review, tested the propositions on benefits of dry port
development via public-private partnership mechanism. This study also looked into
the effect of risks that are considered as impediments for long-term and capital-
intensive dry port investments. Paper 5, like Paper 1 and Paper 3, before the
publication, was preliminary discussed at the Admiral Makarov State University of
Maritime and Inland Shipping (St. Petersburg) during the XIII International Scientific
and Practical Conference called ‘Logistics: modern trends’. Then, the manuscript was
developed additionally in cooperation with the Lappeenranta University of
Technology, Kouvola Unit, and included in the international journal.

Despite the fact that each of the five papers contributed to the main research question,
it was thoroughly answered with the help of covering paper (Chapter 6), in which the
sophisticated model for the research problem was presented, providing new scientific
results.

4.4 Research Quality

Since the goal of the study was the facilitation of dry port development, it was
important to show that the application of the provided methods and models in future
within the same conditions, which include specifics of Russian logistics markets and
risks, can provide the similar positive results and effects. In other words, there was a
need for proving the cause and effect relations between the control actions and
scientific results based on the proposed methods and models. In turn, the probability
of the research and its application in practice depends on the precision of the results.
From this point of view, the research is characterized by two positions: reliability
(internal validity) and generalizability (external validity or applicability), influencing
the precision of the scientific results (Plavinsky, 2012).

To increase the quality of the research (e.g., the positive effect of the theoretical and practical implications) and, therefore, to improve the conclusiveness of the study, the aspects, confronting its provability have been considered. First and foremost, the factors that influence the cause and effect relations in the approaches to the development of dry ports have been identified. These factors can stem apparently from the influence of systematic (bias) and random errors.

Random error occurs because of a deviation of a single observation or measurement from its true value, which is caused by an accident. Random variations occur at any stage of the investigation and, thus, can relate to the variability and random measurement errors. Systematic error, as a rule, is the result of errors in the design and analysis of survey data, and usually, cannot be evaluated by statistical means. On the contrary, statistical significance, confidence interval, the measurement error in absolute and relative values refers only to random factors of negative influence.

Unlike the systematic errors, random errors cannot be corrected, but can be minimized. It is achieved by proper planning studies, repeating the measurement several times and, in addition, by estimating the probability of random error using statistical methods (Klimova, 2013). By doing so, the influence from negative factors is minimized, contributing to the category of reliability.

Reliability (internal validity) of the results of research is determined by how the structure of the study corresponds to the tasks and the findings are valid in respect of the study sample (Fletcher et al., 1998). On this basis, a reliable study is a research, in which the possibility of systematic and random errors is minimized. So as to minimize the influences from both factors the following considerations have been addressed.

The design of the study has been developed in the regards to the tasks of the research related to the assessment of dry ports projects with the allowance for the risks. In particular, the research was designed similar to the structure of the clinics research devoted to the measure of cause-effects relations between the risks factors and mediators (medical treatments). Meanwhile, in the current study, the mediators became the methods and models for designing risk mitigation strategies and efficient portfolios for dry ports implementation. Due to the absence of the possibility to deliberately expose dry ports to a potentially harmful situations, the use of cohort study or case control study was substituted by mathematical and simulation modelling, remaining the principles the same.

For example, the positive aspect of cohort studies is the reduced likelihood of bias, thanks to the absence of the disease at the baseline. Additionally, the possibility of the direct estimate of the incidence, relative risk (e.g., an indicator relationship between exposure and disease) is also considered as positive. That is why this approach was borrowed to identify and evaluate the trade-off between risk and expected return and to choose the course of an action that helped to maximize its value. Similarly, the structure of the developed experiments with the designed model was created on the
ground of two phases. That is the experiments with the model without risks factors and with the model, which included different factors of risks. Doing so allowed the influences of the biased factors to be reduced, because in one model the control actions are made, while in the other are not, giving the obvious reason for differences, which are in controlling influences rather than random factors.

In addition, the risks have been analysed on the ground of different models (analytical and computer simulation), providing the repeating of the measurement several times. The results from the deterministic and stochastic models did not contradict each other. For example, the elasticity of the NPV and DPP were higher for the risks of container’s traffic volume decrease and the timeliness period of commissioning. Meantime, the risks of stable prices for the land and the risk of reduced sales prices have lower impact in both models (deterministic and stochastic models).

However, the results from the simulation modelling have been less influenced by the random error. The data for the model was analysed based on the regression analysis \((R^2\) and p-value), showing a high reliability. Additionally, the magnitude of the random error for a given number of iterations \((N)\) has been taken into consideration (Esipova, 2011; Kazaku and Narkevskaya, 2013):

\[
e_{p} = \frac{1}{\sqrt{N}} \cdot m_{\epsilon}.
\]

The number of iterations ensured the required accuracy of calculations. There was no reason to doubt the accuracy with the proposed 10 000 iterations by the below formula:

\[
N = \left(\frac{m_{\epsilon}}{d}\right)^2.
\]

However, the model did not take into account the effect of confounding factors. Effect of confounding factors leads to a bias or so-called confounding bias. Systematic error due to the influence of confounding factors is evident, when the studied factors are interrelated, and some of them distort the effects of others (Klimova, 2013). It may be due to bias in the selection, under the influence of accident or because of a real interaction of factors that should be considered during the analyses of the results of the study. In the current research, an example would be accusing of bias in the assessment of the some risks of dry ports development in Russia. Specifically, it is generally accepted that, in Russia, the inflation is higher than in the developed countries that increase the level of risks. However, the risks could not be directly related to the inflation, but allegedly could be connected with the confounding bias of neo-colonialism, inducing side effects.

Moving forward, the reduction of such types of systematic errors can contribute to the second category of the research quality, i.e. generalizability. Generalizability (external validity), is the extent, to which the results of the study are applicable to other conditions (Fletcher et al., 1998), e.g. of dry ports development, or even other
transport infrastructure. Since there is an idea of the general characteristics of risks measurement and mitigation risks strategies for dry ports development, the potential of treating risks similar for other transport projects in Russia is considered as possible, but requires further detailed research. At the same time, the used nonprobability sampling method of expert estimations provides a limited external validity (e.g., the application of the proposed methods and models for the terminal and warehousing infrastructure implementation in Russia). However, overall, the empirical data, concerning the impact of risks were in coherence with the scientific results, received from the simulation modelling.

In conclusion, it is worth to add that the reliability of research findings, with a high degree of their accuracy and objectivity of assessments of risks, have been complemented by a number of the following factors:

- Application of modern methods of collecting and processing the initial information (Statistica program, MS Excel, and Vensim);
- Using an extensive array of state and municipal statistics or direct observations;
- Statistical information on the dynamics of the investigated companies for several years;
- The direct participation of the applicant in obtaining the original data and scientific experiments;
- Accuracy of the measurement parameters (NPV, DPP, and elasticity coefficients).

In turn, all of the factors mentioned above did provide the justification, implying conclusiveness or persuasiveness of the conclusions and recommendations of dissertation, which were underpinned by several aspects:

- Correct application of proven scientific research and analytical apparatus (especially, system dynamics programming that was applied for the nature of the challenging task, e.g. planning of economic activity on a time interval, consisting of several years).
- Comparison of the results of the study with the data of foreign and domestic experience;
- Confirmation of the results with the peer review experts;
- Evidence-based analytical findings as the basis of the proposed recommendations;
- Discussion of the results of research on the Russian and international scientific conferences;
- Publication of the research findings in peer-reviewed international scientific journals.

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5 SUMMARY OF THE PUBLICATIONS

5.1 Potential of Connecting Eurasia through Trans-Siberian Railway

The purpose of this paper is to provide reasoning for dry ports’ development within the system of Russian Railways from the macro-level point of view. Based on the Eurasian container traffic flows, the future trends of transit transportation of containers via Trans-Siberian Railway have been evaluated. It was found that the elimination of ‘bottlenecks’ depends on the construction of the terminal and warehousing infrastructure with the higher standards at the hinterland of the Far Eastern seaports.

5.1.1 Literature Review

The Russian rail freight transport plays a major role in the inland transportation of cargo, passing through the seaports. However, the current technology of cooperation between seaports and railways is considered to be insufficient. In particular, the additional changes are required to attract transit container flows from/to Asia. In the Asian part of Russia, potential for transhipping to the Trains-Siberian Railway has mainly cargo, entering through Far Eastern seaports (e.g., Vostochny, Vladivostok, Nakhodka, and Zarubino).

The discouraged transit cargo from the Trans-Sib is redirected from Far Eastern Railway (part of TSR) to the Suifenhe Transportation Corridor. This route starts in ports of Primorsky krai and links only to the middle part of Trans-Sib through the railway station Zabaikalsk. A large share of the Eurasian flows is forwarded by sea route via Suez Canal, despite the fact that it is a relatively longer route. Lead-time by the Russian railway system equals eight to ten days, whereas by the sea through the Suez Canal is 35–40 days. At the same time, the detected factors, such as infrastructure shortcomings, public policy, work technique, etc. showed that the choice of the route through Russia imposes freight forwarder to operate with average figures. On the contrary, the sea transport guarantees an exact time of delivering.

To apply the logistics approach for ensuring more predictable and reliable services and, in turn, favourable conditions for forwarders, it is required to provide a better hinterland infrastructure. Of course, it cannot be regarded as a panacea to cure for all disruptions. However, the inland rail infrastructure can be a base for the implementation of new technologies of cooperation. Nowadays, non-coordinated work between sea and railway transport (typically during severe wintertime) results in so-called ‘abandoned’ trains or ‘traffic jam’ at railways. The construction of the dry port can provide a smooth transport flow with one interface in the form of this project instead of two, one at the seaport and the other one at the inland destination. Therefore, the maritime and land supply chains will have an increased level of functional integration. By the elimination of many intermediate steps in the transport chains and enabling one-stop-shop for many shippers, a single contact point on a
regional or even global level will be provided.

5.1.2 Empirical Study

The article utilises qualitative holistic single case study analysis. This research method was chosen, because of the need in the understanding of the object of study and the decision making on dry ports’ construction. However, the case could not be considered without the context, the railway system and seaports. That is why Far Eastern Railway as a part of TSR connected to the Far Eastern ports was the research environment of the phenomenon. In these circumstances, the dry ports benefits were developed and utilised.

The projected dry ports could be located near the railway stations: Nadezgdinskaya, Hmylovsky, and Makhalino. These rail freight terminals will extend the gates of the seaport inland. Shippers will view centres as an interface to shipping lines. The study of the conception of the investment project of Yuzhny Primorsky terminal has shown that dry port near Nadezgdinskaya railway station can be considered as an interface for Vladivostok sea port. Similarly, near the Hmylovsky railway station, the inland terminal could be an interface for Vostochny and Nakhodka seaports, and near Makhalino railway station, the freight terminal for Zarubino port can be built.

Despite the railway and sea transport context implied in the necessity for dry ports’ development, the boundaries of the case were placed on the inland access to the seaports. With an increase in the volumes of maritime container traffic to/from Far Eastern ports, their inland access is critically strained because road arteries are already reaching their capacity. The alternative feeder trains could be organised so as to reduce the congestion issues associated with freight transported by road. These trains provide the collecting and distribution of containers between seaports and dry ports based on the logistics principles.

The construction of the infrastructure projects as mentioned earlier besides the railway stations and in accordance with the dry port concept can create a condition for applying ‘pull’ system. This logistics principle implies the planning of goods delivery with a start from the consignee. In the process, later operations draw the right quantity of railway cars to the very customer at the required time. When a ship is approaching, the system automatically sends a message to rail system requesting a delivery of the consignment. This batch is accumulated in advance at the facilities of the dry port, called in the article as the transport distributing centres with higher standards. Centres will play a role of a consignee on Russian territory. It means that the unshipped in bond cargo will be removed to this centre by the railway, and the remaining value-added services be provided there.

It is suggested that the implementation of dry ports will allow to increase the competitiveness of the land supply chains with the use of Trans-Siberian Railway compared to transport systems of Japan, China, and Korea. In conclusion, the Russian Railways has significant growth potential, which, in turn, requires serious investment promotion.
5.1.3 Conclusions and Contributions

The study provided insights into the development of the Russian transport system for increasing the level of the service of the clients, transiting containerized cargo through the territory of Russia. Potentially, the ‘bridge’ over Russian land can be considered as a permanent alternative to the sea route via Suez Canal. Despite the crucial role of the railways in the country of long distances, the development of the central backbone of the Russian railway logistics (Trans-Siberian Railway) connected with the sea gateways is insufficient. Specifically, in the Far East region, between the transport systems of neighbouring countries and Primorsky krai there is a gap.

To improve the situation with inadequate seaports and railways’ cooperation for processing smooth traffic flows, the article provides insights on the technologies’ update. Once the necessary inland logistics infrastructure is in place, the principles of dry ports concept and logistics approaches can be applied, i.e. ‘pulling’ system for just in time operation in a transport chain. This technology eliminates at least three days in transit time through the Trans-Siberian Railway, Vostochny seaport, as an example. For additional reduction of transit time, it was suggested to consider the container as an equipment rather than cargo. This action will shorten the time by three to four days. The reduction of the lead time will have a multiplicative positive effect. The possibility of the appearance of the ‘abandoned’ trains can be mitigated. Also, the container and flat wagons turnover will be decreased, resulting in the lessened number of the required fleet, since each unit will be released for further reuse in the operations quicker. Therefore, the total logistics costs will lead to lower prices for clients. In this aspect, the crucial role is of the Russian government concern. Acceptance of the container as an equipment should be supported by issue a proclamation about joining to Convention concerning International Carriage by Rail (COTIF).

5.2 Dynamics of Russian Dry Ports

The second paper continues the arguments of the first document, precisely, the justification of dry ports’ construction. However, the topic is considered at the micro-level. In the previous article (Paper 1), the timeless of their development was regarded to both land and maritime supply chains used in Eurasian landbridge. Instead, this paper looks at the subsystems of Eurasian supply chains. Dry ports’ alternative was addressed to the increase of the seaports’ capacity alone (local level), rather than the supply chains’ productivity, as a whole.

5.2.1 Literature Review

The growth of container traffic at the average annual rate of 21% determines the development of the transport infrastructure that should be orientated on the import flows. The reason behind this is the fact that the containerised trade made up 43.5% of imports and only 5.3% of exports respectively in terms of volume. The imbalance
of containerised trade stems from the specifics of Russian export cargo, which are raw materials, moved in bulk transport, such as oil, ore, metal and other raw materials. At the same time, the importance of containerised trade in imports has been increasing since 2005 (44%) and reached almost 49%, in 2010.

The growing demand for container traffic should primarily be satisfied by the seaports of St. Petersburg, Novorossiysk, and Vladivostok, through which around 60% of Russian container traffic passes. Despite the fact that ports experience similar problems with handling containers, the issues evolve under different local conditions. For example, the seaport of St. Petersburg operates in a region with four customs areas that complicates the smooth implementation of dry ports, as well as adds particular aspects to the concept in the Russian business environment.

In order to simplify customs’ procedures, it is required that seaport and inland terminals have to be under the jurisdiction of one customs station or customs. Meanwhile, the port of St. Petersburg is under the competence of the Baltic Customs. At the same time, most of the inland freight terminals are under St. Petersburg Customs. That is why only the Logistika-Terminal and Logistic Park Yanino are the inland terminals (among group of 10 inland terminals in Russia), which can be named as dry ports. It means that the required principles of the concept are met, and inland terminals are included in the jurisdiction of Baltic Customs (seaport customs).

The peculiarities of the dry ports’ development in St. Petersburg were compared to the progress of inland terminals’ implementation in the area of Vladivostok and Novorossiysk seaports. According to the collected data, the custom’s procedures in the given regions do not impose additional regulations (Russian Act No. 510) like in St. Petersburg area. However, the construction of the dry ports in other than North-West region is less widespread, despite the absence of obstacles related to customs’ operations. The aggregation of dry ports in the vicinity of St. Petersburg can be explained by its vital importance in the international trade. Yearly, around 50% of all maritime cargo in containers is processed within its facilities. However, the capacity of the seaport is blocked by the city infrastructure and cannot be expanded at the site so as to cope with the growing container traffic.

5.2.2 Empirical Study

In this paper, the port of St. Petersburg was used as a case study. Among other researched seaports (Novorossiysk and Vladivostok), St. Petersburg is the largest Russian container harbour that is restricted in its infrastructure development, which is necessary for coping with the highest predicted increase in a container throughput. Its proximity to the city of St. Petersburg presents a relevant case in order to determine the effect of the dry port implementation.

Meanwhile, the boundaries of the research of dry ports benefits were reduced to one of the St. Petersburg maritime terminals that provide almost 50% of the seaport throughput. It is the biggest Russian marine container terminal called as the First Container Terminal. The terminal is ‘locked’ in a semi-ring of apartment blocks that
allow no further expansion of the harbour.

The quantitative study of the alternatives to increase the seaport capacity is referred to three options:

1) Expansion at the site by the release of the territory occupied by office buildings, a service centre, and non-functional warehouses.

2) Increasing the height of the stacking yards.

3) Implementation of an inland terminal.

The presented equations clearly explicate the differences in capacity growth as well as the relations between variables. The chief role in the throughput enhancement is indebted to the retention cycle as the denominator in the formulas of handling capacities, measured in container/day. In the first two options (e.g., expansion of the storage capacity at the seaport by demolishing the unused facilities or by increasing the height of the stacking yards), the retention cycle is a stable variable. It is determined by the average rotation period of peaking and delivering of containers to the maritime terminal, i.e. seven and eight days, respectively. This time can be hardly reduced, if the technology of the container handling, and the customs clearance, is not facilitated.

By contrast, in the third option, the retention cycle is sharply shortened due to the reduction of the time required for customs clearance. The existence of the dry port enables unshipped, in bond containers, to be removed from the maritime terminal to the inland territories once the transhipment operations are provided. The remaining activities, including the customs clearance, are to be made at the dry port. That is why, by reducing of the denominator in a formula, the handling capacity of maritime terminal significantly increases, which, subsequently, and substantially improve the efficiency of St. Petersburg seaport.

5.2.3 Conclusions and Contribution

The contribution of this article lies in the analysis of the Russian container market and the thorough research on subsystems of the supply chains – the domestic dry ports, their classification, and dynamics of the development. Despite the fact that the topic has been studied by many scientists overseas, the article gains an insight into the dry ports’ concept application for the Russian environment. The existing peculiarities of customs organization in St. Petersburg area negatively influence the idea of the dry port implementation. The nature of the customs’ policy results in the construction of the inland terminals with the clearance depots that does not fully comply with the dry port concept. For the smooth operation of a seaport and a dry port, both (harbour and inland terminal) have to be under the jurisdiction of one custom (port customs).

Additionally, the paper provides the study of the dry ports’ effect on the seaport handling capacity in comparison to other alternatives (e.g., expansion at the site and stacking containers highly). It was found out that the seaport’s capacity will be
increased by 2.5 times, if a dry port is created. Meantime, the construction of the inland terminal with the clearance depots cannot guarantee such an increase of the seaports’ capacity. The reason is the complicated customs’ procedures that contribute to the long retention cycle of containers. The customs clearance cannot be simplified unless the seaport and inland terminals fall under one custom, instead of separate ones, i.e. Baltic and St. Petersburg customs.

Overall, the application of entire dry port concept provides the highest seaport capacity enlargement compared to 1.5 times with the seaport’s physical expansion. An option of extra levels in container storage brings less efficiency at the seaport than the alternatives mentioned earlier. It should be noted that all options have been evaluated from the technical point of view, regardless the economic appraisals that are a drawback of this paper. However, undoubtedly the best alternative, dry port construction implies the largest lump sum of investments.

5.3 Perspective Reserves of Russian Seaport Container Terminals

This paper continues to explore the subsystems of the Eurasian supply chains. Notably, the attention is drawn to the Russian maritime container terminals (e.g., their role, classification, technical characteristics, handling, and lifting equipment dependent on the functional zones of terminal territory, etc.). A similar analysis was made in the previous article, when the dry port phenomenon was under the focus of the logistics domain. This article also examines the dry ports development more specifically rather than from the macro level of SCM, since the aim of the paper is to design the factors of their utilization by maritime interested parties. The potential of seaport container terminals is unleashed, if the dry ports are implemented.

5.3.1 Literature Review

In the Eurasian market, the seaport container terminals play the role of the interface between maritime and land supply chains. The productivity of the containers terminals at the seaport influences the lead time, which is essential for consignees of the value-added cargo transiting via seaports’ gateways. Thus, the additional productivity of the terminal makes the lead-time shorter. However, the capacity of the large Russian container seaports is constrained by the several factors. First and foremost, most of them cannot be extended at the site due to the lack of free spaces within seaport container terminals.

In the world practice, this problem is solved by the use of the dry port concept. For example, in 2010, the shuttle system of Port of Gothenburg in Sweden included 26 dedicated services to 23 dry ports. In Russia, the tendency to build dry ports (i.e. inland freight terminals) for releasing coastal lands has been started spreading since the nineties. To understand better the motives for their development that advocate for the potential of the container terminal at the seaport, the current research has been undertaken.
5.3.2 Empirical Study

The research on factors, initiating the seaport terminals to utilise dry ports, was started from the analysis of the regions, where dry ports have been evolving. An examination of the regions was performed on the data provided by the Russian analytic agency that contacted with 1,535 manufacturing companies. The data collected from the companies helped to reveal the most developed regions of Russia (Central, Volga, and Ural Federal Districts). These regions are ‘landlocked’ from the sea. Therein lies the reason to import cargo, primarily containerised, to these regions through the North-West, Caucasian, and Far East Federal Districts, where the largest container seaports are located.

Based on the fact that North-West region serves the primary role in handling international container flows, in the study, the principal seaport of this region has been scrutinized. That is to say, in 2012, Russian seaports handled around 5.1 million TEUs. About 49.8% of this volume was processed in the seaport of St. Petersburg, where the largest container terminals are located. Examples would be First Container Terminal, 1 159 000 TEU and Petrolesport, 541 120 TEU. That is why the container terminal of the St. Petersburg seaport was simulated.

In order to create the model, the discrete-event simulation approach was utilized. As this method works on the low level of abstraction, it was required to collect the data, regarding individual entities. For that reason, two visits to the seaport of St. Petersburg have been made during the study. After the discussions with the personnel and overlook of the premises of the seaport terminal on the special bus, the collected data was sufficient to design the model. The organization of the processing of the containers has been clearly understood and represented, in the template of the maritime terminal, to animate its technology. In particular, the sea container terminal of the seaport was divided into three functional areas:

− Ship-to-shore zone, in which the transfer of containers between the vessel and the dock at the port is made.

− Storage area, where export and import containers are stacked, and loading/unloading of trucks is performed.

− Hinterland zone, which competence covers customs clearance and loading/unloading of wagons.

The information about the handling equipment was utilized to make the algorithmic analysis of the discrete-event operations as the sequence that being performed over entities, such as overloading, movement of the container, and stacking. The performance parameters of the handling equipment determined its deployment to the specific functional zone of the designed terminal. The considered equipment included reach stackers, rubber-tired gantry (RTG) cranes, rail-mounted gantry (RMG) cranes, and ship-to-shore cranes (STS).

The valuable information about the entities (containers) processing, provided by the
personnel, was implemented in the model. The data concerned the differences in the serving of various categories of containers (export, import, and empty). The peculiarities affected the height of stacks in the container yards.

Because ships arrive in predictable time intervals to the seaport, export containers are stored in five or six high stacks. There is no risk that the container located at the bottom of the stack will be needed to be picked up before the top container (e.g., pick up sequence problem). Access to imported containers should be more or less arbitrary, because containers are collected from the port by clients in unpredictable times. Therefore, the maximum height of import containers’ stacks was adopted as four levels in height in order to avoid unnecessary shifting.

The immense territory of the maritime terminal that was partly observed from the bus during the research visit, inevitably strengthen the importance of the internal trucks that was also included in the model. Similarly to the handling and lifting equipment, the trucks were designed with the resources that were seized and released by the entities. In the real world of the terminal work, the internal trucks are occupied by the containers, when the ship (train) is loaded (unloaded). In this case, the performance of the movements of containers between processing areas is provided.

To analyse the productivity and, therefore, the lead time for the created terminal in dynamics (as the real system works), the time for the discrete events has been allocated. For instance, the performance of handling equipment and time for cargo processing was characterized by a triangular distribution. Time of trucks’ arrival at the terminal was set as exponentially distributed. Meanwhile, the arrival time of trains and ships was uniformly distributed.

5.3.3 Conclusion and Contribution

The article presents an argument of the dry port construction that lies in the interests of the parties of maritime supply chains. The designed groups of the factors of dry port development (e.g. technical, economic, operational, and ecological) support the idea of their importance for the sustainable seaport terminals’ functioning. The article also showed that the leading force for using dry ports in the maritime container transport chain is the technical factors, followed by economic, operational, and ecological impacts. That is to say, the inability of extensive development of the seaport at the site in the circumstance of rising container flows. To make this assumption feasible, the computer simulation was conducted.

The outcome of simulations under varying parameters (five conducted experiments) reordered the maximum increase in the marine terminal’s capacity (about 31%) with a dry port included in a container transports chain. Along with the productivity increase, the average lead time for the import containers also became more efficient. Compared to the initial system, the mean duration for each import container was reduced by 8% in the new dry port system. Such an increase is essential for the shipping companies that consider the efficiency of the operations at the maritime terminals of the seaports as vital criteria in choosing the target of their destination to
call on.

5.4 Deregulation of the Russian Railway Freight Market – Learning From Empirical Results

Paper 4 discusses the rail freight environment that imposes the new principles to be included in the concept of dry port development in Russia. With the liberalization of the Russian Railways, the justification of the investments in the development of dry ports became a more acquit problem. The reason is determined by the newly created company JSC ‘RZD’ that considers the construction of terminals’ and warehouses’ infrastructure as not the priority of investment policy.

At the same time, the reduced government control of the railway sector provides better conditions for the creation of new business within the rail freight market, especially for the newly created railway operators. So far, the activities related to the leasing of rolling stock and maintenance of the locomotives, and wagons have been developed. The progress in this area can create the favourable conditions for the start-ups of the other new businesses, including terminal and warehousing.

5.4.1 Literature Review

Transport is the vital industry for Russia, especially important is the role of the railway market that has confronted significant structural changes during the last decade. In 2001, the Ministry of Railways launched comprehensive three-stage Railway Structural Reform Programme. At the end of 2003, the resolution on a separation of regulatory and economic functions of the Ministry of Railways was adopted by the Decree of the President of the Russian Federation. Thus, the public company of ‘Russian Railways’ was founded.

At the beginning of 21st century, JSC ‘RZD’ was quite frequently accused of monopolistic practices, but gradually it has lost the role of monopolist and monopsonist on the railway market. Currently, the number of owners of rolling stock is close to 2,000 along with 158 subsidiary companies of ‘RZD’. The impetus for the liberalisation of the Russian railway market was the division of a single tariff fare into two components: fare for wagons (15%) and fare for the infrastructure (85%). Consequently, private companies became able to lease wagons on the market terms. The separation of infrastructure from operations stimulated the development of competition on the market.

However, in the field of railway infrastructure, the state ownership so far dominates. In contrast to the infrastructure sector, the segment of rolling stock is entirely liberalised. The wagon fleet is focused on the balance of established private companies. Due to investments in the acquisition of new rolling stock, the number of freight wagons increased from less than 4,000 wagons purchased in 2000 to 89,000 in 2011. Consequently, the total wagon number reached over a million in 2012. Alike in European Union, internationalisation is also noted in Russia. For example, Finnish
national railway operator VR and Russian Freight One Company established a company called ‘Freight One Scandinavia’, which has the primary intention to replenish Finnish-Russian railway freight supply and offer more versatile transport prospects.

Furthermore, recently Russian operators have signed agreements with foreign companies to start international cooperation. For example, in 2010 the German operator DB Schenker BTT and Russian TransContainer signed a number of agreements so as to develop cooperation in the organisation of container transportation between Europe and Russia. The parties agreed to set up a container depot in Riga, Latvia. The primary objective was to improve the efficiency of container freight traffic from Europe to Russia and vice versa.

The key reason for several joint agreements with international operators is the future’s changes in the Russian railway market. Nowadays, ‘RZD’ owns only a small volume of wagons, because the main numbers of wagons were transferred to the possession of new railway operators. These railway operators, however, in many instances do not own the locomotives or infrastructure. With the deregulation of the market, railway operators can capitalise on the development of the new business, related to the warehousing and terminal operation.

In order to improve the market conditions further, the developments are continuing. Russian Railways has launched the fourth phase reformation period until 2015 to progress the competition among private companies in the market. According to Khusainov (2014), some provisions of the reform programme have not been met so far. As part of the creation of the Common Economic Space of Russia, Belarus and Kazakhstan, it was agreed to have opened reciprocal access of rail carriers to national infrastructure. In July 2011, Russian President Mr. Medvedev signed a federal law ratifying the agreement (No. 173-FZ of 11.07.2011). Since January 2015, the Agreement on the rules of access to railway infrastructure in the framework of the Common Economic Space had come into force. In the foreseeable future, there is a possibility that the network of Railways will be opened to other international carriers. These plans undoubtedly have the considerable economic potential. The further heightening of competition can improve the quality of the transport service and the efficiency of the overall market.

5.4.2 Empirical Study

The study is based on the qualitative research method and semi-structured interviews. The interviews were provided by 15 experts from 11 organizations. All interviews were completed in spring 2011 by a colleague, whereas the author provided the extensive literature analysis of the Russian publications. The research has shown that the establishment of the new businesses within the national railway freight market confronted acquisition of the rolling stock, bureaucracy, and the investments. The closed nature of the Russian market has revealed that to enter the market without the help from Russians is difficult.
Nowadays, around 2 000 companies are operating in the Railway market. The actors are mostly small and medium-size companies. The sharp competition exists only between the larger railway undertakings. Despite the rivalry in the market, the cooperation between actors is perceived to be close. A similar point of view was related to the JSC ‘RZD’. However, some interviewees mentioned that the cooperation inside the company is less significant. Additionally, due to the country location, sea freight transport was noted as the only transport mode that competes with the railway. That is why Russia has multiple opportunities for the railway undertakings, especially in the sphere that is not the priority of the parent company JSC ‘RZD’. The numerous companies have underlined the existence of the different opportunities for new business.

5.4.3 Conclusions and Contribution

The analysis has shown that the market is already free for the leasing of wagons and maintenance services. If the further deregulation of the market provided, then the conditions for the creation of the new businesses are more feasible. The trends may result in the liberalization of the traction and infrastructure management. What is more important is that the deregulation of the market may bring the liberalization of the tariffs.

Therefore, the favourable circumstance for the attraction of the investments in the warehousing and freight infrastructure (dry ports) will be guaranteed. With the free pricing of infrastructure services, the private capital will be easy to attract in the market. The reason lies in the potential growth of the interests of the investors (first and foremost, from newly created railway operators), since there are chances to manage income from the operation of the infrastructure coupled with the earnings from the previously established business, operation of wagon fleet. Thus, the private companies might be active in the investments in the infrastructure, similarly as they have already been previously in the fully liberalized rolling stock market. Decentralisation of economic decision-making resulted in rapid growth of rolling stock fleet and increase in traffic volumes. At the same time, with the implementation of the free cooperation of the actors on the market and the involvement of the market itself, the competitiveness inevitably increases the uncertainties and risks that have to be taken into account.

It should be noted that the findings from this paper also appeared at the dissertation of the co-author, Ph.D. Milla Laisi. However, the contributions and conclusions made by each author found different applications in the context of both dissertations. For example, the first author stressed the entry barriers for new undertakings on the market, while the second author by providing the thorough literature review revealed the prospect and trends in the Russian Railway sphere that create preconditions for the establishment of terminal and warehousing business. Therefore, the dynamic rail market has been considered from the opposite dimensions in the doctoral research. That is entry barriers and factors that the market contains for the interested investors.
5.5 Justification and Evaluation of Dry Port Investments in Russia

This paper evaluates the benefits of dry ports’ investments in Russia, based on the potential interests of the actors from railways and seaport authorities. As it was mentioned before in the previous articles, the win-win situation is anticipated since the positive effects are derived from technical, technological, and environmental aspects in both sectors (land and maritime supply chains). In order to mitigate the economic burden and risks associated with the development of new business at the liberated transport markets, the public-private partnership scheme was proposed. The potential subsystems cooperation’s (seaports, railways, and containers’ terminals) include two alternative plans (with or without the participation of JSC ‘RZD’ in the investment).

5.5.1 Literature Review

Despite the liberalized market of the Russian Railways, investments in the rail industry are not significantly attractive for the national and foreign private investments. Moreover, the deficit of the financial funds within the JSC ‘Russian Railways’ reduces the pace of the infrastructure developments.

JSC ‘RZD’ is reluctant to invest in the dry ports, despite the obvious benefits expected from these projects. First and foremost, the option of the enlarging of the share in a seaport’s container flows handling is feasible. Nowadays, in import flows of seaports, the road component predominates (63.6%), while the volume of cargo transported by rail does not exceed 21.6%.

The proportion of the road in the transportation of incoming dry cargo of seaports tends to increase. Since 2009 until 2013, its volume grew by 70%. On the contrary, the proportion of the rail share has grown by only 16%. Thus, the current situation in the transport market demonstrates the potential interest of railways to increase their presence in servicing the Russian container seaports. The benefits of the seaports and their maritime container terminals from the utilization of the dry ports at the supply chain are clearly presented in the previous papers (2 and 3).

Depending on the interested parties in the dry port construction, there are two concepts of their development, such as ‘inside-out’ and ‘outside-in’, which are popular among different countries. In Russia, the ‘Land-out & Sea-in’ model can be applied. It can be fitted to the national market in comply with an expected cooperation of the interest of seaport actors willing to expand in the hinterland, and representatives of inland side to move outside.

The difficulties associated with dry ports implementation (lack of funding) can be softened by the public-private partnerships. The analysis of case studies revealed that this scheme was effective in mitigating negative peculiarities of the capital intensive projects, e.g., the construction of railways and inland terminals. Meanwhile, PPP projects have yet to expand within the Russian Railways, which makes the research on the principle of their implementation within Railway sphere useful.
5.5.2 Empirical Study

The empirical part of the study was done by interviewing public actors from the Railway industry. The case company became JSC ‘RZD’. The cause for this choice is based on the estimation of the investments through the PPP schemes with or without the participation of the JSC ‘Russian Railways’ in the financing. Key persons related to the development of the terminal and warehousing infrastructure were interviewed during two meetings held in St. Petersburg, Russia. Through the prepared list of predetermined questions, the interviews were unfolded in a conversational manner (each for two hours), offering participants to stress the main issues, according to their opinions.

In particular, the interviewees stressed that the railway sphere has the absence of the adequate regulatory base, which hinders the utilization of PPP mechanism. Currently, legislative regulation of PPPs in the sector is ensured by the federal law ‘On Concession Agreements’ that was adopted in 2005. Meanwhile, this Law facilitates the utilization of life cycle contracts in the form of concession agreements preferably in the road sector. Instead, in the railway sector, the ‘On Concession Agreements’ does not allow to expropriate rail infrastructure (to deprive an owner of property, especially by taking it for public use). As a result, private investors are forced to invest in state ownership. By contrast, the principle of alienation, i.e. ‘where a terminal can be transferred to another owner if their services stop, and someone else has services to that site’ is well worked out in other European countries. An example would be the UK, where this power has the rail operator, like DB Schenker, which operates the majority of leased terminals sites (Bergqvist and Monios, 2014).

Both interviewees mentioned about the two privately owned dry ports of St. Petersburg seaport. The first one is Logistic Park Yanino, which is connected to the Pertolesport marine terminal. The second is Logistika-Terminal that is linked with the First Container Terminal. Additionally, one of the interviewees underlined that JSC ‘RZD’ also involved in the development of the terminal and warehousing infrastructure in support of Ust-Luga seaport. The seaport of Ust-Luga is reportedly considered as a national project (located at the vicinity of St. Petersburg). That is why the development of rail approaches to the seaport is extensively backed by ‘Russian Railways’ regardless the high cost of the land adjacent to the seaport.

Specifically, JSC ‘RZD’ is invested in the development of the terminal logistics centre (TLC) called Hovrino, which can be attributed to the term of the dry port. It is an important investment project, which exemplifies the successful development of infrastructure through the public-private partnership, involving JSC ‘Russian Railways’. Other three TLCs are supposed to be opened in 2016. That is Lublino (70 ha) in the south-east of the capital. The next is Kuntsevo II (20 ha) in the west of the city. The last is Severyanin (25 ha) in north-east of Moscow. The construction of TLC Kuntsevo II is expected to be provided by JSC ‘RZD’ and its subsidiary JSC ‘TransContainer’.

It is worth noting that ‘TransContainer’ was named by the interviewers as the
potential investor of dry ports. However, the leading attention was paid to Directorate for a management of terminal and warehousing infrastructure of JSC ‘RZD’ as the prominent investor. Nevertheless, the final decision on the participation in the PPP project is made by the parent company of JSC ‘Russian Railways’. In general, JSC ‘RZD’ is interested in the development of rail infrastructure for the transport logistics centres located within the Russian Railways. That is why in the documents of the company, the process of the development of the network of TLCs is described in details, including the responsible enterprises and deadlines. According to the both interviews, the company would build the required and sufficient terminal and warehousing infrastructure, if there was enough finance.

5.5.3 Conclusion and Contribution

The paper provides new insights into the development of the dry ports in Russia. The potential interests from railway companies, seaport actors, and state can be synthesized through their public-private partnership. The importance of understanding the principles of the utilization of this scheme of cooperation increases. One of the reasons for this fact is that JSC ‘RZD’ has already undertaken a project of Horvino terminal. The project was started even during the absence of the sufficient regulatory base at federal and regional levels. To attract the private companies in the investments, the transparent conditions and rules are required.

In the article, the deterministic model of cash flows, costs, and results, allowing for uncertainties and risks have been presented. The model showed that the participation of enterprises of Russian Railways in the project will guarantee the assistance for private companies that can gain the profit from the operation of the created dry port. Moreover, the existing risks that cannot be entirely avoided and concerned with the investments in the dry port project are believed to be shared among the interested partners.

The contribution of the paper, therefore, is essential not only for the academia, but also for the business world. With the liberalization of the transport markets, especially railway freight market in the last decade, the attractiveness of the establishment of the future companies in Russia within the transport services increases. That is why it is timely to provide for the future companies the essential guidance for the undertakings in the developing terminal and warehousing business market.
6 RISK MANAGEMENT OF PUBLIC-PRIVATE PARTNERSHIP
INVESTMENTS IN DRY PORT PROJECTS

6.1 Public-Private Partnership Development in Russia: Legislative Incentives

Private companies and government need to be hand-in-hand for the business development. Seeing the economic advantage of such a type of cooperation, the public-private partnerships have become an international trend. Between 1992 and 2008, the largest number of PPP projects in Europe was implemented in the UK (i.e. two-third of all European PPP projects; Khristolyubova, 2013). However, after the crisis of 2008, activity in the sector of PPPs in the UK fell by almost 40%. The total value of PPP projects in 2009 amounted to half of the same period of 2007. A situation, where private companies do not have sufficient funds to participate in the PPP, as banks are reluctant to give long-term loans, has brought many projects in jeopardy. As a result, in 2009 the British Treasury was forced to allocate 2 billion Pounds from the state budget to support private companies involved in PPPs. A paradoxical situation, e.g., when the government allocates funds for private investors of PPP, has caused a wave of criticism.

Due to this situation, since 2008, the UK share had fallen to the level of 50% of all PPPs in the EU, while the total number of projects, mainly in Spain, France, Germany, and Portugal increased. Gradually, the PPP engulfed different spheres (power, utilities, transport infrastructure, education, science, and health care). Over the past 20 years, more than 1 400 PPP projects were organized in Europe.

Since the beginning of the new millennium, the pioneering British experience of PPP was introduced in the countries of the developing economies, such as India, Malaysia, some countries of Eastern Europe, where the problem of infrastructure construction is particularly acute. Like most emerging economies, Russia is also actively using this form of cooperation for the capital intensive projects. In March 2015, in Russia, there were 586 PPP projects, excluding concession agreements concluded in the Crimea. In 2014, compared to the year 2013, there has been an increase in projects by 5.4 times (Russian Gazette, 2015).

The Centre for Development of PPP in Russia and Ministry of Economic Development of the Russian Federation with the participation of Chamber of Commerce has conducted the analysis of these projects: 427 are concession agreements, of which 8 projects are at the federal level. The rating of Russian regions in terms of the development of PPP in 2015 was topped by St. Petersburg. Reportedly, since 2014 the Government of the Russian Federation adopted an order, according to which the parameter called as ‘The level of development of PPP in the regions of the Russian Federation’ is counted as one of the indicators for assessing the effectiveness of the governors to create a business environment (Russian Gazette, 2015; Russian PPP week, 2015).

However, according to World Bank data, the practice of the application of private funds on the Russian market was initiated only in recent years. The Russian
experience is compared with the practice of using private participation in developing economies, like India and Brazil, is presented in Figure 30.

![Figure 30. Investment in transport with private participation, in million USD (The World Bank, 2014).](image)

In addition, the transport-related sphere is deficient of foreign direct investments (Table 7). In 2010, business activities, wholesale, and retail trade received the most volume of FDI, which in many instances are gained in the developing countries from the use of project finance (Rajan Annamalai and Jain, 2013).

**Table 7. Sectors with potential to attract investment in Russia, in million USD (The International Trade Centre, 2014).**

<table>
<thead>
<tr>
<th>Industry</th>
<th>Inflow 2010</th>
<th>Foreign Direct Investment Inward stock 2010</th>
<th>Chg. p.a. since 2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total (merchandise and services)</td>
<td>13,810.0</td>
<td>116,199.0</td>
<td>6.6%</td>
</tr>
<tr>
<td>Business activities</td>
<td>2,853.0</td>
<td>18,171.0</td>
<td>3.8%</td>
</tr>
<tr>
<td>Wholesale and retail trade</td>
<td>1,912.0</td>
<td>11,021.0</td>
<td>-2.6%</td>
</tr>
<tr>
<td>Petroleum</td>
<td>1,755.0</td>
<td>19,249.0</td>
<td>-18.3%</td>
</tr>
<tr>
<td>Motor vehicles and other transport equipment</td>
<td>932</td>
<td>3,886.0</td>
<td>95.1%</td>
</tr>
<tr>
<td>Finance</td>
<td>777</td>
<td>5,790.0</td>
<td>2.0%</td>
</tr>
<tr>
<td>Machinery and equipment</td>
<td>716</td>
<td>1,933.0</td>
<td>29.5%</td>
</tr>
<tr>
<td>Food, beverages and tobacco</td>
<td>602</td>
<td>6,323.0</td>
<td>18.3%</td>
</tr>
<tr>
<td>Electrical and electronic equipment</td>
<td>499</td>
<td>1,086.0</td>
<td>14.6%</td>
</tr>
<tr>
<td>Wood and wood products</td>
<td>460</td>
<td>3,434.0</td>
<td>9.4%</td>
</tr>
<tr>
<td>Chemicals and chemical products</td>
<td>453</td>
<td>2,868.0</td>
<td>55.3%</td>
</tr>
<tr>
<td>Construction</td>
<td>426</td>
<td>3,017.0</td>
<td>12.7%</td>
</tr>
<tr>
<td>Transport, storage and communications</td>
<td>416</td>
<td>4,100.0</td>
<td>-4.0%</td>
</tr>
<tr>
<td>Agriculture and hunting</td>
<td>360</td>
<td>1,675.0</td>
<td>27.4%</td>
</tr>
<tr>
<td>Non-metallic mineral products</td>
<td>357</td>
<td>2,870.0</td>
<td>-14.1%</td>
</tr>
</tbody>
</table>
Table 7 displays the potential sectors of inward investments, depending on the type of economic activities (primary in yellow, secondary in blue, services in pink). As can be seen, the investments in services, which concern business activities (e.g., legal, accounting, market research, business and management activities; unspecified other business activities; unspecified research and development; and unspecified real estate) have the highest share of FDI within this sector, growing by +3.8% to 2,853.0 million USD in 2010, if compared to the volumes of 2009. Meanwhile, transport, storage, and communications services that, in turn, include post and communications; unspecified transport, storage and communications; and transport and storage classification codes, according to the International Trade Centre (2014), have had negative dynamics during the same period (-4%).

In order to improve the situation within the sphere of FDI, in June 2011, on the initiative of the President and the Prime Minister, the Russian Direct Investment Fund (RDIF) was created (RDIF.ru, 2011). The reserved Capital Fund is 10 billion USD. Russian Direct Investment Fund Management Company is a 100% subsidiary of Vnesheconombank (VEB). An investment fund was set up to attract foreign investment in the fastest growing sectors of the Russian economy.

The transport sphere of the country is partly supported by the government. The government support for the development of the transport system of the country differs significantly for the various modes of transport. The management of JSC ‘Russian Railways’ has repeatedly stated that the ratio of public and non-budgetary sources of financing for rail transport, according to the updated transport strategy, makes the company as not quite satisfied. Mr. Yakunin addresses ‘If the state share in the financing of transport infrastructure is about 50%, the proportion of state involvement in the funding of the railways is from 12.8% to 26%, depending on the scenario, provided that the indexation of tariffs for cargo transportation at the level of inflation’ (Izyurova, 2013). The budget allocation for the period up to 2015 states that about 75% of all submitted public funds are prescribed to the road rather than railways (14%; Ministry of Finances, 2014). If to consider the longer period (up to 2030), then the proportion of the rail industry investment is even more dramatic (Figure 31).
The disproportion in the subsidy of transport industries and the position of Mr. Yakunin in the budget process (especially, when a top manager once again asked for subsidies), according to Interfax news, could be the prerequisite of care Mr. Yakunin from the president of JSC ‘Russian Railways’. The main task of the new president of JSC ‘RZD’, Mr. Belozerov is to lower costs and attract private investment in the sector (Interfax.ru, 2015).

In this regard, it is worth to note the Baltic Sea region, where the transport sector is gradually developed by the use of PPP projects, attracting private investments (Ojala, 2007). Examples would be A1 Motorway completion from Gdansk (Poland and Belarus) and Bridge to Sovets in Kaliningrad (Latvia and Russia). Some public-private projects have yet to be approved. For instance, Rail Baltica (Lithuania, Latvia, Estonia, and Poland), Narva-Ivangorod road and bridge construction (Estonia and Russia), and Salla-Kostomuksha rail link (Finland and Russia) are under development.

The Civil Code of the Russian Federation (1994) allows to utilize concessions in the form of Build-Operate-Transfer (BOT) concession contract that is one of the popular UK tradition of financing the projects (Medda et al., 2013). The terms imply that a private party or consortium agrees to finance, construct, operate and maintain a facility for a specified period and then transfer it to a government or other public authority. The concessionary bears the commercial risk of operating the facility.

PPPs remain popular in road and airport infrastructure development rather than at railways. In the rail sector, there is an absence of adequate regulatory base at the federal level, which hinders the utilization of PPP mechanism (Perepelitsa, 2012b). The problem of regularly base development at railway sphere may stem from the reason that the JSC ‘RZD’ is the private operator of the rail infrastructure. Therefore,
the discussion on how to utilise the PPP in this situation is still underway (Ushkova, 2011b). Currently, legislative regulation of PPPs in the sector is ensured by the Federal law ‘On Concession Agreements’ (State Duma, 2005), or by the local legislation of Russia.

In Russia, the concession is understood as the mechanism by which an object of infrastructure is transferred to a private investor. The company that builds or reconstructs facility there for 30 years operates it, taking the entire risk of demand. At the same time, in Australia, and in many European countries, and gradually in Russia the possibility of risk-sharing construction and operation has already considered. In particular, this is designed by the life cycle contract, or when the private investor builds the infrastructure, and then operates it. For example, in the UK, the infrastructure owner gives the terminal sites for the private owner for almost 125 years ‘on a token peppercorn rent for that they are almost given away’, provided the remaining of the control over the sites. If the terminal sites are not used for a long time, the infrastructure owner can take the place back. Meanwhile, in Sweden, these rules are not assigned in the funding contracts, even if the terminal was developed fully by the public sector, represented by the municipality and national rail authority. At the same time, the UK contracts have less control over the operators, since they can free to operate or invest without the overcautious public supervision of their behaviour (Bergqvist and Monios, 2014).

As a rule, the government pays for the service, e.g. for the fact that the road of good quality, there are no traffic jams and accidents (Ushkova, 2011b). In this case, the investor is interested primarily in providing a right level of service, without worrying about demand or trying to squeeze funds from consumers. The reason is that the expenses will be subsidised by the state (Gorbunova, 2011). Probably, given the social role of railways, such a concept can be applied successfully in Russia (Ushkova, 2011b).

In the case of the construction of the rail lines for the freight traffic, the PPP can be realised based on the principles of guaranteed minimum return on capital. Within this scheme, the risk of the recoupment of the capital investment is to the private partner. The public party pays only, if the profitability of the project reduces lower than the critical level due to objective reasons.

In the case of the dry port project, it is important to take into account that the separation of the ownership of railways from the rail operations adds peculiarities to the development of life cycle contracts. According to Roso et al. (2015), the inland ports should first establish a long-term contract shuttle train paths with the owner of the rail infrastructure and then assign rail operators to use those rail tracks. At the same time, the terminal operator requires a close relationship or even some level of financial integration (e.g., initial decision to fund a terminal) with the rail operator in order to secure the usage of the paths and terminal volume that depends on the linked traffic flows (Bergqvist and Monios, 2014).

Meanwhile, the laws in Russia are mainly facilitating the utilization of life cycle contracts in the form of concession agreements preferably in the road sector. Due to
the fact that the legal framework for road PPP legislation develops most intensively, and government funding for PPP projects is higher than in other segments of the transportation industry, the successful implementation of projects was spotted in the field of road transport (Izyurova, 2013). The contribution to the success is provided not only by the opportunity to use a new form of PPP (e.g., contract lifecycle), but also thanks to the availability of ‘specialized’ public partner – SC ‘Avtodor’ (Federal Road Agency). In particular, the Agency is authorized to exercise the functions of the grantor, following the amendments made in 2012 to Federal Law ‘On Concession Agreements’.

By contrast, for example, JSC ‘Russian Railways’ so far cannot act as a grantor and attract investment for the modernization and renovation of the rail infrastructure. On the ground of the Federal Law from 27.02.2003 No. 29-FL ‘On peculiarities of management and administration of railway transport’ (State Duma, 2003), none of the federal rail transport organizations, may not to make transactions or series of related transactions, which entail the possibility to deprive the owner of the property, the value of which is:

1) more than five percent of the book value of the assets of organizations; 2) the cost of which exceeds five percent of the book value of the assets at the date of approval of its latest balance sheet; 3) the price of which is more than fifty thousand times greater than the statutory minimum wage, SMW (SMW=5 965 RUB since the 1st of January 2015). The exception can be given after the consent of the federal authority for State Property Management, federal executive body for the regulation of natural monopolies in the transport, and the federal executive authority in the field of rail transport. Thus, in the railway sector, the Law ‘On Concession Agreements’ does not allow to expropriate rail infrastructure from the owner, and private investors are forced to invest in state ownership.

Meanwhile, Interfax reports that Transport Minister of the Russian Federation, Mr. Sokolov offers to give Russian Railways the powers of the grantor to enter into concession agreements that will require some changes in the law ‘On Concession Agreements’ (Vsesmi.ru, 2012). According to the Minister, these amendments will more actively promote public-private partnership in the field of railways. This idea was also supported in the book of Yakunin (2010b).

At the same time, on the 26th of April 2013, the State Duma adopted in the first reading the draft of the law ‘The basis of public-private partnership in Russia’ (Aleksandrova, 2013). The text of the document was developed by the Ministry of Economic Development of the Russian Federation and expertise in the PPPs implementations, such as World Bank. Thanks to the efforts for the development of the Federal Law ‘On Concession Agreements’, the number of projects implemented in the framework of the concession legislation has been steadily increasing. In the last year, two sections of amendments to the Federal law were adopted. Some provisions of the Law have already entered in effect on February 1st, 2015, while the other part will be applied from the 1st of May 2015 (Russian Gazette, 2015). The adopted amendments are aimed primarily at improving the procedures for the award of
concession agreements, and to promote a successful preparation and implementation of concession projects.

The amendments primarily concern the question of the introduction of the Private Finance Initiative (PFI). In the UK, PFI projects are ‘a form of PPP, which seeks to combine the advantages of competitive tender and flexible negotiation, and transfer risk away from the public sector’ (Bing et al., 2005). This tool reduces the time and costs of the grantor on the preparation of the draft concession agreement and tender procedures. Experience shows that the lack of funding for project preparation is often the main obstacle to its implementation.

On the whole, the draft of the law allows to utilise almost all forms of the PPPs. Examples would be the contacts classified by United Nations Commission on International Trade Law (UNCITRAL, 2001): Built-Operate-Transfer, Build-Transfer-Operate, Build-Own-Lease-Transfer, Build-Own-Operate-Transfer, and Build-Own-Operate. According to Grimsey and Lewis (2007), the most usual forms that PPPs can take place are BOT/BOO arrangements.

In EU countries, the standardization of the PPP contracts has been advanced considerably. The facilitation and stimulation of the policy and institutional environment was one of the factors for the growth of the European PPP market in the transport sector. The same idea, e.g. the required activity from the policy makers in the creation of regulations, is supported by Rajan Annamalai and Jain (2013). Additionally, the integration processes and the extension of transport operators and their operations geographically had a favourable impact on the progression of PPP.

It should be noted that across sectors and countries, it is quite difficult to find a unique model of PPP that can be easily replicated. The choice for PPP scheme is determined by the public sector agency that has to seek the trade-offs between the various, and sometimes conflicting, goals. In the EU countries, all forms of PPP schemes are considered as an important tool for attracting additional financial resources for high priority investments, such as transport (Medda et al., 2013). Authors conclude that, since the 1990s, the trend of infrastructure financing has shifted from traditional public provision to the growth of private participation. Thus, in public infrastructure projects, the public-private partnership became a popular option to gain the value for money (Bentzen et al., 2003; Bing et al., 2005).

Nowadays, in order to success the TEN-T development that identifies 30 transnational transport corridors on the basis of proposals from the member state, the EU regards the PPP framework as an essential incentive for the completion of the projects (Proost et al., 2014). As in Russia, also in the EU, among transport investments, the road is the most common under PPP agreements, with the UK and Portugal having the largest scope of their evolvement.

So far, Russia has gained considerable experience in financing large-scale projects by involving private investors via PPPs, first and foremost, under BOT contract. However, the number of the PPP projects in the transport sphere is relatively low, if compared to other sectors of the economy (Figure 32).
As can be seen from Figure 32, projects are divided into four main areas of infrastructure. The municipal infrastructure includes 194 projects, social infrastructure – 165 projects, the energy infrastructure – 163 projects, and transport infrastructure – 64 projects (Russian Gazette, 2015).

The outstanding examples of PPPs in transport infrastructure are as follows:

- Ust-Luga seaport (Sberbank of Russia). The largest shareholding is still held by the Russian government, followed by Leningrad region, JSC ‘RZD’, and some private investors (Jackson, 2010).
- Bronka seaport (Sberbank of Russia and foreign investors Hamburger Hafen und Logistik AG). The volume of the state financial support is 15.2 Bl RUB. Private investments are 43.7 Bl RUB.
- Taman seaport (Sberbank of Russia), according to Ermolenko (2013b). The government investments are 50 Bl RUB, private investments are in three times higher (Popova, 2012).
- Reconstruction of the airport ‘Pulkovo’ (VTB). The project consortium is represented by the company Fraport, which is the leading European operator of the airports, and Greek company Copelouzos. The total financial capital of the project is 1.2 Bl EUR (Pankratov and Antanovsky, 2012).
- Implementation of the project ‘Belkomur’ (VEB).
- Development of high-speed dedicated railway line Moscow–St. Petersburg (VTB).
- Creation of toll highway – Western High-Speed Diameter (Sberbank of Russia). The project is based on the principle of the following proportion: 1 RUB of the state finances and 2 RUB of the private party finances. In the meantime, in the EU, the projects of PPPs are based on the principle of 1 RUB of state finances to 4 RUB of private sources (Andreeva and Svyatkina, 2011). After the exploitation of the road, it is transferred to the balance of the government.
– Projection of a new road in St. Petersburg: streets Fayansovaya – Solnaya (potential investors are VTB, Sberbank, and Citibank).
– Primorsk Oil Terminal in the Leningrad region.
– Bridge via Kama River and Bui River in Udmurtia and over Lena River in Yakutia with the potential investor of VTB (Ermolenko, 2013b).
– High-speed railway ‘Moscow – Kazan’.

The potential national and foreign financial institutions for PPP could be the following organizations:

– State Corporation ‘Bank for Development and Foreign Economic Affairs’ (VEB);
– Bank VTB (more than 20 banks and financial companies in 19 countries);
– JSC ‘Special Economic Zones’ (SEZ);
– Holding ‘Rostekhnologii’;
– Sberbank of Russia, etc.

Taking into account the formation of the institution of PPPs, as well as the development of the regulation base, especially the enactment of the new law on concessions in Russia by State Duma (2015), the projects of the dry port can be implemented by this mechanism. Broadly speaking, this form of cooperation will provide synergy among the interested parties from land and maritime transport chains, and the state. For example, in aspects of the ownership and management of ports, the transfer of commercial risks to the private actors and separation of the harbor infrastructure and service provision results in the higher efficiency of the harbor, because of the developed level of competition between service providers operating within the seaport (Chiu et al., 2015; Roso et al., 2015; Trepte and Rice, 2014).

Similarly, the development of dry ports via PPP mechanism will make the idea of improving the quality of service to clients feasible. The world experience shows that inland ports, such as Hallsberg terminal in Sweden, Virginia Inland Port (VIP) in the USA, and Minto terminal in Australia tend to focus on substantial investments in value-added services, such as freight forwarding, quarantine, packing services, inspection, repairs, etc. These services are provided in addition to the standard services of rail transportation, transshipment, storage, and customs operations (Roso et al., 2015). Broadly speaking, the whole integrated transport chain can provide agile and lean logistics for the customer (Hilletofth, 2008). In particular, general logistic services are for 80% of clients and value-added services – for 20% of customers (Verbulo, 2014).

GLS (General logistics services) for 80% of clients:

– Storage;
– Stuffing and unloading of containers/transport modes;
– Consolidation;
– Cross-docking.

VAS (Value-added services) for 20% of clients:
– Packaging, labeling, assembly;
– Reverse logistics – the control and moving of the returned goods (rejected, used, with the left working life).

Overall, the utilization of PPPs for the development of the transport infrastructure, including dry ports within the system of Russian Railways, will benefit the Transport Strategy of the Russian Federation until 2020 (Ministry of Transport of the Russian Federation, 2005). According to the Strategy, the investments in the development of transport will rise from 2 percent of GDP to 4–4.5 percent of GDP. Approximately, 60 % will be represented by the off-budgetary sources to cover the total investment in the infrastructure of the transport sector.

6.2 To the Question of the Economic Peculiarities of PPPs

With the use of PPPs, the projects can be realized at substantially less cost, but that requires experience (YE.com, 2014). The problems of concessions’ development in Russia deserve the concentration on several aspects, rather than mainly on legislative issues (Varnavsky, 2004). The problem of concessions is not confined to one or more laws. From the systems point of view, the attention should be paid to economic principles of the PPP functioning, likewise.

The world experience claims that one of the key characteristics of the PPPs is related to the possibility of sharing risk among the partners (Center of public-private partnership development, 2013; Ernst&Young, 2012; Grimsey and Lewis, 2007). Medda et al. (2013) stress that the contract is the strategy that allows to shift risks to the private sector from the public partners. At the same time, Burke and Demirag (2015) underscore that, for example, the interpretation of risks by the Government in Ireland and their dissemination to the private partner in PPPs are changing over time due to economic downturn and obstacles in funding PPP projects. Particularly, the rules of PPP framework are shifting in favour of the private parties at the expense of the taxpayers, who, reportedly, are considered as the losers in the PPP mechanism. On the whole, there is more generalised perception that risk is allocated to the partner, who is best able to manage it, and who is best equipped to minimize its costs or manage the risks at the least cost (Grimsey and Lewis, 2007).

In this regard, Bing et al. (2005) identified four risk allocation categories and their examples: 1) The public sector risks 2) The private sector risks, 3) Risks divided between public and private sectors, and 4) Specific risks related to particular projects. Therefore, the economic assessment of the projects is in need for the consideration of risks that are natural for the PPP risk allocations and the current economic environment, especially in Russia. In these circumstances, the development of methods and models for economic evaluation of primary dry port projects with the allowance for the associated risks is reasonable.
It is important to evaluate the risk associated with the estimated returns on investments. The concept of risk is related to the uncertainties associated with events. The dry port as the key elements of intermodal supply chains inherits the breadth and scope of all risks that naturally present in uncertain global supply chain environment (Barry, 2004; Lättiälä, 2012; Moslemi, 2016). In the context of projects, a risk is ‘an uncertain event or condition’, which if occurs the positive or an adverse effect on project’s objectives appears’ (Bender and Ayyub, 2001).

For the mega infrastructure projects, the risks involved are high, but they are treated in a deficient manner in feasibility studies and project appraisals (Bruzelius et al., 2002). In the current economic environment, especially in Russia, the investments in transport projects, such as dry ports based on PPP, require the consideration of different factors of risks. Normally, different classifications of risks are provided in the scientific literature, which is the relevant to PPP and risk management (Bing et al., 2005; Ke et al., 2011; Power et al., 2015). Moslemi (2016) proposes five categories of risks: environmental risks, industry risks, organizational risks, problem specific risks, and decision making risks that are attributed to both perspectives (e.g., customer and company). Grimsey and Lewis (2007) suggest that at least there are nine categories of risk that are attributed to any infrastructure project (e.g., technical risk; construction risk; operating risk; revenue risk; financial risks; force majeure risk; regulatory/political risks; environmental risks; and project default).

Wibowo (2005) researched on the risks related to the transport projects (e.g., toll roads construction). All risks were classified into three groups: 1) political risks, 2) financial risks, including foreign exchange risks, interest rate risks, inflation risks, and 3) market risks, i.e. land acquisition risks, construction risks, operational and maintenance risks, traffic volume risks, toll risks, and force majeure risks.

Ameyaw and Chan (2013) present a comprehensive analysis of risks related to PPP on several groups of the infrastructure project, including transportation. The breakdown of risks include up to 81 factors. Based on the provided variety of classification of risks, it was found out that the most frequent risks are related to political risks, construction and operational risks, including land acquisition, and financial/market risks.

Bergqvist and Monios (2014) address the risks related to the dry port projects. Examples would be an inability to support a sufficient quality of the rail services to attract the clients, for example, shippers and forwarders. The results can be as damaging as cease of the operation of the terminal or on-going public subsidy. According to Barfod et al. (2011), the decisions, which are based on risk analysis, should take into consideration extreme events. The probability of occurrence of different risks can be assessed as one of the following three categories (Practices Guide, 2014):

- High – Greater than 70% likelihood of occurrence.
- Medium – Between 30% and 70% probability of occurrence.

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Low – below 30% likelihood of occurrence.

The categorisation of risks, as a rule, is based on the assessment of the project managers with the input from the project team. Due to the reason that the risk is the function of the two variables:

\[ \text{Risk} = \text{function (Likelihood; Consequences)}, \]

Additionally, the impact of each risk can be attributed to the following three categories (high, medium, and low). The risks, which are related to the development of the warehousing and terminal business in the Russian market, can be designed with the use of red/green/yellow colour coding (Figure 33).

Figure 33. Map of the risks related to the warehousing and terminal business development (CDC.gov, 2014).

According to expert estimates, there are two main groups of risks that should be taken into account: economic and market risks. The first group of risks, economic risks, include the following aspects:

1. Stagnation of the economy.

That is to say, the current macroeconomic situation in Russia that is characterized by a predominance of the effects of the crisis: the economic slowdown, higher inflation, the decline in consumer demand, etc. In the medium term, the unstable macroeconomic situation in Russia is projected.

1. The decline in freight traffic.

1. Long-term structural barriers to industry development.

The long-term structural obstacles to the transport sector are the lack of modern infrastructure. Those are warehouses, seaport facilities, border crossing points, approaches to transportation centres, and container terminals. Additionally, there are inter-ministerial and bureaucratic barriers to the creation of infrastructure by private companies, deteriorated by the lack of the state’s role as a regulator of the economy.

These factors make a consistent development of terminal and warehousing
infrastructure quite cumbersome. The second group of risks is related to the uncertainties of the market and is represented by the following factors:

2.1 The deceleration in the development of the warehousing business. JSC ‘Russian Railways’ is at risk of the diminished activity within the warehousing market, such as the reduction of the leased space, rental rates, etc. The reason lies in the fact that regional Directorates of the warehousing infrastructure not only provide terminal and warehousing services, but also own the storage facilities.

2.2 Increased competition for consumers.

The increase in competition within the terminal and warehousing services was expected after the end of the economic crisis in the medium term of 2010–2012. Especially, the effect was noticeable after the commissioning of new warehouse space in the Russian regions and the growth of the supply of services for the storage of goods.

2.3 Changes in the structure of demand for terminal and warehousing services towards integrated services with higher added value.

The weaknesses in the organization of terminal and warehousing infrastructure of JSC ‘Russian Railways’, according to the experts, are insufficient modern technological equipment. Moreover, there is the gap at the level of automation of warehouse operations. It hinders the implementation of the integrated terminal and warehousing services that are in demand on the market.

2.4 The expansion of international warehousing operators, consolidation and the emergence of large domestic companies.

Major international companies, which operate in the Russian market, provide a wider range of services that are considerably comprehensive. Reportedly, large Russian companies also propel transportation services and cargo handling operations. These companies include JSC ‘TransContainer’, JSC ‘Far Eastern Transport Group’, and a group of companies ‘Evrosib’, which are quite competitive to JSC ‘Russian Railways’.

The experts note that the level of competition varies considerably among regions of Russia, because of the wide geographical distribution of facilities of JSC ‘Russian Railways’. That is why some unsystematic risk can be determined directly by the project.

In this regard, the implementation of the project may have the following risks, continuing the list provided in the previous page:

3. Production risks.
4. Technological risks.
5. Investment’s risks.
7. Transformation risks.
The production risks, for instance, relate to the high level of dependence of sales of terminal business services from JSC ‘Russian Railways’. That is the inability to function effectively without the participation of JSC ‘Russian Railways’. Moreover, the orientation to the new clients can result in the necessity to update the technological processes, which can bring the related risks.

The afore-mentioned types of risks can be partly attributed to the technological hazards. The implementation of the new information systems may result in some failures and difficulties of their integration with the existing terminal and warehousing technological processes. For that reason, in Russia, on the whole, companies are interested in upgrading and installation of additional modules of the IT to the already established information systems. Meanwhile, only 25% of freight forwarding and about 18% of warehousing operators are interested in changing information systems (Loginet.ru, 2014).

The investment’s risks imply the possibility of lack of potentially interested investors, for which the particular attractiveness mechanism has yet to be developed within the JSC ‘Russian Railways’. Management risks reportedly can be associated with the ongoing organizational changes, which could bring about massive layoffs and changes in methods of calculation of wages. Consequently, it can lead to the increase of conflicts and decrease of productivity. The transformation risks are connected with the uncertainties of the liberalisation of the warehousing businesses within Russian railways. That is why reformation processes may increase the possibilities of inconsistencies of actual performance indicators with the planned targets, because of the changes in the macroeconomic environment, legislation, and market. In general, the proper evaluation of risks can benefit the process of meeting the overall goal of the facilitation of the infrastructure projects, such as dry ports (Bergqvist and Monios, 2014). For that reason, the development of methods and models for economic evaluation of primary dry port projects with the allowance for the associated risks is reasonable.

### 6.3 Methods of Project Risks Assessment

According to Bender and Ayyub (2001), risk assessment is ‘a technical and scientific process, by which the risks of a given situation for a system are modelled and quantified’. There are different methods for pricing risks and several capital budgeting approaches (Boussabaine, 2013). The literature review has shown that economic models rely on the following techniques. For example, Keown et al. (2013) consider four commonly used criteria for determining the acceptability of the investment proposals: (1) payback period, (2) net present value, (3) profitability index, and (4) internal rate of return (IRR). Pyles (2014) additionally mentions (5) discounted payback period, which differs from the payback period by one aspect, incorporated time value of money.

Authors named the benefits of the payback period, such as easy to visualize, quickly understood, easy to calculate, and the ability of the projects’ liquidity indication.
At the same time, the focus was on one of the most favourable capital budgeting approaches, such as net present value (Drury, 2009; Keown et al., 2013). Due to the possibility to recognize the time value of money, the NPV, in many instances, is perceived as a technique superior to others’ decision criteria (Dymowa, 2011; Keown et al., 2013; Pyles, 2014; Vitollo and Cipparone, 2014). However, discounted payback period also adjusted for the time value of money.

In the research of the Bhandari (2009), which explores six capital budgeting decision criteria, including modified internal rate of return (6), the discounted payback satisfies almost ten characteristics. That is simple to understand, measure profitability, ensure liquidity, etc. None of the six mentioned above criteria meets all the requirements of an ideal criterion like DPP and NPV. Bhandari (2009) states that the DPP is not fewer relevant criteria than NPV and should be better utilised as the decision-making technique in the risky investment climate.

Methods that allow to calculate the consequences of risks and their effect on the six above-mentioned performance criteria are as follows: expert estimates, analogy based estimation, method of adjusting the discount rate, sensitivity analysis, scenario method, etc. The analysis of the accuracy and reliability of the methods for the economic appraisal of risks investment in the construction of the dry port showed that leading techniques include simulation. In the EU, different countries use specific approaches in the transport investment planning. For example, in some countries such as Italy, investment decisions are seldom supported by master plans or cost-benefit analyses (CBA). On the contrary, the methodology of CBA and its application to transport investments is a strong transportation planning tradition in the UK (i.e. either project is focussed on CBA), France, the Netherlands, and Germany (Medda et al., 2013; Proost et al., 2014).

The challenges of price installing within the PPP framework for the provision of transport infrastructure are precisely described by Macário (2010). One of the challenges is related to the translation of the so-called issue ‘of asymmetries of information between parties into a risk-taking language’, in other words, pricing risk phenomenon. The essential probabilistic nature of the risks is hardly met with a formula-based analysis. That is why some methods can be inappropriate to evaluate the payoff of the investments in the infrastructure. For instance, discounted cash flows (DCF), CBA, and multiple criteria decision analysis (MCDA), which are usually associated with capital investments with the public agency as the decision maker (Leviakangas and Michaelides, 2014; Saranen and Hilmola, 2009), if considered from deterministic approach. As a result, authors have been fostered to adopt different approaches (Grimsey and Lewis, 2007).

Simulation allows to mimic the behaviour of the real system. One of these methods is Monte Carlo analysis that can be regarded as a compound of the sensitivity analysis and the method of scenario analysis based on the probability theory (Popova, 2012). As a rule, randomness is artificially incorporated into the system or model (i.e. it uses random numbers from the study rather than assumed Gaussian curves). In other words, simulation techniques imply ‘means for performing robust estimations with a
limited number of input samples’ (Zio, 2013).

Due to these reasons, researchers resort to the combination of Monte Carlo simulations with the deterministic methods (Ambrasaite et al., 2011; Esipova, 2011; Lorenzo et al., 2012; Salling, 2013). The Monte Carlo method is proposed as one of the most suitable quantitative risk assessment techniques (Ambrasaite et al., 2011; Grimsey and Lewis, 2007; Kazaku and Narkevskaya, 2013).

According to Lättilä (2012), the Monte Carlo test is one of the most powerful tools for the analysis of investment risks that is relatively easy to conduct. It takes into account the maximum possible number of environmental factors and can cope with uncertainties. The analysis and modelling of uncertainties or factors of risks enhance the ability to make appropriate decisions (Ayyub and Klir, 2006; Datta, 2009). However, many simulation studies lack the application of this method (Lättilä, 2012).

The use of simulation techniques, e.g. probabilistic approach is more prevalent in discounted cash flow analysis. The DCF technique has a distinct preference compared to other methods, even within the deterministic systems (Schauten et al., 2010), despite the fact that some authors address its pitfalls. They include the misunderstanding in the use of the nominal discount rate with the real cash flows or the use of the exaggerated discount rates (Booth, 1995; Courtney et al., 2013).

However, according to Booth (1995), modelling allows to mitigate the pitfalls of the discounted cash flows analysis that is used for the investment appraisals. Therefore, with the use of Monte Carlo method, the value of the DCF technique amplifies. The Monte Carlo analysis can describe the probabilistic environment, and, therefore, can increase the accuracy of the DCF technique (Amédée-Manesme et al., 2013; Esipova, 2011).

In many instances, Monte Carlo is used to calculate NVP from the probabilistic point of view (Amédée-Manesme et al., 2013; Bannerman, 1993; Booth, 1995; Piranfar and Masood, 2012; Samis and Davis, 2014). However, according to Bhandari (2009), Kim et al. (2013), and Power et al. (2015), NPV rule ensures profitability, but not liquidity. In other words, the decision making on the acceptance of the project by the positive NPV does not take into account the period or the project’s useful life. In such cases, the NPV rule typically undervalues projects (Power et al., 2015). These setbacks can be easily mitigated by the use of DPP (Bhandari, 2009).

Meanwhile, due to the popularity of NPV, Monte Carlo is used for probabilistic analysis of the NPV value more often (Ambrasaite et al. 2011; Amédée-Manesme et al., 2013; Bannerman, 1993; Booth, 1995; Piranfar and Masood, 2012; Samis and Davis, 2014). Less frequently Monte Carlo is used in regard to the discounted payback period and internal rate of return (Esipova, 2011; Grimsey and Lewis, 2007; Jeffery, 2004; Lorenzo et al., 2012; Merkova et al., 2013).

According to the authors, the only viable solution to generate a complete probability distribution of the payback period for general stochastic cash flows is the simulation (e.g., by Monte Carlo method). However, the practical tools for probabilistic payback
analysis are very limited because of their complexity (Kim et al., 2013). On the whole, the Monte Carlo test in the conjunction with the capital budgeting decision criterions, amplifies their benefits (Amédée-Manesme et al., 2013; Esipova, 2011; Lorenzo et al., 2012).

Some studies concern the use of Monte Carlo for the calculation of free cash flow (Akalu, 2003). The article of Amédée-Manesme et al. (2013) is related to the application of the Monte Carlo for managing the risk of real estate portfolios. The authors clearly present the positive aspects of the simulation techniques in combination with other methods, claiming the possibility of obtaining the range of outcomes instead of a fixed result.

Additionally, Ambrasaite et al. (2011) underline that the combination of Monte Carlo simulation with cost-based analysis allows to take into accounts the economic impacts and strategic criteria. In turn, it enhances the decision support in such a big infrastructure project like Rail Baltica. Salling (2012) also writes in favour of the combined methods, e.g. deterministic benefit-cost ratios (BCRs) with stochastic Monte Carlo analysis that can be applied to the infrastructure projects. In particular, the investments’ appraisal of the new fixed link across the Òresund connecting Denmark to Sweden was based on the adoption of a quantitative risk analysis (Monte Carlo) with CBA. This approach brought the probabilistically accumulated results.

Having these ideas in mind, the current research is geared towards the justification of viability of the combination of Monte Carlo method with DCF technique based on the system dynamics simulation approach for the decision appraisal of the investments in dry ports. The system dynamics approach was in nature of the challenge tasks. As a rule, the subject of the system dynamics programming is the complicated processes. A so-called multi-step process generally implies the developments over time that are divided into several ‘steps’ or ‘stages’ for the simplicity of the calculations or the other explicit requirements, such as planning of economic activity on a time interval, consisting of several years. Many processes can be divided into stages artificially. Therefore, this method received a broad coverage, including the sphere of risk management processes (Armstrong, 1976; Siegmann and Lucas, 1999; Wijnen, 2003). In the current study, the process of dry port development with the allowance for the uncertainties and risks of the surrounding environment is proposed in the form of the multi-step strategy for the project implementation. The consensus on the same principle of continual investment was gained by the seaport management, considering that this method allows improving the port resilience to risks (Trepte and Rice, 2014).

For the mitigation of risks, the approach is complemented by the benefits of real option theory (Dimakopoulou et al., 2014; Gao and Driouchi, 2013; Karttunen, 2009; Michailidis and Mattas, 2007) and portfolio theory (Markowitz, 2011; see also Ho, 2014). The synergy from the above-mentioned integration, which was used for the proposed explicit decision-making tool, is tested via the developed model. It takes into account the risks’ factors that have been empirically analysed in Sub-chapter 6.2.
6.4 Combination of Monte Carlo Method with DCF Technique

The viability of proposed combination is tested through its application to public-private partnership investments in dry port project, using the probabilistic point of view. The combination of both methods may extend the DPP application that in the future can be comparable to the use of NPV for the different decision appraisals. The base for the calculation of DPP with the use of Monte Carlo analysis can be a system dynamics approach, which is appropriate for solving the problems of decision making. Nowadays, according to the system dynamics society, system dynamics refers to a computer-aided approach to policy analysis and design (System dynamics.org, 2014).

In the current study, the simulation model is created to analyse the decision-making performance criteria of the dry port project development in the risky environment. As was mentioned in Sub-chapter 1.1, risks bring the deviation of the future cash flows from the expected flow of the project, resulting in project overruns and changes in project performance indicators. Therefore, it is assumed that the Monte Carlo method can provide a better assessment of risks. In particular, the standard deviation of the values obtained from the outcome of the model can be used as a measure of risks, while the mean values can represent the expected net present value and discounted payback period.

Prior to the model development, the following assumptions have been made. Continuing the analysis of the previous chapters, the railway companies are one of the most potentially interested parties of the public-private partnerships. That is why the investment flows of the dry port project were allocated partially to private rail enterprises, rail network owner, and Sberbank of Russia. It is worth noting that the organizations mentioned above are just suggestions of this research, and not necessarily real.

It is assumed that the investment period (settlement period) is 20 years, the beginning of construction is 2015. Overall, the expected state of a container terminal implies a dead-end type of its scheme with a customs’ post, four container yards, warehouses, etc., located in the area of 24 hectares. In the considered example, the area of the dry port was determined on the basis of the size of its projected processing capacity. The proposed handling capacity of the dry port was calculated regarding the required throughput of the seaport terminal JSC ‘Petrolesport’. In particular, the dry port will handle 19% of container traffic of the seaport container terminal, which, in the long run, will increase its capacity from 540 ths. TEU to 2–3 Ml TEU (Panova and Korovyakovsky, 2013). The increase of the processing capacity of the dry port will trigger the change of serial number of its technical conditions (Figure 34).
Figure 34. Characteristics of technical states of the dry port.
According to Figure 34, the technical conditions of the terminal are as follows:

1. Land for the construction of the main railway track No. 1 (L=25 km) and railway line No. 2 (L=25 km), the container yard No. 1 (colored in green in Figure 34), checkpoint of the terminal, transformer substation, the guard of terminal, electricity, household premises for machine operators and stevedores, embankment base for the adjacent road, handling equipment, water supply, sewerage, heat node, and communications, as well as bonded container yard, warehouse, the area for parking and turning of the trucks, carrying and lifting equipment (three reach stackers), adjacent road, and service and technical buildings; 1\textsuperscript{st} year.

2. Mainline railway track No. 1, container yard No. 2 (coloured in yellow in Figure 34), access rail track (three), setting rail track, dock rail tracks (three), rail crossings, and handling equipment – one gantry crane; 6\textsuperscript{th} year.

3. Mainline railway track No. 2, container yard No. 3 (coloured in violet in Figure 34), level crossings, docking rail tracks (three), and handling equipment – two gantry cranes; 8\textsuperscript{th} year.

4. Container yard No. 4 (coloured in red in Figure 34), the guard of terminal, the container yard for the repair of containers, the site turning of trucks, docking rail track, handling equipment (two reach stackers, two gantry cranes), the road for the circle movement of trucks; 10\textsuperscript{th} year.

Each of the listed dry port conditions is given in addition to previous ones, which allows performing an on-going development and enlarging terminal capacity discretely in the 1\textsuperscript{st}, 6\textsuperscript{th}, 8\textsuperscript{th}, and 10\textsuperscript{th} years of the investment horizon in response to the growing container traffic. The advanced state of the terminal is represented by the ordinal number ‘4’, provided that the preceding technical conditions of the terminal, such as the 1\textsuperscript{st}, 2\textsuperscript{nd}, and the 3\textsuperscript{rd} technical states, have been constructed previously (Figure 34). The annual processing capacity of the terminal of final stage will be equalled to 383 ths. TEU. The percentage of TEU and FEU is respectively 30\% and 70\%, which means that the box factor equals \((0.3+0.7)/(2\times0.7+0.3)=0.59\).

Given the fact that the designed dry port is located in the areas owned by the Russian Railways, the facilities of the dry port, is transferred to JSC ‘Russian Railways’. The infrastructure includes the terminal and approaches to the seaport. The transfer is provided after 20-years horizon of investments at the prices on the date, according to the contact. Hereafter, the private party will rent the facilities or receive the loan (free use) of an object.

In the model, the attention is focused on the scenarios of the dry port development that can be indicated by the appraisal approaches, such as DPP and NPV. These capital budgeting criteria were considered as the main outcome \((Y_1\) and \(Y_2\)) of the model. The relationships of the phenomena \((Y_1\) and \(Y_2\)) were identified in connection with the array of the predictors \((X_1, X_2,\) and \(X_n\)). The predictors were assigned to the competitive environment, government regulations, and company profitability. When the model was lengthened, these predictors became the antecedents to the different
types of deterministic cash flows. A deterministic model of cash flows may include the benefits and costs related to capital, financial, and operational activity that is always estimated for the efficiency of the infrastructure projects like roads (Kazaku and Narkevskaya, 2013). In the current study, the following cash flows are considered:

1) Investment cash flow is connected with activities that include investments for the construction of the dry port. The investments’ cash flows were divided into four parts in the time of the settlement period of 20 years. Thus, the investments are accounted for December of the periods 1, 6, 8 and 10 (2015, end of 2020, 2022 and 2024 respectively with an end of investment period in 2035). The central component of capital investments is the land cost. In the North-West region, the market prices, which were determined by the performed analysis, equal to 40 Euros for 1 sq.m. of land. The area of the dry port settlement is located within the industrial development zone (near Shushary sorting rail station; SPblands.info, 2012). The allocation of the investment funds was designed, regarding the increase in the processing capacity of the dry port that triggers the change in its technical conditions in stages.

2) Operating cash flow is associated with the operating activities that encapsulate, in turn, inflows and outflows.

2.1) Inflows are revenues from the following activities: transportation, handling, and storing of containers, as well as additional operations (e.g., use of wagons and containers, shunting operations, customs clearance, weighting, etc.). The maximum amount of revenue is expected to be received from a site at the end of the prescribed period [0; T], i.e. by the residual value of the land. The saving in operating costs (the degree of the reduction of losses that were the case before the construction of the dry port due to the deficit of storage yards) is summed up with the inflows. Additionally, with the building of the dry port, the seaport can receive and process in the same area more containers per year. Without any technology upgrade, at the better turnover is provided, resulting in higher inflows.

2.2) Outflows from the operating activities are operating costs connected with the operation of the dry port, including rail approaches to the seaport. These cash flows contain prime costs for lifting operations with the containers, costs of shunting services, expenses connected with the presence of wagons and locomotives under the operations at the dry port, the costs of running the trains, locomotives, their maintenance, energy consumption, as well as salary of the trains’ crew, wagons inspectors, who check technical conditions of the wagons within the trains, which arrive/departure from the dry port.

Additionally, depreciation costs have to be considered in the model. The calculation of the annual depreciation implies a yearly replacement cost for each piece of equipment and each capital item, subsequently for building up over a period of a fund to replace a productive asset at the end of its useful life. Depreciation is accounted in the inflows.

3) The financial cash flows should be considered individually for each project and
will not be included in the designed model.

1) On the basis of the calculated cash flows within the prescribed period \([0; T]\), the balance of the investment \((\varphi_t)\) is computed:

\[
\varphi_t = \sum_{t=0}^{T} I_t,
\]

where \(I_t\) – investment for the construction of dry port, million Roubles.

2.1 ) Inflows \((R_{total}^t)\) are computed as the sum of the results of the following formulas.

Revenues from the transportation of containers \(R_t\):

\[
R_t = 365 \sum_{t} \left( I_{lt} l_t P_{lt} + I_{et} e_t P_{et} \right),
\]

where \(P_{lt}, P_{et}\) – tariff per one loaded and empty TEU and FEU, depending on the distance between dry port and seaport, Roubles, including VAT; 365 – days of the year; \(I_{lt}, I_{et}\) – forecast intensity of loaded and empty TEU, cont./day.

\[
I_{lt}^{k} = I_{lt-1}^{k} \times (1 + \frac{k_l t}{100})
\]

where \(I_{lt-1}^{k}\) – current intensity, cont./day; \(k_l\) – the growth rate of the \(k\)-type container at step \(t\).

Revenues from the handling of containers \(R_h\):

\[
R_h = 365 \sum_{t} T_t \times P_{ht} \times 2,
\]

where \(P_{ht}\) – tariff per one container, Roubles, including VAT; \(T_t\) – throughput of containers at dry port, cont./day, taking into account the rate of the growth at step \(t\); 2 – minimum number of operations with the one container.

Revenues from the storing of containers \(R_s\):
\[ R_s = 365 \sum_{t}^{T} T_t \times P^s_t, \quad (5) \]

where \( P^s_t \) – tariff per one container, depending on an average time of the storing, Roubles, including VAT.

Additionally, revenues from the shunting operations at the dry port, as well as from the use of wagons and containers are included in the calculations of operating inflows.

Revenues from the additional operations (customs clearance, weighting, etc.) with containers \( R_a: \)

\[ R_a = 365 \sum_{t}^{T} T_t \times P^a_t, \quad (6) \]

Saved costs at the seaport, which were associated with a deficit of storage yards \( R_l \), are calculated by the following formula (Abdikerimov et al., 2013):

\[ R_l = 365 \sum_{t}^{T} T_t^s \times (t - 1) \times (365/t) \times P, \quad (7) \]

where \( T_t^s \) – number of containers, cont./day, shifted from the seaport to the dry port, taking into account the rate of the growth at step \( t (T_t^s = T_t); (t - I) \) – average reduction of time for storing of containers at the seaport, one day, since the containers are delivered to the dry port within one day preferably by container block trains; \( T_t^s \times (t - 1) \) – released spaces at the seaport, container-slots; \( 365/t \) – turnover of containers at the seaport; \( P \) – average profit per one container at the seaport, Roubles. Therefore, seaport will be able to receive and process at the same area, without any technology upgrade, at the same turnover of 365/t more containers per year.

Additionally, residual values were calculated (\( C^v_{\text{total}} \)). Residual value of the land by the end of the prescribed period \([0; T]\), i.e. the maximum amount of revenue expected to be received for a site:

\[ C^v = C^m_t \times \gamma, \quad (8) \]

where \( C^m_t \) – market price of the land at the beginning of the settlement period; \( \gamma \) – the coefficient, which includes the annual growth of prices for land.
The residual value of the assets other than land, i.e. the maximum amount of revenue expected to be received is as follows:

\[ C^a_v = C^a_t - C^r_t, \]  

(9)

where \( C^r_t \) – market price of the assets; \( C^r_t \) – reduced cost of the assets due to depreciation.

2.2 Outflows of the operating activities (\( C^\textit{total}_t \)) are calculated by summing of the outcomes of the below formulas.

The operating costs connected with the exploitation of the dry port, including rail approaches to the seaport, are as follows:

Prime costs for lifting operations with the containers:

\[ C_l = 365 \sum_{t} T_t \times C^l_c \times 2.\]  

(10)

where \( C^l_c \) – prime cost for lifting operations per container, Rubles/container-operation (Gombosed, 2013).

The costs associated with the storage of containers:

\[ C_s = N_s \times C^s_c \times T, \]  

(11)

where \( N_s \) – the total number of places for containers in dry port; \( C^s_c \) – the cost of storage of container, Roubles/day; \( T \) – inventory turnover, taking into account the average ‘shelf life’ of containers waiting for shipment from dry port, times/year (Abdikerimov et al., 2013).

Apart from operating costs there are value-added tax, profits and property taxes (\( N^\textit{total}_t \)), which were included in the model:

\[ N^\textit{total}_t = R^\textit{total}_t \times 18/118 + 0.2 \times (R^\textit{total}_t \times 100/118 - C^\textit{total}_t) + \frac{2.2 \times I_t}{100}. \]  

(12)

where \( R^\textit{total}_t \) – total inflows; \( C^\textit{total}_t \) – total operating expenses; 18/118 – coefficient for calculating the value-added tax of 18%; 100/118 – coefficient for calculating the revenues without VAT; 0.2 – profits tax in absolute measure (or 20%); 2.2 – property tax.

Additionally, depreciation costs (Rouble/year) have been accounted in the model:
where \( R^d_i \) – annual depreciation and amortization rate, %; \( I \) – investments in the object, Rouble.

On the basis of the calculated cash flows within the prescribed period \([0; T]\), the balance of the operating flows (\( \varphi_{ot} \)) is computed:

\[
\varphi_{ot} = \sum_{t}^{T} (R^d_t \times I).
\]  

Next, the balance of the total flows of investment (\( \varphi_i \)), operating (\( \varphi_{ot} \)), and financial activities (\( \varphi_f \)) is determined:

\[
\varphi_t = \varphi_i + \varphi_{ot} + \varphi_f,
\]

With the allowance for the detected cash flows, the simplest appraisal approach of the payback period (Drury, 2009) is found:

\[
T = \varphi_i + \varphi_{ot} + C_d \geq 0,
\]

Once all cash flows have been discounted to their present values \((t=0)\), the discounted payback period (Drury, 2009) was calculated. The discounted net total cash flow is worked out by the formula:

\[
\varphi'_t = \varphi_t \times \alpha_t,
\]

To account for the time difference values of cash flows, the discount factor was used. The discount factor at the \( t \)-step is computed using the equation:

\[
\alpha_t = \frac{I}{(1 + E_t)^t},
\]
where $E_t$ – the discount rate per year in step $t$. The discount rate varies in different projects, and should be considered in advance. In the described project of dry port, the discount rate $E_t$ is based on the guaranteed rate of return on equity (or the refinancing rate of the Central Bank of the Russian Federation).

Thus, the deterministic model of cash flows, costs and results of the construction of the dry port can be designed in the following form:

$$NPV = \sum_{t}^{T} \alpha_t \times \left( R_t^{total} + C_v^{total} - C_t^{total} - N_t^{total} + C_d + \varphi_{ft} \right) - \sum_{t}^{T} \alpha_t \times I_t \cdot (19)$$

Apart from the cash flows, the risks’ events, which have a high probability of occurring, were included in the model, forming the so-called moderators ($Z$). In the given model, the following risks are taken into consideration: political risks, land acquisition risks; revenue risks; traffic volume risks, and construction hazards.

The risky environment inevitably needs the mediators. Peculiarities of the Russian market are characterized by subjectivism, the dependence of non-economic factors, and the high degree of uncertainty. These risks can be assessed by the use of the Monte Carlo method. In order to perform the Monte Carlo analysis, the Vensim computer simulation program was used ‘as a framework and an easy-to-understand graphical interface’ (Bai and Long, 2012). With the help of simulation, the mental model of the risk analyses was practiced. In other words, simulation allowed imitating the system behaviour through numerical calculations, which were performed by a computer, on the ground of a system dynamics model (Figure 35).
Figure 35. The system dynamics model for appraisal of investment dry port project with the allowance for risks.
6.5 System Dynamics Modelling of Risks and Appraisal of Project Performance

Each type of risk was represented by the several parameters (Figure 35). One of the largest groups of risks that were taken into account is market risks, which in turn include revenue risks, land acquisition risks, traffic volume risks, and construction risks (coloured in green, yellow, blue, and violet in Figure 35). Finally, a political group of risks was considered. The parameter for modelling political risks is coloured in red on Figure 35.

Starting from revenue risks, the following assumptions have been made. The prices of sales for the services can be volatile as the result of the crisis or other ‘black swan’ event. Knowing the concept of Andrew Lawrence and its application to practice, it is possible to suppose the financial situation in the next years (Lawrence, 1999). The theory is that the growing ambitions of a boom in the economy are depicted by the construction of the world’s tallest skyscraper. This phenomenon might have a meaning that the economy requires changes.

With the building of a new skyscraper in China (2,749-foot tall building in Changsha), the world might be on the brim of a new financial crisis. However, the construction of this project was delayed. Meanwhile, Saudi Arabia’s Kingdom Tower might be constructed by 2019 (Theweek.com, 2014). Regardless the fact that it is often impossible to predict precisely when such events like crisis can occur, it was supposed that the ‘black swan’ event could happen during the realisation of dry port project within period of 2015–2019. By the use of the distribution function for this factor, the probability of its occurrence was assessed. The year of possible ‘black swan’ event occurrence was modelled with the uniform distribution, while the rate of prices’ decrease was taken as 20% by the application of normal distribution function.

The next type of risk, which was taken into account, relates to the market risks (e.g. land acquisition risk). The likelihood of land prices to change dramatically is high, according to the estimation of the trends in the past. The prices for the territory can grow exponentially and increase by 1.7 times by the end of the investment horizon. The forecast was made on the grounds of the best-suited trend. That is the exponential approximation rather than linear, because of $R^2=0.86$ (Figure 36).

![Figure 36. Expected growths of prices of the market land, in US dollar per m² (Property bulletin, 2014).](image-url)
Regression analysis started from proposed line function fitted in MS Excel, and it was continued in the ‘Statistica’ program. Like the exponential line shows, the regression R is over 0.50 and is statistically significant (Figure 37).

From the output of the regression analysis ($R^2$ and p-value) can be noticed that the reliability is high, which means the trend is likely to persist as time goes by. Meanwhile, these indications are guidelines, and the conclusions cannot be perceived as a rigid truth based on Durbin-Watson statistic. The volatility of the price of the land
was simulated through the uniform distribution function since the trends from the past do not necessarily hold in the present.

Continuing on market risks, the risks related to the construction phase was taken into consideration. In particular, it implies that the time overruns can occur, resulting in loss of earnings. Within four phases of the project development, one phase (Technical state 2, Figure 34) of construction and operation of the project was delayed so as to simulate this risk. Instead of the allocated time for the investments in technical state 2 of the dry port (2020), the investments were deferred by one-two years to 2021–2022. The traffic volume risk concludes the group of market risks. To model this risk container traffic volume was decreased by 30%, starting from 6th until 8th year (Figure 38).

![Graph of container traffic volume](image)

**Figure 38. The risk of container traffic decrease.**

Finally, political risks were simulated by the interest rate parameter. The evaluation of projects in countries with the high governmental risks, as a rule, increases the required rate of return. In the described project of the dry port, the interest’s rate determines the discount rate. In turn, the latter parameter is comprised of the guaranteed rate of return on equity (or the refinancing rate of the Central Bank of the Russian Federation). During the years, 2008–2009, the refinancing rate of the Central Bank of the Russian Federation fluctuated from 8.25% to 13% and to 15% in the recent period. Since 16.12.2014 Central Bank of Russia raised its key rate to 17% per annum, and since 02.02.2015 decreased it to 15%, and since 16.06.2015, the rate was reduced to 11.5% (Central Bank of the Russian Federation, 2014; Press Office of the Central Bank, 2015). As a reason, it was assumed that the interest rate could fluctuate from 8.25% to 11.5%. The absence of the sufficient information on how the interest rate may change over the settlement period can be mitigated by the use of the uniform distribution for the simulation of the probability of this type of the risk. The high range of the interest rate is used to reflect the potential for an adverse consequence that the project can have due to the negative political hazards.

All results from the simulation were taken after 10 000 (N=10 000) iterations in order to reduce the error. The lower forecasting error of the expected final values means that the model has a smaller variance, which is used to check the validity. In particular, the
validating mechanism is based on the comparison of variances from the predictable mean of the final value (Akalu, 2003).

The first simulation was done when all the parameters were stable (without risks). That is the growing price for the land, interest rate, as well as the absence of ‘black swan’ event, delay in investments, and the decline in container traffic. The point estimate of NPV and duration of the payback period, according to the outcome of the model is 3.959 BI RUB and 8 years 7 months, respectively (Figure 39).

As can be noted, the calculation of the performance criteria is not accurate (i.e. there is an only one-point estimation of DPP and NPV). The reason behind this is that net cash flow models are formulated as deterministic. For example, when modelling fist type of market risks (revenue risk), the ‘black swan’ event may happen deterministically only during year 4 rather than stochastically between year 1 and 5. The rate of decrease in tariffs can be only determined figure (20%), excluding any deviation from the mean. As a result, it will cause the deterministic changes in net cash flows, NPV and DPP (Figure 40).
As can be seen from Figure 40(b), there is only a point estimate of NPV (e.g., without or with a ‘black swan’ event, 3.959 and 3.89 Bl RUB, respectively). The same deterministic rule applies to DPP that equals 8 years 7 months without risks and 9 years 1 month with ‘black swan’ event. However, in the real environment, the net cash flows can vary due to the changes and uncertainties of the conditions, bringing stochastic changes to NPV and DPP. The use of the Monte Carlo simulation provides the probabilistic distribution of the outcome in accordance with the uncertainty of the surrounding conditions (revenue risk factors and others) and generates accurate results of the project performance measures. That is why the Monte Carlo method provides superior basis for many financial risk-management systems. That is why it was employed in the capital-appraisal model of the investments in the construction of dry port.

The accurate results were collected, concerning the effect of each type of the risks on the performance criteria from the probabilistic point of view. When the first type/factor of risk was modelled, the other parameters were kept stable. In the last experiment, all factors of risks were taken into account. In all Monte Carlo simulations, the random data were generated from the specified distributions. In the
first experiment, the *revenue risk* was modelled by the following statistical distribution functions. The probability of ‘black swan’ was defined by uniform distribution (in the first five years from the start of the investments, i.e. 2015–2019). Additionally, the normal distribution was used to model the possible rate of decrease in tariffs by 20% on average (Figure 41).

![Figure 41. Stochastic parameters of the model with the allowance for revenue risk.](image)

The outcome shows how the sensitivity analysis allows to understand the implications of uncertainty in input on the likely results (NPV and DPP). The model indicates that modest uncertainty of the assumptions’ results in modest uncertainty about the value of the NPV and DPP (Figure 42).

![Figure 42. The output of the model (effect of revenue risks on DPP and NPV), in million RUB.](image)
This sensitivity graph shows the uncertainty in the net present value and discounted payback period over time. With the stochastic approach, half of the simulations have generated a value in the proportion of 50%, three-quarters within the 75% region, and 3.8-quarters within 95% and so on.

In the modeled unstable financial situation (revenue risk), the DPP increased to 9 years 1.8 months. NPV decreased on average by 1.8% from the base scenario. The mean, minimum and maximum values of NPV equaled 3.887, 3.878 and 3.893 Bl RUB, respectively with StDev 3.899 Ml RUB and unitized risk value also known as coefficient of variation (CV) of 0.1%. According to the confidence intervals, which were installed during the simulation experiment, and the table of cumulative probability (or table of the normal distribution), the following assumptions have been made. A rate of 75.18% corresponds to a satisfaction level $Z=1.15$. Therefore, the probability value to receive NPV, which belongs to the boundaries $[3.887-3.899 \times 1.15; 3.887+3.899 \times 1.15]$ Ml RUB equals 75.18%. With a probability close to 0, NPV of the dry port project could be below 3.878 Bl RUB. Thus, the obtained results from the modeling of revenue risks can be considered as more accurate than the outcome of the deterministic model (Figure 40).

The next type of market risks, which were modelled, is land acquisition risk. This risk had a less negative cumulative effect on NPV and DPP (Figure 43).

Since prices for the land were stable, the residual value of the land at the end of the investment horizon was lower than in the base scenario where the prices increased at the rate of 3.5% per year. Therefore, NPV reduced by 1.6%, if compared to the base scenario. It equalled 3.897 Bl RUB. DPP increased to 8 years 10 months.

The construction risk resulted in higher impacts on NPV and DPP than previous two types of revenue and land acquisition risks. The delay in investments was modelled with uniform distribution, settling the 1–2 years of postponement to years 2021–2022.
from the year 2020 (Phase 2, Figure 34). As a result, the container traffic flow was growing, while the stance of the facilities remained as unexpended. Consequently, the operation expenses increased dramatically. As a matter of fact, the NPV decreased by 11% to 3.521 Bl RUB with the StDev of 149.2 Ml RUB and unitized risk value (CV=4.24%). Meanwhile, the DPP increased to 10 years 11 months (Figure 44).

Figure 44. The output of the model (effect of construction risk on DPP and NPV), in billion RUB.

In the next experiment, the container traffic was modeled as stochastic, holding the other parameters constant, to analyze the impact of the traffic volume risk (Figure 45).

Figure 45. The output of the model (effect of traffic volume risk on DPP and NPV), in billion RUB.
The decrease of container traffic was prescribed from year 6 to 8. The unstable traffic is simulated with the uniform random distribution. The outcome of the experiment showed that this types of risks significantly change NPV that reduced by 45.4\% on average from the base scenario to 2.161 Bl RUB with the StDev of 22.38 Mi RUB and coefficient of variance of 1.04\%. According to Figure 45, DPP increased to 12 years 10 months. NPV may deviate from the mean, receiving the following values: [2.135; 2.187] Bl RUB with the probability of 75.18\%.

The next experiment with the system dynamics model was made to measure the effect of the political danger (Figure 46).

![Figure 46. Sensitivity analysis of the political risk on NPV and DPP of the project, in billion RUB.](image)

<table>
<thead>
<tr>
<th>Political risks</th>
<th>50%</th>
<th>75%</th>
<th>95%</th>
<th>100%</th>
</tr>
</thead>
<tbody>
<tr>
<td>'NPV vs. initial time'</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Variable</th>
<th>Count</th>
<th>Min</th>
<th>Max</th>
<th>Mean</th>
<th>Median</th>
<th>StDev</th>
<th>(Norm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NPV vs. initial time sensitivity results at time 20 Runs: Political risks</td>
<td>10000</td>
<td>2.266 B</td>
<td>3.897 B</td>
<td>3.012 B</td>
<td>2.982 B</td>
<td>466.7 M</td>
<td>.1549</td>
</tr>
</tbody>
</table>

**Figure 46. Sensitivity analysis of the political risk on NPV and DPP of the project, in billion RUB.**

On Figure 46, sensitivity graph shows better different confidence bounds due to the high level of coefficient of variance (15.4\%). It should be noted that in the current and previous experiments, the values of confidence intervals and their colors were set by the author. Vensim program allows ‘to enter up to 8 confidence bound regions (in any order) and the color that should be used to display them. For example, for a confidence bound at 50, 1/4 of the runs will have a value bigger than the top of the confidence bound and 1/4 will have a value lower than the bottom’ (Vensim.com, 2015). Thus, in the current case, the investments will pay off on average by the time – 9 years 4 months (DPP). However, DPP can deviate from the average figure by ±5 months with the probability of 75\% or might be ±6 months (with the probability of 95\%). The political risk also affected the net present value. In average, NPV decreased by 23.9\% from the base scenario of the risk-free environment. NPV equalled 3.012 Bl RUB with StDev of 466.7 Mi RUB, fluctuating around the mean within the boundaries [2.695; 3329] (50\%) or [2.475; 3.548] (75.18\%), if the additional Z value for the correspondent confidence interval 50\% equals 0.69 (Figure 46).
The last experiment was related to the measure of the effect of all types of risks on discounted payback period and net present value (Figure 47).

Figure 47. The probabilistic distribution of NPV and DPP (all types of risks), in billion RUB.

As can be seen from Figure 47, due to the impact of different risks, the investments will pay off only in 15 years 5 months. The NPV will be 1.173 B1 RUB (with StDev of 294 MI RUB and coefficient of covariance 25.06%), which is lower of the cumulative profit of the scenario without risks, by 70% (Table 8). The probability value to receive NPV, which belongs to the confidence interval [834.9; 1,511] MI RUB, equals 75.18%. With a probability close to 0, the NPV of the dry port project could be below 631.6 MI RUB. On the other hand, the best performance that can realistically occur is that the investments will be returned within 14 years and 3.5 months with the cumulative profit of 1.835 Bl RUB.

The analysis of the five types of risks showed that traffic volume risks had the highest absolute impact on the cumulative profit (net present value) and discounted payback period, which align with the collected empirical data. That is, the information gained from the most common method of data collection used in the qualitative research: interviews (Figure 32). The aggregated outcome from the experiments also allowed the calculation of the relative impact of risks, depending on the elasticity of NPV (DPP) to risks. The second column from the right-hand side of Table 8, i.e. elasticity coefficient of NPV and DPP to the factors of risks divides the ‘% change of NPV (DPP)’ by the ‘% change of risk parameter value’.
Table 8. The elasticity of NPV and DPP to the factors of risks.

<table>
<thead>
<tr>
<th>Factors</th>
<th>NPV with factors of risks</th>
<th>NPV without risks</th>
<th>DPP with factors of risks</th>
<th>DPP without risks</th>
<th>Coefficient of variance</th>
<th>Changes</th>
<th>Base</th>
<th>Elasticity of NPV (DPP in parenthesis)</th>
<th>Relative impact: rating, according to impacts of risks on NPV (DPP in parenthesis)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revenue risk</td>
<td>3.887 Bl RUB (1.8%*)</td>
<td>9 years 1.8 months (6.6%*)</td>
<td>0.1%</td>
<td>Decrease of sales prices by 20% annually during ‘black swan’ event (1–5 years from the beginning of projects realization)</td>
<td>Growth of sales prices &lt;0.5% annually during the investment horizon</td>
<td>4 (4)</td>
<td>0.093 (0.33)</td>
<td>5 (5)</td>
<td></td>
</tr>
<tr>
<td>Land acquisition risk</td>
<td>3.897 Bl RUB (1.6%*)</td>
<td>8 years 10 months (2.9%*)</td>
<td>0%</td>
<td>Growth of price for the land at rate of 10% annually</td>
<td>Growth of price for the land at rate of 3.5% annually</td>
<td>5 (5)</td>
<td>0.46 (0.83)</td>
<td>4 (4)</td>
<td></td>
</tr>
<tr>
<td>Construction risks</td>
<td>3.521 Bl RUB (11%*)</td>
<td>10 years 11 months (27.1%*)</td>
<td>4.24%</td>
<td>Delay in implementation of Phase 2 for 2 years (10% delay within 20 years’ time horizon)</td>
<td>Absence of the delay in implementation of Phase 2 (0% delay within 20 years’ time horizon)</td>
<td>3 (2)</td>
<td>1.1 (2.7)</td>
<td>3 (1)</td>
<td></td>
</tr>
<tr>
<td>Traffic volume risk</td>
<td>2.161 Bl RUB (45.4%*)</td>
<td>12 years 10 months (49.5%*)</td>
<td>1.04%</td>
<td>Decrease of container traffic by 30% from the 6th until the 8th year from the beginning of the project construction</td>
<td>Container traffic decrease equaled to 0%</td>
<td>1 (1)</td>
<td>1.51 (1.65)</td>
<td>2 (3)</td>
<td></td>
</tr>
<tr>
<td>Political risk</td>
<td>3.012 Bl RUB (23.9%*)</td>
<td>9 years 4 months (8.7%*)</td>
<td>15.49%</td>
<td>Risk-adjusted discounting rate 11.5%</td>
<td>Risk-free discounting rate 8.25%</td>
<td>2 (3)</td>
<td>7.36 (6.65)</td>
<td>1 (2)</td>
<td></td>
</tr>
<tr>
<td>All risks (calculated by simulation)</td>
<td>1.173 Bl RUB (70%*)</td>
<td>15 years 5 months (70.6%*)</td>
<td>25.06%</td>
<td>All changes mentioned above</td>
<td>All base scenarios mentioned above</td>
<td>Note: 1.8%* – change in percentage, i.e. decrease of NPV/lengthen of DPP, if compared to the scenario without risks</td>
<td>83.7%*</td>
<td>94.8%*</td>
<td>All changes mentioned above</td>
</tr>
</tbody>
</table>
The coefficient of elasticity of less than one means the inelasticity of NPV and DPP to the revenue risk and land acquisition risk. As a result, these risk factors received lower ratings (5 and 4, respectively). The elasticity to other risks is greater than one. Accordingly, NPV and DPP are sensitive to the construction risk, traffic volume risk, and political risk, since each percent change in the risk leads to further changes in NPV and DPP value, i.e. decreases NPV and lengthen DPP on average by 1.1–7.36% (Table 8). That is why these risks (especially, political risk and construction hazards) have a higher rating in relation to the impact on NPV and DPP, respectively.

According to Table 8, the sum of the impacts on the net present value in percentage from each type of risk (compared to the base scenario) equaled to 83.7%. This figure is higher than the cumulative impact (70%) received from the previous experiment, where all types of risks have been modeled. The cumulative effects of different risks on the discounted payback period in percentage (94.8%) also are higher than the figure of impact generated from the last experiment (79.6%). The aggregated impacts from risks calculated manually as the sum of impacts from each type of risk, which, in turn, were modeled separately in several experiments, were more adverse than the outcome of modeling of risks within one experiment. Therefore, Monte Carlo method provides more optimistic results when the maximum possible number of risk factors is taken into account.

Moving forward, the decomposition of risks into several groups allowed to propose the sharing of the risks among the public and private sector, despite the fact that the Russian market has a lack of consensus between the parties with respect to the optimal distribution of the key commercial and financial risks in PPP projects. As a rule, risks, which are closed by the state include: changes in legislation; political decisions regarding the project; stability control on the macro level; changes in the tax, customs, and other regulation. The private partner provides the following risks: construction risks, including the excess of the duration of the project realization and the value of the project; the likelihood of demand for services/products; operational risks; and changes in the cost of funds and inflation, and currency risks. Some risks are closed jointly by the state and private partners: the modification of the agreement; lack of experience in the implementation of public-private partnership; force majeure; and distribution of powers between partners (Center of public-private partnership development, 2013; Ernst&Young, 2012).

By sharing risks, the state tries to shift some of risk to the private sector. However, in practice, there is no possibility to transfer them fully, so some of the risks are divided between the parties. Partners tend to have a different opinion on the correct risk-sharing (Ernst&Young, 2012; Center of public-private partnership development, 2013). The key factors for the participation of private investors in the projects of the public-private partnership are guarantees of public authorities to pay compensation in the event of political risk. In this regard, the World Bank developed a programme of safeguards against political risks, which, in fact, are the rules on the financial support of the project. The purpose of this programme is to provide state guarantees for the
implementation of certain of its obligations prescribed in the contract (Kovaleva, 2014).

In the model of risks assessment of the dry port project, the political risk has been modeled with the use of the refinancing rate of the Central Bank of the Russian Federation. This parameter is significantly connected with the inflation rate and the currency exchange risks from the point of neo-colonialism (Nkrumah, 1966). This risk was evaluated on average of 23.9% (Table 8). However, it does not mean that the total value will be compensated by the state. For example, the refinancing rate is correlated with the currency exchange rate. If to take into account the Euro, the state could compensate the growth of the Euro up to 100 Roubles. After that, the risk is so significant, even for the public part, that it should be somehow distributed between the private party and the state. It may be 50 to 50, it can be any other ratio, but the government, given the current extremely high volatility, is not interested in taking the unlimited risk. Another note concerns the inflation rate. If the risks-adjusted rate was predicted based on the inflation rate of 10–11%, but the inflation rate, in fact, became higher, e.g. 20%, a certain distribution of risk should initially be agreed between the public and private parties (Gsom.spb.ru, 2015).

The other commercial risks, which are represented in Table 8, are compensated more often by the private party. However, in practice, these risks can be so large that they cannot be closed solely by a private company. Therefore, sometimes the public party also bears the responsibility. Moreover, some of the risks are associated with each other, and, therefore, changes in one are affected by changes in the other. Apart from the instance given before, i.e. about the political risk and their relations to the commercial risks, the second example would be the risks of traffic flows decrease due to the governmental regulations, concerning food embargo. Thus, the detailed examination and classification of the risk can hardly be accurate, since the exact boundary between each type of risk is quite difficult to carry out. However, the risk classification helps to find the balanced distribution of risks between the private and public sectors, as well as contributes to the accuracy of risk analysis and their mitigation strategies.

To a great extent, the risks presented in Table 8 can be a divided into two groups. Most of them are attributed to the non-systematic risks, and only several can be called as a systematic or non-diversifiable risk. The latter risks are closely linked to the overall market and, as a rule, can be compensated by the public sector, while non-systematic risks are mainly in the responsibility of the private sector. The so-called unsystematic or diversifiable risk can be partly mitigated.

By knowing the risks and uncertainties on the market, management may change the strategy of dry port development so as to mitigate losses, first and foremost, from the non-systematic risks. Accordingly, the theory of real options can be used for such an enormous investment project (Gao and Driouchi, 2013; Karttunen, 2009;). The alternative scenarios may help to react on the unexpected environment in the future reactively and proactively. Kirilmaz and Erol (2015) stress that creation of the alternatives relates to the latest steps in the risk management, which as a rule
comprised of three main steps: risk identification, risk evaluation, and risk mitigation. At the same time, in recent studies, the risk monitoring and control phase was also included in the SCRM process (Figure 48).

![Figure 48. SCRM process (Kirilmaz and Erol, 2015).](image)

Since two phases of the SCRM process were considered in the previous sections of the Sub-chapters 6.2-6.5, the following discussion will concern the latest steps, primarily, risk mitigation strategies. For this reason, three scenarios of dry port project realisation are further developed. Some of them rely on the portfolio theory, according to which the non-systematic risks can be reduced by investing in the variety of assets, i.e. through diversification (Markowitz, 2011). However, even the most optimized portfolio will still be subject to systemic danger, because it is a risk that impacts the entire economy and, as such the investments.

One of the most probable and specific risks of dry port development relate to the decrease in container traffic volume. The experiments with the model showed that this risk had the highest absolute impact on cumulative profit (NPV) and discounted payback period of the dry port project. Therefore, the mitigation of this risk was put under the focus in the design of the alternative tactics (Table 9).
<table>
<thead>
<tr>
<th>Base scenario</th>
<th>Reactive alternative No. 1: defer of the investments</th>
<th>Proactive alternative No. 2: additional small container terminal in the another region instead of Phase 4 of the base scenario</th>
<th>Proactive alternative No. 3: additional services at the dry port: grain and metal processing, which brings changes to Phase 2,3 and 4 of the base scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land for the construction of the main railway track No. 1 (L=25 km) and railway line No. 2 (L=25 km), the container yard No. 1 (coloured in green in Figure 34), checkpoint of the terminal, transformer substation, the guard of terminal, electricity, household premises for machine operators and stevedores, embankment base for the adjacent road, handling equipment, water supply, sewerage, heat node, and communications, as well as bonded container yard, warehouse, the area for parking and turning of the trucks, carrying and lifting equipment (three reach stackers), adjacent road, and service and technical buildings; 1st year.</td>
<td>The same as in the base scenario; 1st year.</td>
<td>The same as in the base scenario; 1st year.</td>
<td>The same as in the base scenario; 1st year.</td>
</tr>
<tr>
<td>Mainline railway track No. 1, container yard No. 2 (coloured in yellow in Figure 34), access rail tracks (three), setting rail track, dock rail tracks (three), rail crossings, and handling equipment – one gantry crane; 6th year.</td>
<td>The same as in the base scenario; 6th year.</td>
<td>The same as in the base scenario; 6th year.</td>
<td>Mainline railway track No. 1, container yard No. 2 (coloured in yellow in Figure 34, however, the yard will be divided into smaller yards specialized for the grains and metal goods processing that include four storage silos, warehouse, access rail tracks (three), setting rail track, dock rail tracks (three), rail crossings, and handling equipment (one continuous bucket elevator-noria, two container tilters, two forklift bucket, and grab excavator to fill a container with scrap; 6th year.</td>
</tr>
<tr>
<td>Mainline railway track No. 2, container yard No. 3 (coloured in violet in Figure 34), level crossings, docking rail tracks (three), and handling equipment – two gantry cranes; 8th year.</td>
<td>The same as in the base scenario. However, the investments are postponed from the 8th to the 14th year.</td>
<td>Everything is as in the base scenario, excluding handling equipment (three gantry cranes).</td>
<td>Everything is as in the base scenario, excluding handling equipment (one grab excavator to fill a container with scrap, one gantry crane, and one container tilter; 8th year.</td>
</tr>
<tr>
<td>Container yard No. 4 (coloured in red in Figure 34), the guard of terminal, the container yard for the repair of containers, the site turning of trucks, docking rail track, handling equipment (two reach stackers, two gantry cranes), the road for the circle movement of trucks; 10th year.</td>
<td>The same as in the base scenario. However, the investments are postponed from the 10th to the 18th year.</td>
<td>Additional terminal in the South region, which is built in three phases (Figure 49).</td>
<td>Everything is as in the base scenario, excluding facilities (four storage silos) and handling equipment (two reach stackers, two gantry cranes, one noria), the road for the circle movement of trucks; 10th year.</td>
</tr>
</tbody>
</table>
The decrease in container traffic became the problem of the North-West seaports in the recent years as was mentioned in earlier chapters. The economic crisis and a food embargo (e.g., ban of food import from Australia, Canada, the European Union, Norway, and the United States) led to a redistribution of cargo among the several seaports. In turn, the volume of goods increased passing through the southern ports of Russia, mainly because of an increase in imports of food and other commodities from Turkey, Israel, and the Middle East (Eubusiness.com, 2015; Vedomosti.ru, 2015).

Due to this fact, in January-June 2015, the throughput of the port of Novorossiysk has grown to 63.7 million tonnes (+4.8%), while the turnover of the St. Petersburg seaport reduced to 26.3 million tonnes (-12.0%; Morport.ru, 2015). At the same time, statistical information from the seaports of St. Petersburg and Novorossiysk shows that the throughput of both seaports decreased in container tonnes by -16.7% and -8.9%, respectively, in January-July 2015, if compared to the same period of 2014 (Administration of Seaports of the Baltic Sea, 2015; Nmtp.info, 2015). In general, according to Vedomosti.ru (2015) sanctions and the economic downturn have led to a decrease in import freight by 25–40%, depending on the type of goods. According to Worldcargonews.com (2015d), due to weak foreign trade traffic with Russian seaport, the container throughput via Hamburg also became distinctly lower in 1H/2015 than last year’s (by 35.9% at 212,000 TEU).

The risk of cargo decrease in the project of the dry port can be reduced by different measures that could be similar to the planned seaport resilience. For example, Trepte and Rice (2014), for the failure of the one port, proposed the volume shifts to the alternate port. Since the variety of tactics may include reactive and proactive approaches, the current study utilised both of them. Due to the fact that reactive tactic implies ‘wait and see’ approach, which does not have actions before the risky event (Kirilmaz and Erol, 2015), in the case of the dry port project, this approach foresees the delay in the investments during the decrease of container traffic from the 6th year until the 8th (Figure 37, Table 9).

The proactive strategy is represented by other two alternatives (Table 9). Knowing that the cargo can be redirected to other seaports, the additional inland terminal, for example, in the South region of Russia can be built instead of the Phase 4 in the base scenario of dry port project (Table 9). The investment horizon for the additional terminal is 15 years, rather than 20 years, which was proposed for the large dry port, because the small terminal includes only two container yards that can be built in three stages (in addition to the logically prior): 1) Construction of container yard (width 19 m), service and technical buildings, asphalted road (3.5 m), fence, transformer substation, the unit of water supply, and installation of a gantry crane. Construction of the railway track (473 m), asphalted road (7 m), household premises for machine operators for 50 people, a fence, a transformer substation, sewerage. 2) Construction of container yard (width 23 m), railway crossing, rail track (391 m), the installation of gantry crane. 3) Construction of rail track (473 meters), the installation of gantry crane (Figure 49). The planned processing capacity of the small container terminal at the end of the investment
The third scenario of the dry port project realization also foresees proactive tactics (Table 9). The food embargo that resulted in the decrease of import referred containers in St. Petersburg seaport can be diversified by the development of the other services for customers. This idea is employed in the designed strategy. In particular, the container yard number 2, which is proposed in the second phase will be specialised for the metal and grain cargo processing that have a high potential for the export market from Russia.

Association of Sea Ports recorded growth in scrap handling already in 2014 by 27.9% to 4.7 million tonnes and ferrous metals by 5.9% to 23.3 million tonnes. It is supposed that loading scrap and ferrous metals also can increase within the network of Russian Railways. Due to the devaluation of the Ruble in 2014, the cost of production of metals and scrap declined. Therefore, exports of these products became more attractive (Liner.ru, 2015). The same tendencies are forecasted on the market of the grain cargo. North-Western Shipping Company (NWSC) in the 1st quarter of 2015 could gain on the transportation of the export cargo. Most of the traffic was consisted of export goods, such as grain, scrap, coal, chemical, and mineral fertilizers, transportation of which increased by 41% to 0.85 million tonnes for NWSC.

Thus, the provision of the additional services, e.g., related to the export of grain, scrap, and ferrous metal can mitigate the risk of the decline in import flows. For instance, the loading of specialized containers by scrap and grain at the dry port can bring substantial benefits (Panova et al., 2012). In many instances, in the case of the storage of grains in the seaport more than statutory 20 days, the exporter has to pay the excess fare per each ton of storage per day. The lands, where the dry ports located are far cheaper than maritime territories, therefore, the tariffs for services are significantly lower. Additionally, the loading of grain in containers at the dry port may increase the productivity of the seaport, because the average loading rate of

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**Figure 49. Scheme of the additional inland terminal in the South region of Russia.**

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grain in containers to the ship can be higher than the loading rate of bulk grain in the rainy days.

The analysis of different scenarios of the dry port development was made with the use of the previous model (Figure 35), which was specified to the needs of the experiment. For example, in the first alternative, changes were made to the year of Phase 3 and Phase 4 of the construction. Due to the decline of the container traffic from year 6 onwards until year 8, the proposed years to introduce Phase 3 and Phase 4 were deferred to 14th and 18th year, respectively, instead of 8th and 10th year. By doing so, the NPV could be increased on average to 1.792 Bl RUB with the standard deviation of 341.7 Ml RUB. Meanwhile, DPP can be reduced to 11 years 9 months (Figure 50).

It should be noted that the selected years to introduce the Phase 3 and 4 are the most rational, as the output of the model had showed. The introduction of these stages in earlier or later years provides less cumulative profit from the projects (1.510–1.782 Bl RUB) and times when the investments pay off. Thus, the ‘wait and see’ approach allows to decrease risks of losing cumulative profit and longer payback periods. In particular, net present value increases by 52% to 1.792 Bl RUB from the NPV in the scenario with all risks and no actions undertaken (1.173 Bl RUB, Table 8). At the same time, the DPP shortens by 3 years 6 months from the worst scenario (15 years 5 months, Table 8). Additionally, diversification of risks by this mitigation strategy lead to a reduction of risk, because the variation coefficient became significantly less (19.07%) than in the base scenario with all risks (25.06%).

The second alternative that could mitigate specific risks of the dry port project is related to proactive strategy. The survey on the benefits from the implementation of the small terminal instead of one Phase 4 of the dry port project (Table 9) required the adjustment of system dynamics model (Figure 51).
Figure 51. Proactive alternative No. 2 of dry port project development: a) The simplified casual loop diagram; b) The detailed model of risk assessment.
Based on the simplified causal loop diagram (Figure 51a), a more detailed model of risk assessment in the proactive scenario No. 2 was developed (Figure 51b). The model proposes that out of 30% of declined container traffic during 6–8 years, 20% will be shifted from the primary inland container terminal to the smaller terminal. The construction of the additional terminal allows reducing risks more dramatically than the previous reactive risk mitigation scenario, but takes higher investments. The outcome of the model shows that total investments will pay off within 10 years 7 months, which is less than in the worst scenario (i.e. with all risks and absence of risk management strategies) by 4 years 8 months. However, if to consider the investments in both container terminals separately, the primary inland terminal will provide 1.58 Bl RUB of the cumulative profit and DPP of 13 years 5 months. Meanwhile, the investments in small container terminal will pay off within 5 years 5 months and provide a cumulative profit of 1.213 Bl RUB by the end of the investment horizon (15th year). Therefore, the total NPV from both undertakings, which represents the proactive alternative No. 2 of the dry project development, would be 2.793 Bl RUB that is higher than in the scenario without risk management practices by 1.4 times. Additionally, the proposed mitigation strategy also reduces the risk, because the standard variation coefficient became less than in the base scenario: the weighted average of variation coefficient of the two options (Figure 52b and 52c) included in the portfolio of dry port project (Figure 52a) is as follows: 17.37×(1.213/(1.213+1.58))+20.51×(1.58/(1.58+1.213))=19.15%.
Figure 52. Sensitivity analysis of the proactive alternative No. 2 (diversification of risks by additional container terminal in another region). Note: a) Dry port project portfolio, which includes b) Primary inland container terminal, and c) Small inland container terminal.

It should be noted that combination of this proactive strategy with reactive tactics allows gaining more favorable results in risks mitigation. Due to the decline of container traffic in the one part of the project of the dry port (within the primary inland container terminal) from the 6th year until the 8th year the introduction of the 3rd Phase was proposed to postpone for 7 years (from the 8th year to the 15th). The experiments with the model showed that the defer of the implementation of Phase 3 until year 15th is the most rational compared to other earlier or later years, because it provides the highest NPV and shortest DPP, i.e. for the primary inland container terminal option is 1.89 Bl RUB and 11 years 2.5 months, respectively (Figure 53).
Figure 53. Sensitivity analysis of the combined alternative (reactive alternative No. 1 and proactive alternative No. 2), concerning one option of dry port project portfolio (i.e., primary inland container terminal option).

Since the combined alternative affects positively the return on investments in primary inland container terminal option, it was supposed that it would have favorable effect on the whole dry port project, which includes also the option of small inland container terminal. In this regard, the total NPV (for the primary inland container terminal and additional small inland container terminal) was computed (1.89+1.213=3.103 Bl RUB). The diversifiable risks by the proposed combined mitigation strategy (reactive alternative No. 1 and proactive alternative No. 2) were likewise better taken on than in the former proactive alternative No. 2 alone, because the coefficient of variation of this portfolio became generally less (17.96×(1.89/(1.213+1.89))+17.37×(1.213/(1.213+1.89))=17.73%) than the weighted average of the variation coefficients of the previous proactive risk management alternative No.2 (19.15%). The DPP for the portfolio (Figure 54) equaled 9 years 7 months.

Figure 54. Sensitivity analysis of the combined alternative (reactive alternative No. 1 and proactive alternative No. 2), concerning both options of dry port project portfolio (i.e. primary and small inland container terminal options).

The next alternative of dry port project development is also proactive. It implies the introduction of additional services (grain and scrap and ferrous metals processing). In order to analyze the mitigation of risks from this tactic, the system dynamics model from Figure 35 was tailored by traffic flow of grains and metal and their processing orders (Figure 55). The arrival of grains and metal equals to 500 and 2000 tonnes per day by the end of the investment horizon.
Figure 55. The model of risk assessment of the proactive alternative No. 3 (additional services within the dry port).
The experiments with the adjusted model allowed collecting the data about cumulative profit and the time, when investments will pay off (Figure 56).

According to Figure 56, the investments will pay off within 13 years 6 months and bring a cumulative profit of 1.743 Bl RUB, with the CV of 21.67%. However, if to combine this option and reactive alternative 1, the results will be more optimistic. For that to happen, the combined alternative was developed. Proactive alternative 3 was amended by putting off the investments in Phase 3 and Phase 4 from 8th year and 10th year, respectively to 13th and 15th years due to the reduction of container traffic during 6–8 years. These changes provide the following outcomes (Figure 57).
Figure 57. Sensitivity analysis of the combined (reactive alternative No. 1 and proactive alternative No. 3).

The cumulative profit will be 2.202 Bl RUB, with the standard deviation of 407.2 Ml RUB, while DPP will equal to 10 years 8 months. The CV would be 18.48%, meaning the reduction of risks, if compared to the base scenario with all unmitigated risks, in which the CV equals to 25.06%.

On the whole, the results from five scenarios of dry port project development are presented in Table 10 in the form of comparative analysis. By knowing the value of the NPV, DPP, CV, with (without) risks tactics and initial capital investments in each alternative, it is possible to quantify a measure of the satisfaction with the additional investments in the risk management strategies. That is marginal utility of investments (MUI) in the risk mitigation alternatives of dry port project realization: \( E(I_{NPV}) \), \( E(I_{DPP}) \), \( E(I_{CV}) \). It was developed based on the elasticity concept and utility theory (Black et al., 2012; Law, 2008; Pereira et al., 2005). MUI shows the amount, by which a utility would be increased, if given a small quantity of additional money, per unit of the increase. The amount of investment then enters as the argument of the utility function and the marginal utility of investments arises from the increase in this argument: \( E(I_{NPV}) = f(\Delta I) \), \( E(I_{DPP}) = f(\Delta I) \), \( E(I_{CV}) = f(\Delta I) \). Therefore, the deduced formulas of MUI assume that investors derive utility directly from the financing of the risk mitigation strategies of dry port development. The below equations reflect clearly the degree of impact of changes in capital investments \( \Delta I \) (i.e. difference in the amount of investments between two scenarios, with and without risk mitigation strategies – \( I_m \) and \( I_p \), respectively) to the change either in the net present value (\( \Delta NPV \)) or in discounted payback period (\( \Delta DPP \)), or in unitized risk value(\( \Delta CV \)):

\[
\frac{\Delta NPV}{NPV} \times 100\%, \quad \frac{\Delta DPP}{DPP} \times 100\%, \quad \frac{\Delta CV}{CV} \times 100\%.
\]

where \( NPV' \), \( DPP' \), \( CV' \) – computed value respectively of \( NPV \), \( DPP \), and \( CV \) for the scenario of dry port development, which envisages additional investments to take actions on risks; \( NPV \), \( DPP \), \( CV \) – the value of the \( NPV \), \( DPP \), and \( CV \), respectively calculated by the decision appraisal model, in which all parameters are set without risk mitigation tactics (Table 10).
<table>
<thead>
<tr>
<th>Scenario</th>
<th>Financial evaluation techniques</th>
<th>Capital investments without risks mitigation tactics, ( I_r ) (prices at the 1st year of the investment horizon)</th>
<th>Capital investments with risks mitigation tactics, ( I_m ) (prices at the 1st year of the investment horizon)</th>
<th>Ranking of alternatives based on ( E(\text{NPV}) ) and ( E(\text{DPP}) ), as well as ( E(\text{CV}) )</th>
<th>MUI in risk management strategy: ( E(\text{I}<em>{\text{NPV}}) ), ( E(\text{I}</em>{\text{DPP}}) ), ( E(\text{I}_{\text{CV}}) )</th>
<th>Ranking of alternatives based on ( E(\text{I}<em>{\text{NPV}}) ) and ( E(\text{I}</em>{\text{DPP}}) ), as well as ( E(\text{I}_{\text{CV}}) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reactive alternative 1 (delay in investment)</td>
<td>NPV with risks mitigation tactics (ANPV) 1.792 Bl RUB (52.7%)</td>
<td>11 years 9 months (23.8%)</td>
<td>19.07% (23.9%)</td>
<td>2. 951 Bl RUB (const.)</td>
<td>4 (3)</td>
<td>-</td>
</tr>
<tr>
<td>Proactive alternative 2 (diversification by investment in the additional terminal in another region)</td>
<td>NPV without risks mitigation tactics 2.793 Bl RUB (138%)</td>
<td>10 years 7 months (31.4%)</td>
<td>19.15% (23.5%)</td>
<td>3.244 Bl RUB (2.473 Bl RUB +70.5 Ml RUB) (9.9%)</td>
<td>2 (4)</td>
<td>13.93, 3.17, 2.38</td>
</tr>
<tr>
<td>Reactive alternative 1 with proactive alternative 2</td>
<td>NPV with risks mitigation tactics (ANPV) 3.103 Bl RUB (16.5%)</td>
<td>9 years 7 months (37.8%)</td>
<td>17.73% (29.2%)</td>
<td>3.244 Bl RUB (2.473 Bl RUB +70.5 Ml RUB) (9.9%)</td>
<td>1 (1)</td>
<td>16.66, 3.82, 2.95</td>
</tr>
<tr>
<td>Proactive alternative 3 (diversification by investment in other services)</td>
<td>NPV without risks mitigation tactics 1.743 Bl RUB (48.6%)</td>
<td>13 years 6 months (12.4%)</td>
<td>21.67% (15.5%)</td>
<td>2. 947 Bl RUB (4%)</td>
<td>5 (5)</td>
<td>12.15, 3.1, 3.38</td>
</tr>
<tr>
<td>Reactive alternative 1 with proactive alternative 3</td>
<td>NPV with risks mitigation tactics (ANPV) 2.202 Bl RUB (87.7%)</td>
<td>10 years 8 months (30.8%)</td>
<td>18.49% (26.2%)</td>
<td>2. 947 Bl RUB (4%)</td>
<td>3 (2)</td>
<td>21.93, 7.7, 6.55</td>
</tr>
</tbody>
</table>
The analysis of a range possible alternatives of risk management strategies (Table 10) shows that one of the rational portfolios for mitigation of risks impact on the dry port project would be a combination of two tactics, e.g., defer of investments in Phase 3 and Phase 4 (reactive alternative 1), which is complemented either by diversification of the investment in other services, such as grain and metal processing (proactive option 3), or by the construction of the additional small inland container terminal in another region (proactive option 2), provided in Table 9.

The portfolio, which consists of reactive alternative 1 and proactive option 2, provides an absolute high effect from taken actions on risks, as financial evaluation techniques depict (NPV=3.103 Bl RUB, DPP=10 years 7 months), with a low coefficient of variance (unitized risk value=17.73%). The other portfolio (reactive alternative 1 and proactive option 3) brings the following absolute values of the discounted cash flow approaches: 2.202 Bl RUB and 10 years 8 months, with the unitized risk value of 18.49%. Assuming that investor is risk-averse, a portfolio with less risk (i.e. reactive alternative 1 + proactive option 2) would be in preference of investor. As a rule, the higher the level of risk aversion, the closer will be the portfolio with the minimum variance portfolio (Markowitz, 2011, see also Black et al., 2012; Law, 2008).

However, according to the portfolio theory, apart from risk preference, various structures of utility should be considered (Law, 2008). For this purpose, the proposed marginal utility of investments (Formula 20) could be utilized. Since capital investments in two portfolios are not the same (Table 10), and more often are higher than in the base scenario (without risks mitigation strategies), the efficiency of investments in risk management strategies of dry port project development have been computed by Formula 20.

The investments in the portfolio of reactive alternative 1 with proactive alternative 3 are comparatively less than in the most capital-intensive portfolio (reactive alternative 1 + proactive option 2), which, naturally provides absolute maximum expected utility, concerning NPV, DPP, and CV (Table 10). However, from the point of marginal utility of investments, NPV, DPP, and CV, are more elastic to the change of investments that characterize the portfolio of reactive alternative 1 and proactive option 3, since each percentage change (1%) of investments from the base scenario (without risks mitigation tactics) leads to higher positive changes in expected utility of a risky prospect of dry port development, bringing higher MUI (i.e., 21.93% and 7.7%, and 6.55%, respectively).

Another portfolio (reactive alternative 1 + proactive option 2), on the contrary, provides the relatively lower marginal utility of investments (16.66%, 3.82%, and 2.95%, respectively; Table 10). It means that average percent change of investments to take actions on risks, related to the dry port project realization, brings the increase of net present value and decrease of discounted payback period, as well as unitized risk value only by 16.66%, 3.82%, and 2.95%. Therefore, the portfolio, consisting of reactive alternative 1 and proactive alternative 3, could be considered as more attractive for the risk-averse investor, because it is characterized by more efficient
portfolio frontier (Black et al., 2012). That is, higher maximization of the expected value of the outcome of risky prospect of dry port development, such as NPV and DPP, for a given level of risk and higher minimization of the variance, denoted by the unitized risk value, if given a small quantity of additional investment, per unit of the improvement. The same characteristics cannot be applied to another portfolio (reactive alternative 1 + proactive option 2), because it has a lower efficiency of the investments in a risky prospect of dry port development (i.e. lower marginal utility of investment).

In conclusion, it is worth to stress that the proposed capital-appraisal model of investments in risk management strategy of dry port project realization was built on the grounds of several pillars. Those are the popular capital budgeting techniques, including appraisal approaches that use discounted cash flow principle, as well as Monte Carlo method, real option theory and portfolio theory combined via system dynamics simulation approach. Doing so provided a higher accuracy and reliability of the outcome of the economic appraisal.

The system dynamics simulation is more advanced, if compared to any deterministic approach, because it provides the distributed value of the financial evaluation techniques. The deterministic model for the economic appraisal of the project performance criteria, such as the DPP and NPV, lacks the accuracy in measurement of project uncertainties, since it permits only fixed dimensions computed by DCF appraisal routine (either the fixed value of the time required before the forecast of discounted cash inflows from an investment will equal the initial investment expenditure or the point estimate of the present value of the investment project).

On the whole, the first appraisal approach, net present value, is one of the standardized and superior project performance criteria. However, NPV is based on the assumptions of certainty of the project life. Therefore, it was not used as an explicit capital budgeting decision approach alone, especially for the environment that is not free of uncertainties. In other words, the decision making on the acceptance of the project by the positive NPV could not reflect the period or the project’s useful life. This period, as a rule, can be exposed to risk due to changes in political, technological, and regulatory factors.

Thus, the pitfall of the first economic appraisal technique was easily mitigated by the employment of the second technique, discounted payback period. Through the developed system dynamics model, which was simulated by the Vensim software, the benefits of DPP to explicate project liquidity for the decision appraisals have been revealed. Thus, DPP is not less significant capital budgeting criterion than net present value for determination of the preferred investment in the dry port projects, developed in a risky environment.

The model shows that for the Russian environment, the importance of the DPP criterion from the stochastic point of view can be comparable to NPV. The variety of political and market risks require, from managers, to focus on capital budgeting of different investment alternatives that ensure project profitability and liquidity.
The only criterion, which satisfies both, is DPP (Bhandari, 2009). Consequently, the results of the simulation suggest that both criteria (NPV and DDP), as well as CV, should be utilised in the feasibility studies of risk management strategies of dry port development via public-private partnership investments. With a view to determining an alternative of dry port development, which is likely to give the highest efficiency of investments, the proposed marginal utility of investments can be used. Rational investors, who averse to taking increased risks unless they are compensated by the adequate increase in the expected utility of a risky prospect, can compute the so-called commensurable indicator of the efficiency of investments on the ground of the results from systems dynamics model.
7 CONCLUSIONS

7.1 Theoretical Implications

The conducted study was geared towards the search for the answer to the question ‘How the development of dry ports can be facilitated, knowing peculiarities of Russian logistics markets and risks?’. In the pursuit of the goal, the research has been developed through the gradual steps. The logical sequence of the steps was provided from the systems point of view (Gammelgaard, 2004; Lindskog, 2012). Each step, which approached the sub-research question, contributed to the understanding of the compound problem of public-private partnership investments in dry ports within the Russian business environment. It is, however, not deprived of the risks (Goriaev and Zabotkin, 2006; Hilmola et al. 2008; Saleem and Vaihekoski, 2008).

The first sub-research question is ‘What stimuli initiate the investments in the dry port projects within Eurasian supply chains?’ The answer to the question defines and formulates the multilateral problems and opportunities for the Russian transport system. First and foremost, for the railways and co-located dry ports (Hanaoka and Regmi, 2011; Monios and Lambert, 2013) that should support advanced logistics services in transiting countries. Chapter 2 and Paper 1 ‘Potential of connecting Eurasia through Trans-Siberian Railway’ clearly point out how important is to provide a high quality of export of transport services for the operation of intermodal transport. It is regarded as means to reach an unprecedented level of integration to Eurasian logistics systems. Additionally, the low level of logistics costs eventually wins approval. The statements are mainly addressed for the Trans-Siberian Railway, which is the central backbone of Russia, to be transformed into the international bridge, transiting cargo between Asia and Europe.

The critical role is paid to the stance of the terminal and warehousing infrastructure along the transport corridor on the approaches to the seaports, especially in the Asian part of Russia (Far Eastern region). The Far Eastern ports Vladivostok, Nakhodka, and Vostochny, passing the cargo from the Asia to countries of EU and back, require harmonious cooperation with the Trans-Sib. It can be attained through the concept of dry ports (Ambrosino and Sciomachen, 2014; Henttu and Hilmola, 2011; Monios and Wilmsmeier, 2012; Rodrigue and Notteboom, 2012; Roso, 2009, 2013). The development of dry ports will improve the quality of the service of the clients and reduce the cost expense for shippers in the case of choosing TSR for a transit of goods to other countries. The reasons for these expectations are as follows. The dry ports will permit to apply the ‘pull’ logistics principle, decreasing the lead time on average by three days. The concentration of the range of inland activities, such as bulk storage, customs clearance, container picking/unpicking, order picking, container loading/unloading, and orders palletising, inevitably, meets the requirements of the clients. Customers will no longer need to suffer from delays and an insufficient assortment of the logistics services at seaports.

Thus, by investing in the terminal and warehousing infrastructure, such as dry ports,
the basic expediting services can be easily expanded to the value-added logistics operations, forming a so-called all inclusive door-to-door shipments. The requirements for the comprehensive services that could be organized by fourth-party logistics providers are determined by the necessity to export high quality of logistics services. In this regard, the first contribution of the study can be attributed to the designing of the framework, which is appropriate to use for the theory development, justifying the investments in dry port projects from the macro and micro points of view.

The second sub-research question is ‘Which types of principles and factors define the alternative variants of dry port project realization in support of strategic plans to increase national logistics markets agility?’. It extends the findings from the macro level of previous Chapter 2 and Paper 1 to the micro level, holding the entire logic of the research. Namely, the base for international supply chains, which are represented by the land transport corridors, remains railways, seaports, and terminal/warehousing infrastructure. However, the supply chain elements are analysed from the lower level of abstraction. That is within the framework of the national intermodal system of traffic. The studies in Chapter 3 ‘Russian Logistics Market: Problems and Prospects for Intermodal Transport Development’ and two Papers (2, 3) amend the certain points in the definition of dry ports based on empirical analysis of principles and factors of their development, as well as indicate the common interests of different parties in their construction.

Regardless the generally accepted idea of dry port, the definition of this phenomenon can vary due to national laws and regulations. The intergovernmental agreement on dry ports (2012), which was created by Economic and Social Commission for Asia (ESCAP) with the active participation of the Russian delegation, intends to fix the concept at the normative legal act, once it is ratified. The signed agreement specifies a dry port location within the country, identifies its connections to one or more modes of transport, as well as defines its core functions (e.g., processing, storage, customs control, and inspection of goods carried in the course of international trade in accordance with the law). For these functions to be useful, it is required to consider all relevant aspect and possible side effects.

In particular, albeit there have been efforts to develop dry ports throughout Russia, their implementation took place more actively near the seas. Dry ports located in deep inland areas remain at an early stage of development (Chapter 3). For that reason, Paper 2 ‘Dynamics of Russian dry ports’ considers the main purposes of the dry ports based on the experience of their widespread implementation in the busiest North-West sea basin of Russia. So as to ‘extend’ the seaport functions to ‘dry’ port and carry out customs inspection directly inland, implying internal customs transit (ICT) without the need for re-registration of cargo in the seaport, inland terminals should be developed under the jurisdiction of the customs, which is the same as for the seaport. Otherwise, the simplified customs’ procedures are not possible to provide. Consequently, on the ground of the findings from the empirical analysis of dry port projects realisation on the regional level, one can conclude that the term of
the dry port is more sophisticated for the Russian practice due to the specifics of customs organisation. In this respect, the concretised definition of the dry port can be considered as the second implication of the research.

To complete the answer to the second sub-research question, Paper 3 ‘Perspective reserves of Russian seaport containers’ addresses different factors of dry port utilisation by the seaport terminal. If, for example, in the EU, congestion and environmental concerns have become major policy factors for dry ports development (Bergqvist and Monios, 2014; Roso, 2009; Roso et al., 2015; Trepte and Rice, 2014; Wan et al., 2014), their development in Russia is determined mainly by the technical group of factors, which were regarded the most important among the others (e.g., ecological, economic, and operational). At the same time, investments in dry ports near the sea by any interested party are reasonable only for the seaports, experiencing the inability to expand seaport at the site. This hypothesis was proven by computer simulation model, which was based on information from seaports of St. Petersburg, Novorossiysk, and Vladivostok, where the container traffic has been booming before the crisis.

Additionally, Paper 2 concludes the analysis, concerning the superior role of the dry port in enhancing the productivity of seaports. This alternative is compared to other options, such as physical expansion at the site or changing the container yard management. If a dry port is created, the seaport capacity can be increased by 2.5 times compared to 1.5 capacity enlargements from the seaport’s physical expansion. An option of extra levels in container storage will bring less efficiency at the seaport than the alternatives mentioned above.

The benefits from the development of dry ports can be placed in the scope of interests of the seaports administrations, as well as the representatives of railways. Chapter 3 indicates about the need for the proactive role of the rail transport companies and the state in the dry ports implementation. For instance, the activity of JSC ‘RZD’, its subsidiaries, and undertakings are anticipated for the improvement of the current situation on the market of terminal and warehousing business. The transport company that owns warehouses and freight terminals can potentially process a larger volume of traffic flows (Abdikerimov et al., 2013; Hanaoka and Regmi, 2011). The deficit of the warehousing facilities at railways and postponed high demand for handling containers do not give a reason to doubt the guarantee for the growth of the this business in foreseeable future. The warehousing capacities that are connected with railways will be on the demand for consignees and transport operators on the Russian market. The investments in the inland terminals, such as dry ports linked by a high-capacity mode of carriage with the seaports, are beneficial for the railway companies. By doing so, JSC ‘RZD’ can increase the volume of traffic on railways, i.e. reduce the road presence in connection with the seaports.

Without the extra capacity of rail approaches to the seaport, inland terminal and warehousing infrastructure, the flow of cargo will be constrained. The insufficient support of the mentioned technological parts of the maritime logistics supply chains handicaps the ability to import and export larger volumes of cargo, heading to or out
of the seaport. This idea was depicted by the discrete-event simulation model, which revealed that the increase of terminal equipment along with absent of sufficient space or technological upgrade of the seaport operations has a limited potential for the growth of the throughput. Meanwhile, dry port permits a reduction of a lead time, which is a dominant aspect of the capacity increase from the systems point of view.

By and large, quick and timely transportation of goods with the use of railways, by which inland terminals are connected with the seaports, creates preconditions for attracting transit flows on the network of JSC ‘Russian Railways’. To a lesser but growing extent, the Russian Federation will be able to export services, in excess of the raw materials, and comparable to the international standards logistics services that have become the driving force of modern economic development.

The described outcome from Paper 2 and 3, and Chapter 3 cemented the third contribution of the study that can be affiliated with the classification of factors of the public-private partnership investments in dry port projects, among which the technical group is the most important, if compared to ecological, economic, and operational factors. Moreover, the primary group of factors have been formalised by analytical and simulation models, allowing to depict the considerable benefits that potential investors, mainly representatives of seaports administration and railway companies, can generate from dry ports realisation.

The third sub-research question is ‘What project selection criteria and methods are used to specify public and private concerns about the contextual environment of the dry ports implementation?’ It considers the choice of the alternative ways of dry port development, as well as the variety of cooperation options for possible subsystems based on public-private partnerships. Behrends (2011) stresses that public-private cooperation is needed both on a local and regional levels for the interaction of urban freight and intermodal transport. The integrated model of transport planning, rational land use and environmental regulations contribute significantly to the reduction of the vehicle kilometre mileage, energy consumption, and emissions. Therefore, this policy became of the central importance nowadays (Bisen et al., 2013; Bergqvist and Monios, 2014; Tang et al., 2014; Liu et al., 2015). Since the current study is focused on the intermodal transport, mainly the rail haulage and transhipment nodes, the primary attention is paid to the cooperation of public and private actors within the regional transport systems. First and foremost, the investment schemes consider the participation of JSC ‘Russian Railways’. The reason behind the proposed form of cooperation is hidden in the increasing role of rail transport in the world in the last years due to the deregulation processes, allowing to increase and improve services for the client at the reasonable prices (Hilmola and Laisi, 2015; Laisi, 2013; Saranen, 2009). This idea also discussed in the Paper 4 ‘Deregulation of the Russian railway freight market – learning from empirical results’.

The findings from this paper complemented the previously mentioned third contribution of the study. That is the grounding of the economic reasoning, which is closely related to the deregulation of the Russian Railways, and was provided in addition the array of factors of dry port investments that have been described earlier.
The national rail system is not an exception from the global trends in the fractioning of this sector towards its renovation and liberalization, affecting the competitive forces like, for example, in the USA (Hilmola and Laisi, 2015). The transformation of Russian Railway that was started in 2001 resulted in the establishment of 2,000 companies, which have entered the market by providing leasing services. Within contrast to other countries, traction in Russia is only supplied by the national railway undertaking, JSC ‘RZD’. The situation is expected to change shortly, which will transform the whole market structure. The Russian market is now in the transition process of the establishment of new undertakings, including the development of private maintenance companies, terminal and warehousing businesses, etc., opening the opportunities for new prominent participants. Bergqvist and Monios (2014) stress that due to the liberalisation of rail sphere in Europe, the role of public and private sector gain principal importance in the establishment of economically competitive inland terminals.

Albeit attractiveness of the private business within railway industry is growing, the entry barrier of capital, including both the investments and know-how, is particular to the whole Russian railway freight market, and more keenly, for the terminal and warehousing business. The challenge of capital barriers, as a rule, is aggravated by the financial crisis, leading to austerity in different sectors of the economy (Kentikelenis et al., 2014; Looney, 1986; Pollin, 2003). In Russia, the budgetary cutbacks of the financial funds for the rail sphere, if compared to the state support for roads, negatively influence the strategic plans of the development of the infrastructure. Notably, the rail approaching seaports, the freight terminals and warehouses can be more vulnerable for the austerity. In these circumstances, the inevitable and fast development of dry ports in Russia can be facilitated through the public-private partnership.

The findings in the Paper 5 ‘Justification and Evaluation of Dry Port Investments in Russia’ depicted that, in many countries, the financial burden has been overcome through the PPPs. The example countries would include Spain, Sweden, New Zealand, and India. The world experience shows likewise that the main investors in the dry port projects are rail and terminal infrastructure owner, as well as operator of terminal (Antai and Olson, 2011; Bergqvist et al., 2010; Monios, 2011; Monios and Wilmsmeier, 2012; Ng and Cetin, 2012; Ng and Gujar, 2009; Pekin and Macharis, 2013; Roso, 2013). Moreover, overseas practices prove that public actors tend to position themselves as landlords (Bergqvist and Monios, 2014). However, they are more often than not included in the different routine situations.

From this point of view, JSC ‘Russian Railways’ has to take a more active role in the development of dry ports. The JSC ‘RZD’, if included in the project, will receive the profit right after the beginning of the dry port exploitation. The income can cover operating costs, which will otherwise exist insufficiently balanced, if to act as landlords. The participation of enterprises of Russian Railways in the project will also guarantee the assistance for private companies that can gain the profit from the exploitation of the created dry port. Meanwhile, the public party can merchandise the
know-how implemented by the private investors, during the development of the projects based on PPP.

On the whole, the mechanism of PPP investments can be considered as the most feasible way to implement large projects in the conditions of lack of funding (Chen et al., 2013; Khristolyubova, 2013; Korol’, 2015). Therefore, the fourth contribution of the study was attained by the formalization of the feasibility study of the public-private partnership investments in the dry port project, allowing to mitigate the financial barriers. The modeling of cash flows, both inflows and outflows of the dry port project and their discounting over time, was based on the deterministic approach. Knowing that the future receipts and project outgoings are subject to uncertainties, in the appraisal rate of discount, the risk premium was included to reflect the degree of risks. Additionally, the sensitivity analysis was applied to counterbalance the simplicity and insufficient accuracy of the risks’ allowance by the risk-adjusted discount rate. The outcome of the model computed with the discounted cash flow principle revealed that is worthwhile investing jointly in the dry port project, from which each of the investors can benefit to the certain extent.

Since the investment project dependent significantly on risks, which are one of the key characteristics of public-private partnerships, the following more detailed analysis has been conducted. Scientific literature, which is the relevant to PPP and transport infrastructure projects provides different classifications of risks and their categories with breakdown level from 3 to 81 elements (Ameyaw and Chan, 2013; Grimsey and Lewis, 2007; Moslemi, 2016; Wibowo, 2005). However, few studies address the risks, concerning the dry port projects (Bergqvist and Monios, 2014; Roso, 2009). Chapter 6 ‘Risk Management of Public-Private Partnership Investments in Dry Port Projects’ contributes to filling this knowledge gap partly, as it presents a created map of the risk related to the warehousing and terminal business development (Figure 33). Despite the fact that provided risk classification may not be accurate, since the exact boundary between each type of risk is quite difficult to carry out, it helps to find the balanced distribution of risks between the private and public sectors. Moreover, it permits the effective risk assessment and allocation of risk mitigation strategies.

The proper evaluation of risks benefits the process of meeting the overall goal of facilitating the investments in the dry port development. In this regard, the largest groups of risks, such as market risks, i.e. revenue risk, land acquisition risk, traffic volume risk, and construction risk, as well as the political group of risks have been identified for the allowance for by the capital-appraisal model. The given classification of risks should be considered as the fifth contribution of the study, because such scheme of grouping includes the main features that permit to structure the parameters of uncertainties in the form, which is suitable for modelling the impact of each group of risks on project performance indicators.

As a rule, a capital budgeting process, in which an organization appraises a range of investment projects in a view to determining which is likely to give the highest financial return, adopts several approaches. One of the standardized and superior
project performance criteria is a net present value (Dymowa, 2011; Keown et al., 2013; Pyles, 2014; Vitollo and Cipparone, 2014). Taking into account the fact that NPV is based on the assumptions about the certainty of the project life, it cannot be an explicit capital budgeting decision approach alone. The reason is hidden in the environment of dry port development, i.e. global supply chains that have inherent characteristics, such as uncertainties and risks (Barry, 2004; Lättila, 2012).

The causes of the uncertainties can stem from the changes in political, technological, and economic factors. The variety of risks’ factors requires, from managers, to focus on capital investment appraisals, which ensure project profitability and liquidity. That is why the decision making on the acceptance of the project by the positive NPV alone omits the exposure of the project’s useful life to risks. These challenges can be readily mitigated by the use of discounted payback period, which satisfies both characteristics (profitability and liquidity; Bhandari, 2009). Therefore, for the Russian environment, the importance of the DPP criterion can be comparable to NPV.

However, the DPP as well as NPV likewise lack the possibility of proper measurement of uncertainties, if the figures are found from the deterministic point of view (e.g., by deterministic model of discounted cash flow analysis), because a certain set of circumstances, naturally, provide only one fixed value of each measure of appraisal approaches (Chang, 2005). It can be either the discounted payback period, i.e. the time, required for the project to repay its initial outlay, or the value of the cumulative profit at the end of the investment horizon (Law, 2008; Paper 5).

In order to improve the outcome of the research, the study subsequently applied instead of deterministic approach the stochastic approach and two theories, i.e. real option theory and portfolio theory that have fewer limitations. In contrast to traditional discount cash flow approaches and CAPM, the theory of real options provides profitable investments based on the proper decision making. That is due to the utilisation of the proposed alternatives in the right time that allow to reacts to the uncertainty of future (Dimakopoulou et al., 2014; Gao and Driouchi, 2013; Michailidis and Mattas, 2007). The second – portfolio theory guarantees the reduction of risks through the diversification. The expected results from the latter theory can be even more reliable, if to accept the idea of the rationalities for the utilisation of the discounted payback period for the evaluation of the efficiency of investments.

Thus, the assumptions of portfolio theory on the net present value or internal rate of return, which it regards as better criteria of decision appraisals (Pereira et al., 2005; Magni, 2009; Harrington, 1987) can be relaxed. More precisely, the discounted payback period, which is widespread in business practice, can be not fewer relevant criteria for the investment selection and risk measure (Bowen, 1984; Bhandari, 2009; Mao, 1970), especially when uncertainty is included in the decision support systems. In this case, the statistical mean should stand for the expected value of the NPV and DPP, while the characteristic of uncertainty and risk will be indicated via standard deviation. Therefore, the sixth contribution of the study is in the justification of the both stochastic project performance criteria (NPV and DPP) for the economic
appraisal of public-private partnership investments in dry ports.

In order to prove this statement, the combination of the deterministic methods with Monte Carlo analysis as one of the powerful tools to cope with uncertainty (Ambrasaitė et al., 2011; Esipova, 2011; Grimsey and Lewis, 2007; Kazaku and Narkevskaya, 2013; Lättilä, 2012; Popova, 2012) was provided. The idea became viable on the grounds of system dynamics simulation approach that allowed to receive the synergy effect from the integration of the benefits of each technique, i.e. discounted cash flow appraisal calculation, Monte Carlo method, real option theory, and portfolio theory. Consequently, the combination of different methods and models on the ground of systems dynamics approach helped reducing disadvantages of each technique. As such, the seventh contribution of the research is in the developed methodological tool, admitting the inclusion of the stochastic parameters of uncertainty and increasing the values of each method used in combination for solving specific tasks of the complex problem of the risk management process of dry port development.

Normally, it includes three main steps: risk identification, risk evaluation, and risk mitigation, according to ALARM, AIRMIC, IRM (2002), COSO (2004), FERMA (2003), ISO (2009) standards, Kirilmaz and Erol (2015). Due to the phased risk management processes, the application of different approaches has been allocated in the following sequence. If, for the risk identification phase, it was sufficient to use methods of theoretical study (e.g. analysis) based on the qualitative research, the risk evaluation steps employed mathematical methods: a combination of Monte Carlo analysis with discounted cash flow technique on the ground of system dynamics simulation. The latest steps in the risk management process, i.e. risk mitigation strategies, required the approaches mentioned above complemented by the theory of real options and portfolio theory.

The proposed methodology, first and foremost, was used to analyze the five types of risks separately, and then their cumulative impact, as a whole. The outcome showed that traffic volume risks had the highest absolute impact on net present value and discounted payback period. The collected empirical data aligned with information gained from the qualitative research. That is the map of risks (Figure 33), where these risks have the highest likelihood and the worst consequences. Moreover, based on the outcome of the experiments, the relative impact of risks, depending on the elasticity coefficient of NPV and DPP to the uncertainties and risks was calculated. In this regard, higher rank received political risks and construction risks that have elasticity coefficients greater than one in connection with the impact on NPV and DPP, respectively. Meanwhile, lower positions in this ranking were prescribed to land acquisition risk and revenue risks.

As was mentioned before, apart from the assessment of each risk the methodology permits identifying the summative effects of risks. They impact significantly the performance parameters of the investment project (e.g., the NPV reduced by 70% and DPP lengthen by 80%, respectively). That is why, in the justification and planning phases of the dry port projects development, it is necessary to pay great attention to
mitigation of negative consequences of risks. In this regard, for the subsequent stages of risk management process, such as risk mitigation and control phases, the following solutions have been outlined.

All risks, which were presented in Table 8, were divided into two main groups: non-systematic risks and systematic risk. Acknowledging that the latter risks can be compensated by the public sector, the private sector responsibility can be attributed to the non-systematic risks. Since systematic risks are related to the overall market, they are hardly diversifiable. Meanwhile, the non-systematic risks are more diversifiable risks, and therefore, should be mitigated.

Due to the fact that the most probable and specific risks of dry port development relate to the decrease in container traffic volume, the reduction of these risks was put under the focus for further analysis. For this reason, five scenarios of dry port project realization have been developed (Table 9, 10). The likelihood of cargo decrease in the project of the dry port can be reduced by reactive and proactive measures (Kirilmaz and Erol, 2015). The alternative 1 adopts reactive tactic, which implied ‘wait and see’ approach (e.g., does not have actions before the risk event). In the case of the dry port project, this approach foresees the delaying of the decision on the investments, because of the decrease in container traffic from the 6th year until the 8th (Figure 38, Table 9).

The proactive strategy is represented by other two alternatives (proactive alternative 2; proactive alternative 3). Since the cargo can be redirected to other seaports, the additional small inland terminal, for example, in the South region of Russia can be built instead of the omitted one phase (Phase 4) in the base scenario of the dry port project. That would be an alternative 2, which is compared to the alternative 1 is proactive (Table 9). The next alternative 3 of the dry port project realization is also proactive. It implies the option of diversification of risks from the food embargo that resulted in the decrease of import referred containers in St. Petersburg seaport. To mitigate the situation, the container yard number 2, which was proposed in the one phase (Phase 2) of the base scenario of the dry port project, has been re-specialized for the metal and grain cargo processing that have a high potential on the export market of Russia.

The remained alternative 3 and alternative 4 are represented by so-called portfolios, the combinations of proactive and reactive alternatives mentioned above. To make an analysis of all risk management strategies of dry port development, the systems dynamics capital-appraisal model has been tailored by additional parameters to denote the specifics of each alternative. On the ground of the outcome of the model, the comparative analysis of scenarios of dry port development was provided in Table 10. It shows that one of the rational alternatives for mitigation of risks impact on NPV and DPP of the project would be a combination of reactive option with one of the proactive alternatives (e.g., delaying decision on the investments in Phase 3 and Phase 4 complemented either by diversification of the investment in other services, such as grain and metal processing, or the development of the additional small inland container terminal in the other region). More precisely, the first portfolio
is a combination of reactive option 1 with proactive alternative 2, while the second portfolio encapsulates reactive option 1 and proactive alternative 3.

According to the portfolio theory, the first portfolio is more effective than the second one, because it provides a higher effect from taken actions on risks, as financial evaluation techniques depict (NPV=3.103 Bl RUB, DPP=10 years 7 months), and lower coefficient of variance (unitized risk value=17.73%), which risk-averse investor potentially would prefer. However, if, apart from risk preference of the investor, take into account the proposed marginal utility of investments (Formula 20), the chosen portfolio would be the second one. The reason behind is that it is close to the efficient portfolio. That is, the portfolios that maximize the expected value of the outcome of the risky prospect of dry port development, such as NPV and DPP, for a given level of risk and minimize the variance, denoted by the unitized risk value, if given a small quantity of additional investment, per unit of the improvement.

In this regard, each percent increase of the investments in the second portfolio provides the growth of the net present value on average by 21.9%, shortens the discounted payback period by 7.7%, and reduces the unitized risk value by 6.55% (Table 10). Those characteristics are relatively lower for the first portfolio (16.66%, 3.82%, and 2.95%, respectively). As such, the portfolio, consisting of reactive option 1 and proactive alternative 3, is considered as the most efficient prospect for the rational risk-averse investor, because the marginal utility of investments is greater than that of the first portfolio. Thus, the development of the indicator of the efficient portfolio, i.e. the deduced marginal utility of investments for the risky prospect of the dry port project, contributed to the eighth implication of the research, providing the theoretical assumptions on the selection of portfolio to achieve the most preferred combination of risks and utility of investments.

In conclusion, it is worth to mention that the developed methodology of risk management process (PMBOK, 2000) of public-private partnership investments in the dry port project is described in Chapter 6. That is why this chapter is regarded as one of the outstanding in the conducted research. However, its scientific outcome would have been scarce, if a sequence of findings from research papers were not provided. It helped gradually to answer the main question of study. The research designed theoretical propositions for project selection criteria and sophisticated decision model for making capital budgeting of risk management strategies of dry port development. The provided tools and techniques facilitate the initial phase of project life cycle, and therefore, tend to stimulate the investment process in dry ports in Russia.

On the whole, the central technic that allowed increasing the value of the results was the system dynamics simulation approach. The designed dynamic computer model provided a better understanding of the possible scenarios of dry port development and permitted subsequently the calculation of the probabilistic project performance criteria, allowing to select the most efficient alternative to facing a risky prospect of dry port realization. The general advantages of the designed stochastic model over deterministic analysis were in following aspects:
- Probabilistic results. The outcome showed not only the possible events, but also the probability of their occurrence. In other words, the results revealed the dynamic nature of the net present value and payback period through the utilisation of the distributed scores instead of point estimates.

- A graphical representation of the results. The model allowed to create various graphics effects, depicting the probabilistic nature of the outcome. It is important in the transmission of the results to other interested parties.

- Scenario analysis. In deterministic models, it is quite complicated to model different combinations of parameters with the various initial values, and, therefore, to assess the impact of a truly distinct scenarios. Applying the Monte Carlo test, it is possible to determine exactly, what the initial data lead to certain values of the efficiency of the investments.

- Sensitivity analysis. With rare exceptions, the deterministic analysis allows to determine accurately the variables, which mostly impact the results. By using stochastic model, it is easy to see, which baseline data had the greatest impact on the final results. In particular, it helps to identify risks that have maximum absolute and relative effects on the efficiency of the investments, and further provide a balanced sharing of them between public and private investors.

- Monitoring and observation of the system. With the use of system dynamics modelling, some non-systematic risks can be tackled by the managerial influences on control variables during the experiments with the stochastic model.

Therefore, the application of modern methods of simulation, by use of which the system dynamics model was created, has contributed to the theoretical significance of thesis, which, in turn, is complemented by the deduced indicator of marginal utility of investments in risky prospects of dry port development. As shown by the calculations and gained scientific results, this methodology can be applied to risk management processes of large investment projects, such as dry ports, which are developed under PPP schemes.

### 7.2 Managerial Implications

The managerial implications are based on the results of the studies represented in the five publications and covering paper. All implications are summarized in Table 11. The first publication discusses the potential of Trans-Siberian Railway that depends on the efficiency of the cooperation between its Far Eastern section and the seaports of Vladivostok, Nakhodka, and Vostochny. The negative technological aspects of their collaboration stem from the shortage of the hinterland terminal and warehousing infrastructure. The dry ports within this region are developed at a moderate pace, if compared to the North-West region of Russia. The area needs the investments in the dry ports, because they allow eliminating the loss of the hours in the whole maritime supply chain.
The second publication reveals the peculiarities of the dry ports’ development in the North-West, South, and Far Eastern regions. The managers should take into account that the largest container seaport of St. Petersburg operates in an area of four customs. As a result, seaport and inland terminal have to be under the jurisdiction of one customs station or customs in order to apply the benefits of the dry port concept. In accordance with the Russian law related to dry ports, the inland terminal should be included in the jurisdiction of Baltic Customs (seaport customs). In other cases, the simplified customs’ procedures are not possible to provide.

In the third publication, the alternative of dry port construction is compared to the other options, such as an increase in handling equipment, purchase of additional internal trucks, and both options, i.e. acquirement of the number of handling equipment and fleet of domestic trucks, which are considered together. The study was provided based on the simulation techniques, e.g. AnyLogic software. The simulation models allowed mimicking the real system. Specifically, close-to-real-world parameters, such as triangular, exponential, and uniform distributions were used to model the arrival of transport modes or the duration of the delays on the entrance or under the operations. This stochastic approach helped to obtain the reliable and exact statistics that differed from the formula-based analysis. The reason is that activities in the ‘real world’ depend upon statistical fluctuations and not mean-value averages that are employed in the formula-based analysis. Therefore, the decisions about the development of the infrastructure can be improved by the use of the simulation approach. For example, the number of the required loading/unloading techniques within the terminals, if calculated via simulation, can be significantly less than the amount computed by the formula-based approach. Consequently, the budget of the company can be saved.

The fourth publication provides the characteristics of the Russian railway freight market. The liberalization of the rail industry creates the favourable conditions for the development of private business in railways. In the light of these events, the main market peculiarities should be outlined. First and foremost, the importance of personal relations could not be underestimated. Close relationships ensure smooth functions in the market. It concerns all functionalities: needed documents, rolling stock maintenance, and arrangement of traction. Additionally, the managers should be aware of the common entry barriers in the market that are as follows: acquisition of rolling stock, bureaucracy, and needed investments.

The fifth publication addresses the importance of the quality of the risk assessment analysis, allowing to reduce the cost overruns in capital-intensive projects, such as dry ports. It was found that the discounted payback period is not less important capital budgeting criterion than net present value for the estimation of the impacts of the project risks. The outcomes also showed the low accuracy of the risk-adjusted discounting rate method compared to the sensitivity analysis. Moreover, the pitfalls of both capital appraisal techniques can be mitigated by the use of the simulation technique, e.g. Monte Carlo simulation. By doing so, the potential of dry ports projects development under public-private partnerships can be improved.
Table 11. Managerial implications of the individual papers.

<table>
<thead>
<tr>
<th>Article</th>
<th>Implication</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The delays in the seaports can be reduced by the development of dry ports. As a result, this reliable service can be built in the shippers supply chains and operated with the confidence.</td>
</tr>
<tr>
<td>2</td>
<td>Managers need to take into account the peculiarities of dry port development in the busiest North-West sea basin of Russia.</td>
</tr>
<tr>
<td>3</td>
<td>The simulation techniques can provide more accurate results for the scenarios of dry port development.</td>
</tr>
<tr>
<td>4</td>
<td>The characteristics of the Russian railway market include the main opportunities and barriers for the business set up.</td>
</tr>
<tr>
<td>5</td>
<td>The quality of the assessment of risks can improve the economic potential of public-private partnership investments in dry ports.</td>
</tr>
</tbody>
</table>

On the whole, the practical significance of the thesis is in the designed system dynamics model that can be recommended for the decision-makers on the dry port projects, which are financed via a public-private partnership. The model allows investors to make a decision on the efficiency of investments more accurately, since it considers probabilistic nature of capital budgeting process. The model permits to calculate net present value, as well as the discounted payback period, which is widespread in business practice (Bhandari, 2009; Bowen, 1984). Moreover, DPP and NPV are treated as random variables, depending on different risks factors. In this case, the statistical mean stands for the expected value of the NPV and DPP, while the characteristics of risks are indicated via standard deviation.

Additionally, investors can find a risk of project investments failure and guaranteed recoupment of capital investment (Esipova, 2011). The first parameter shows the probability of receiving a specified value of the discounted payback period, which is set as a reference by the investor, shorter than the empirical period, which is calculated by the model. The second one, conversely, indicates the probability of obtaining the empirical DPP, which is equated to/or not exceeded the specified by investor period.

The last but not least important point is that model creates preconditions for controlling the process of dry port development, i.e. making managerial changes and identifying the most stable parameters that contribute to the optimal alternative scenarios of the project realisation in the uncertain and risk environment. Thus, with the help of the model, managers can make proposals for the improvement of the efficiency of the investments.

7.3 Limitations of the Research

The thesis concentrates on the research of public-private partnership investments in the Russian dry ports, meaning the findings can be hardly generalised to the other markets. The study relies on the scientific articles, books, reports, and statistical data. Some publications employ the web-based articles and consultant reports, because several themes were not discussed in the academic references. It should be noted that the second-hand data (e.g., case studies from other countries) were the primary source
of the information. The reason for that is that Russia has yet to gain the experience in dry port construction based on the public-private partnerships. The first-hand data were obtained during a few interviews.

Apart from the qualitative method of the research, the study applies the quantitative approach. In particular, some articles are based on simulation models that, however, also have limitations. For example, the discrete-event model in the fourth publication takes into account the fixed sizes of the containerships and trains. At the same time, the model operates on the low level of abstraction, allowing to mimic all necessary processes within the container terminal. On the contrary, the second model for the discounted cash flow appraisal calculation is built on the higher level of abstraction via the systems dynamics approach. The model is mainly linear; only a few feedbacks have been employed in the designed structure of the model. Meanwhile, the limitations mentioned above do not impact the actual results from this thesis.

The validity of the results is confirmed by the outcomes of the experiments that are similar to calculations made in studies of the transport sector. The conclusions from the research are not inconsistent with existing notions of economic efficiency of investments in the construction of terminal and warehousing infrastructure that is on the balance sheet of JSC ‘Russian Railways’.

7.4 Suggestion for Further Research

Concerning each publication, the further research goes into different directions. In the first publication, the exploration of the subsystems of the Russian Railways, e.g. land border crossing points, and their bottlenecks can improve the amplification of the outcome, i.e. increasing the transit container flows through the Trans-Siberian Railway. The timeliness of this research is determined by the development of the free port in Vladivostok and probably in other Far Eastern seaports in the later phases. This alternative will provide a growth of the cargo base for the Trans-Sib that nowadays has already used for the regular services. Direct rail transportations, for instance, via Russia and Kazakhstan, which is shorter and faster than sea transportation via Suez Canal, can be studied from the point of view of the existing technical and technological constraints of land border crossing points.

In the second publication, the research can be extended to two prospects. Firstly, the dry ports concept can be approached from the benefits of the reduction of the logistics costs that are high in Russia. This rate of logistics costs negatively characterizes the development of transport logistics, indicating on the existing constraints for obtaining favourable conditions on the global trade market. The reduction of logistics costs, which take on the average about 20% of GDP (8900 BI Roubles), by 1% will provide a saving of 445 billion Roubles/year. As such, the improving of logistics processes and services based on the dry ports idea may lead to significantly lower national expenditures and higher revenues. Secondly, the ecological issues can be taken into account, especially in a view of 2017, being the Year of Ecology in Russia, but also in the global context. The situation on the inland
infrastructure can change in the next years due to activated restrictions on the sulphur content of marine fuel in 2015 in the Baltic Sea region, North Sea, and the English Channel, but also worldwide from 2020 in more strict form. These regulations on the reduction of the emissions are increasingly a reason for the growth of the sea freight rates. As a result, European companies in a reasonably foreseeable future may partly redirect the cargo flows from the maritime transport to the land routes. The impacts and consequences from the reorientation of freight flows towards the transport corridors and co-located inland terminals could be examined.

The potential venue for further research in the third publication would be the analysis of the barriers of the application of the dry port concept. The reason behind is that the article examines and classifies only the factors of dry port development. Meanwhile, the hypothesis on the most significant impediments, such as the deficit of budget financing and risky environment have been given based on the case studies provided in many countries, but not in the national market. That is why, the grouping and valuing of the obstacles for dry port project realization via public-private partnerships, could be desirable.

In the fourth publication, the research can be prolonged to the examination of the Russian railway freight environment, because the whole rail industry is under fractioning. Therefore, the analysis of the processes and peculiarities of the private sector development within other businesses related to rail, such as terminal and warehousing, traction, and maintenance could provide additional insights for the newcomers to the markets.

The fifth publication can be an antecedent for the further theoretical study of the government and private companies’ hand-in-hand business development. Seeing the economic advantage from public-private partnerships of dry port construction, the new techniques of the project appraisal should improve the process of the decision making on their implementation. Due to the limitations of current system dynamics model in the automatic segmentation of risks between public and private companies, further research can include these shortcomings. In addition, several new parameters could be built in the model, for example, currency fluctuation, deficiency of loans, etc. On the whole, it would be desirable to enable a risk management of the investments in dry ports in the easier form, e.g. with a fewer required steps of calculations or approximations of the random factors of risk, provided that the accuracy of the method can be retained. From the practical point of view, it is important to continue the research on the facilitation of the involvement of foreign investors and concessionaires in dry port projects development, anticipating higher experience and technology, which makes a significant difference.
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London, UK.

PART II: PUBLICATIONS
Publication I

Panova, Y. (2011)

Potential of Connecting Eurasia through Trans-Siberian Railway

*International Journal of Shipping and Transport Logistics*

Vol. 3, No. 2, pp. 227–244.

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Potential of connecting Eurasia through Trans-Siberian Railway

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Abstract: The unique geopolitical location of the Trans-Siberian Railway (TSR) is to play the role of international bridge connecting countries from different continents. First, are China, Japan, Republic of Korea and Russia with the European Union. However, the transporting of containers involving the Russian transport system remains incompatible with deep sea route. The purpose of this article is to systematise the reasons for the absence of transit traffic on the trans-Sib in order to offer the solutions. Analysis revealed the main bottleneck in the far eastern section of TSR. The improving cooperation between the Far Eastern Railway and far eastern seaports by applying ‘pulling’ system for just in time operation in transport chain and using overseas experience in ‘dry port’ concept will provide economical and environmental benefit.

Keywords: Trans-Siberian Railway’s potential; container transportation; far eastern seaports; Far Eastern Railway.

Reference to this paper should be made as follows: Panova, Y. (2011) ‘Potential of connecting Eurasia through Trans-Siberian Railway’, Int. J. Shipping and Transport Logistics, Vol. 3, No. 2, pp.227–244.

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1 Introduction

The Trans-Siberian Railway (TSR) is the main transport corridor from west to east on Russian territory covering the distance of 9,244 km. It has been always the area of interest for Russian researchers as well as for foreign ones. Trans-Sib is an important backbone of the Russian railway logistics as found by Hämäläinen and Korovyakovsky...
(2007) during the survey of the logistic factors in the TSR operation. The amount of container traffic through the TSR has been gradually increasing since the year 2000 (Tsuji, 2009). However, transit potential of Trans-Sib has been underused currently despite the efforts of rail and sea transport companies in attracting transit container traffic.

For the last few years the countries of Asia has been increasing by the number of transportation and taking the lead in world trade (Hilmola, 2009). In such economical circumstance to develop the transport infrastructure of the Trans-Sib our country must harmoniously fit with what our European and Asian neighbours are doing. In this case the international trends in container traffic have been examined. The transportation corridors in North-East Asia depict clearly current activity of TSR in this region (Mitsuhashi, 2005). However, Tran-Sib is mostly involved in transportation, Far Eastern Railway, which is a section of it, is on the minor route due to some negative influencing factors as described by Kholosha and Gavrilov (2009).

Starting from a literature review on the compatibility of the Trans-Sib, this article presents a review of existing competitive advantages against the deep sea route and reveals disadvantages coming from negative external and internal factors. The objective of this article is to systematise deficiencies in the TSR in order to find out the arrangements for managing them. Therefore, the purpose of the article is to clarify the bottlenecks of the Trans-Sib and recommend measures required in increasing its compatibility.

2 Method and choice

This study started with an extensive literature review on the subject of the TSR in developing collaboration between the European Union and Asia, which provided good insight into the existing and planned container traffic in the world with involving the Russian transport system. The trade journals, investment projects and programs, internet as well as based documents provided support for the identification of existing and future volumes of transit cargoes in containers across the world, while scientific journals were the main source of information regarding the research on possible areas and fields in the Trans-Sib for developing and investing.

The choice of this case study is in section of the TSR (the Far Eastern Railway) result of the previous research field of the Trans-Sib, which generates understanding the potential of it. Consequently the Far Eastern Railway is an area of interest for further investigation. The cooperation of technology, between the Far Eastern Railway with far eastern ports on the ground of logistics principles, which could be introduced into practice. Along the supply chain sea transport – railway transport the just in time operations will be extended by ‘pulling’ system and applying ‘dry port’ concept. The sustainable functional operating through the transport supply chain will bring economical and environmental benefit.

3 The compatibility of the TSR

The TSR is a renewable resource for Russia, which could bring ongoing profit for the state budget. However, the potential of the Trans-Sib in connecting Eurasia is underused.
Why do the majority of consignors prefer deep sea route regardless the fact that it is a relatively longer route? Lead-time by Russian railway system equals eight to ten days, by sea through the Suez Cannel is 35–40 days. Current problems in sea transportation, make ships travelling from Asia to Europe go around Africa, which increases lead-time and prices. Meanwhile, the transit time by TSR is aiming for 7.6 days in 2011 and to seven days in 2012 as Briginshaw (2009) reported from the recent 1,520 railway conference in Sochi (Russia). As the piracy in the Gulf of Aden has a negative influence on international trade the Trans-Sib is getting more attractive for customers. The Piracy Reporting Center of the International Maritime Bureau said that pirates operating across the Gulf of Aden and along the coast of Somalia attacked 214 vessels in 2009, resulting in 47 hijackings (The New York Times Press, 2009). In light of current circumstance, fostering the shift of goods to electrical and speedy railway is feasible. A study of the project of decision by Science Technical Convention Joint Stock Company RZD in task regarding necessity of improving the efficiency of railway container traffic, including transit container traffic (Corporate seminar, 2009b) has shown that switching from the sea route to the TSR will increase the volume of transit container traffic on it by 4.5 times as compared with volume of 2008 year.

Tsuji (2009) found that the amount of container traffic through the Trans-Sib has been increasing since 2000 year (Figure 1).

**Figure 1** International container traffic by the TSR (see online version for colours)

Note: Figures in Figure 1 are by thousand.

In the plan for developing Joint Stock Company RZD, JSC RZD until 2015, the perspective container traffic between different countries is estimated. Germany will share approximately 10% container traffic in connection with China and about 30% with Japan and the Republic of Korea. Poland and countries of Central East Europe (because of building railway tracks with gauge of 1,520 mm between Koshitsy-Bratislava-Vienna) are about to have nearly 15% container traffic with China and roughly 30% with Japan and the Republic of Korea. Finland, the Baltic Countries, Ukraine, and Belarus are going
to realise about 40% container traffic in connection with China, Japan and Republic of Korea. According to the Corporate Seminar (2009a), the total volume of transit cargo in containers through the system of JSC RZD in 2015, account for more than 560,000 TEU (Table 1).

Table 1  Forecast of container transit through the system JSC RZD in 2015

<table>
<thead>
<tr>
<th>Country</th>
<th>China</th>
<th>Republic of Korea</th>
<th>Japan</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Export</td>
<td>Import</td>
<td>Export</td>
</tr>
<tr>
<td>Finland</td>
<td>8</td>
<td>22</td>
<td>1</td>
</tr>
<tr>
<td>Baltic nations</td>
<td>20</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Germany</td>
<td>87</td>
<td>46</td>
<td>17</td>
</tr>
<tr>
<td>Poland</td>
<td>46</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>Countries of central East Europe</td>
<td>39</td>
<td>7</td>
<td>19</td>
</tr>
<tr>
<td>Ukraine</td>
<td>66</td>
<td>4</td>
<td>16</td>
</tr>
<tr>
<td>Belarus</td>
<td>7</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>273</td>
<td>85</td>
<td>64</td>
</tr>
</tbody>
</table>

Note: Figures in Table 1 are by thousand

The developed countries of the European Union still hold the significance in the world economy, but in transportation, the growing number of transactions indicates that ‘the fast phase’ developing countries have already taken the lead. Hilmola (2009) suggests that in four years time European and Asian container transport has turned from European export surplus to clear dominance of export from Asia. Energetic activity of Asian neighbours in developing the traffic corridor parallel to the TSR could create a precarious situation for the Far Eastern railway. The Suifenhe Transportation Corridor, which starts in ports of Primorsky krai (Vladivostok, Hakhodka, Vostochny) links to the Trans-Sib through railway station Zabaikalsk. In this case, the TSR is mostly involved in transportation, but the transit of the Far Eastern Railway has been running at a loss.

Korea is planning to turn the sea route between Busan port and Primorsky krai ports to the Korean Peninsula West Transportation Corridor (Busan-Seul-Pyongyang-Shenyang-Harbin-TSR). The lines linking the Republic of Korea, ROK and the Democratic People’s Republic of Korea, DPRK are about to start operating. These plans are considered to be realistic in light of a current agreement between the ministers of Democratic People’s Republic of Korea and Republic of Korea about the beginning cooperation in railway traffic since 2008. If progress is made on the development of the disconnected section, this corridor would promote transportation between DPRK and ROK. It is also a means of transporting freight from East Asia to Europe, as noted by Mitsuhashi (2005) spotted. The remaining sea route from Japan is very important to hold for transit container traffic through Russian territory. The far eastern ports need new technologies in transportation in order not to divest Primorsky krai of Japanese transit. There is a ferry between Japan and Korea, which might be used to transit goods through Busan ahead by Korean Railway system.

The main sea gateways for international cargoes in the Far East region are Vostochny, Vladivostok, Nakhodka, and Vanino seaports. Vanino port is an entrance for Baikal Amur Mainline, BAM trade corridor. This corridor begins at Vanino port, which links
Potential of connecting Eurasia through Trans-Siberian Railway

Sakhalin with the Eurasian continent, and runs via the heavy industrial zone of Central Siberia to Taishet, where the corridor can link up with the TSR.

**Figure 2** Container handling in Vostochny and Vladivostok seaports (see online version for colours)

![Graph of container handling in Vostochny and Vladivostok seaports]

Note: All figures in Figure 2 are by thousand.


**Figure 3** Container handling in Nakhodka and Vanino seaports (see online version for colours)

![Graph of container handling in Nakhodka and Vanino seaports]

Note: All figures in Figure 3 are by thousand.

The Far East largest region’s port in container handling is Vostochny port. Almost all the containers handled at the port were international freight of which is approximately 90%, is transhipped to the Trains-Siberian Railway and transported on all over the country. According to Vostochnaya Stevedoring Company (VSC), which handles loading and unloading at the port, the volume container handled in 2008, was 400,724 TEU (Figure 2).

The Russian far eastern second largest container handling amount is located in Vladivostok port. The amount of containers processed in 2008 was 267,277 TEU (up 20% on the previous year). According to Vanino and Nakhodka seaports annual reports the volume of container handling in them has also been increasing (Figure 3).

The stable growth of container traffic via far eastern ports until 2009 triggered a development projects for meeting the demand ahead. Loglink.ru (2008) analysed current and planned capacities of far eastern ports. Therefore, Vostochny seaport has the biggest construction project among far eastern ports in increasing capacity from 500 000 TEU up to 2.5 million TEU. The next largest project related to Vanino seaport which planning 12 hectares container terminal of annual turnover one million containers. Due to the conception of investment project of Yuzhny Primorsky terminal (2007) Vladivostok seaport has been investing in developing capacity of 600 thousand TEU by year 2015. The terminal of maritime fishing port Nakhodka will eventually be able to handle up to 400 thousand TEU a year. Besides these projects, the other port of Zarubino is about to be developed: container terminal with capacity ahead of 400 thousand TEU per year planned to build in five years time with $100 million investment.

The developing of seaports in Primorsky krai, Primorye are stressed by the possibility of creating a transcontinental corridor Korea-Russia-Europe. For the first step, is to link the railway station Khasan (Russia) to the seaport Rajin (DPRK). JSC has been participated in reconstructing railway track Khasan-Rajin and building container terminal in port Rajin the RZD press.ru (2008) reported. For the second step, is to build railway to the seaport Busan (ROK). On one hand, the railway line Busan-Rajin-Khasan is very important for Russia because in the West destiny more than 60% container traffic origin in Korea, 27% in China and 1% in Japan. On the other hand, with implementation of this project, the Korean seaports could course the decreasing of transshipment in southern Primorye ports.

Figure 4  Existing supply chain in transport (see online version for colours)

The Russian rail freight transport plays a major role in the inland transport of cargoes passing through the seaports. Balalaev and Leontev (2009) highlighted that the volume of export and import cargoes delivered by railway to ports equals 70%. That is why the
supplying efficient cooperation between these modes is crucial. The current technology of cooperation is as on Figure 4.

This technology accompanied by list of bureaucratic operations which discourage the transit cargoes from the Trans-Sib. Kholosha and Gavrilov (2009) found out that the choice of route and transfer ports to on overwhelming degree depends on the custom policy (69%) of the state and transport tariff policy. Sea news of Russia (2009) also mention about documentation shortcomings for transit traffic. As compared with Europe in Russia, the processing of ships in ports is complicated. It is required to fill up about 15 documents for eight controlling organisations. Abroad the convention concerning international carriage by rail (COTIF), is widely used. The international railway transport committee (CIT), as a mute document between railway transport and sea transport eases the procedure of transportation. The documents for international cargos through the Russian railways system have been alliterating when the modes are changed. It brings premiums and time consuming. Generalov (2009) displays the disadvantages in Russian Federal Custom Tariff Act concerning the container transit through the Trains-Sib. According to the law, the container is cargo instead of equipment. This situation implies the customs declaration, due for custom service and, as a result, the detention of ships and bills for extra storage time. On average, the custom clearance increases by three to four days. While the container staying in port the procedures of customs and traffic documents are being process. Then container entrains on flat cars and removals to a railway station where the detention time also exists. It is because of container stands idle on average three days (45 containers per a day, 140 containers in the train) in accumulation for the full-long train. Thus, the choice of the route through Russia imposes freight forwarder to operate on average figures, while the sea transport guarantees exact time delivering.

Figure 5  Indexation of freight internal and international railway traffic (see online version for colours)


Besides problems in customs clearance, that goes through quite complicated procedure and takes a long time tariff policy influences negatively on custom’s choice. The cost of
transit transportation based on transhipment expense and freight railway operation. The tariff for handling operation in port depends on the rental pier rate of stevedore companies. Seaports Press (2009) carried out that the representatives of stevedore companies claimed that the rising of leased cost will inevitably increase the tariff. In current economical climate, the high pricing policy for handling and storage service would not be sensible. The terminal operator might undertake this extent action, if the business was unprofitable. The port charges in far eastern ports are half more than chargers in foreign ports, which indicate about exceeded port rates.

The origin for counting the charges on the railways is the tariff book for freight traffic №10–01, which started in 1990. The railway tariff used to elaborate as uniform price for Soviet Union, USSR. In 1993 in Commonwealth of Independent States, CIS for import-export freight traffic, introduced chargers in foreign currency. Hence, Russian railways system the rates in foreign currency was approximated to the rates of tariff book №10–01 and accounted in Swiss franc except the traffic by TSR, which calculated in US dollars. The tariff policy has estimated in accordance with inflation rates. Since July 1997 until November 1999, the freight tariff had been stable. In 1999, the function for regulation of tariff did assign to federal tariff service of Russia. Since that time adjustment for inflation in freight tariff, carry out every year (Figure 5).

In case of high rates pace in tariff the federal tariff service of Russia makes a decision about decreasing price for some groups of cargoes carried by railway transport. For example, Usov (2008) announced in Gudok press that on the 4 December of 2008 the Federal Tariff Service of Russia adopted an order about exceptional rate for loaded forty feet container with car components ($900) sending from countries of Asia Pacific region through far eastern ports and for empty 40 feet container ($400) sending back in block trains. The purpose of this tariff was to maintain compatibility of TSR compared to alternative sea route through the ports of North Europe. In accordance with Association of Russian sea trade ports, the transhipment volume in seaport terminals increased by 8.7% to the same period of 2007 year, as the Loglink.ru (2008) showed up.

Due to flexible tariff policy, the Trans-Sib is been intensely operated for the recent years. The meaningful role in this has played the realisation cooperation between JSC RZD and the Railways of Yakutia. So far has been signed eight deals proved the uniform tariff between these railways. Until 2006, the railways of Yakutia did not have the position of thoroughfare railway transport with in the infrastructure. It means that Yakut railway was not in monopoly company register. The tariffs used to confirm by Regional energetic commission of the Sakha (Yakutia) Republic. With restating the position of Yakut railways the tariff of the Yakut Railways Company regulated in accordance of legislation by Federal Tariff Service of Russia. On 25.03.2008, Federal Tariff Service of Russia installed the exceptional rate for loaded and empty containers passed through Yakut railways. Declined coefficients were 0.49, 0.53 and 0.58 for 3 tons, 5 tons and large-capacity containers respectively. Yakulina (2008) displayed that this new system of adopting tariff on the federal level enabled the consigner who sending goods towards the Yakut railways or back way to pay for the whole trip on the departure railway station. Introducing of new uniform service was timely for Yakutia. The investment project called ‘Complex developing of south Yakutia’ until 2030 incorporated the constructing of rail tracks between Berkakit-Tommot-Yakutsk, Ulak-Elga, Ust-Kut-Nepa-Lensk, Khani-Olekminsk, Yakutsk-Magadan forced the amount of railway traffic. The next project far more enhanced the railway operation in this region was related to building the pipeline Vest Siberia – Pacific Ocean. Akieva (2009) found that annually since 2004 via
railway Berkakit-Tommot in connection with railways of JSC RZD passed around two million tons of cargo. In 2007, the cargo volume was over two million tons. By 2012 it is about to achieve nearly eight million tons and by 2017 might be 38 million tons. The idea of adopting discounts for loaded (empty) containers sending to and back from Yakutia was for remaining freight flow on the TSR and bringing the profit for JSC RZD.

The counting method not less than the regulating of tariff influences upon the volume of railway traffic. For instance, in port the counting method in Russian Rubles imposes the foreign ship owners to be dependable on Russian Ruble valuation. Esipenko (2008) explained the procedure as follows: foreign ship owners pay chargers in US Dollars to agents. Then agents exchange US Dollars into Russian Rubles and pay port dues on behalf of foreign ship owners. Thus, the higher exchange rate RUR/USD the more port chargers in US Dollar equivalent. Moreover, the agents pay commission fee during change of currency, which summed to the expense of foreign ship owners.

The rate of US Dollar and Euro to Russian Ruble influences on the import quarter in railway traffic as well. Turtia (2008) acknowledged that in case of accelerating rates of Euro as compared the rates of US Dollar towards Russian Ruble the Russian importers shift purchasing from ‘Euro zone’ to ‘US Dollar zone’ or making procurement within countries of CIS or even within Russian Federation, if finding the cargo-substitutes is possible. The Russian Ruble valuation for the decade is described in Table 2. In overall, the rise of exchange rates (RUR/USD, RUR/EUR) brings the reduction of import cargoes and simultaneously stimulates the export quarter in Russian trade.

**Table 2** The Russian Ruble valuation

<table>
<thead>
<tr>
<th>Exchange rate</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>RUR/USD</td>
<td>28.16</td>
<td>29.17</td>
<td>31.36</td>
<td>30.67</td>
<td>28.81</td>
<td>28.31</td>
<td>27.03</td>
<td>25.55</td>
<td>24.87</td>
<td>31.77</td>
</tr>
<tr>
<td>RUR/EUR</td>
<td>25.99</td>
<td>26.13</td>
<td>29.69</td>
<td>34.68</td>
<td>35.82</td>
<td>35.16</td>
<td>34.11</td>
<td>35.03</td>
<td>36.45</td>
<td>44.20</td>
</tr>
</tbody>
</table>

*Source: Currency base of Russian Central Bank (2009)*

**Figure 6** The current technology between railway and seaports

The rise of US Dollar rate in 2009 compared to 2008 year led the escalating the export transhipment in ports. Loading of export cargoes in ports of Russia by rail in January to
November 2009 increased by 5% in comparison with the same period of the last year and made 241.2 million tons. According to the RZD press.ru (2009), over 46.1 million tons (+23%) did tranship to the ports of the Far East. Loading of coal has also increased by 31% (+6.1 million tons), ferrous metals by 43% (+2.3 million tons), oil by 19% (+1.3 million tons), and coke up by 2.7 times (+0.4 million tons). Growing dynamics of cargo traffics to the Far East revealed the problems in logistical scheme of cooperation between Far Eastern Railway and seaports (Figure 6).

Hämäläinen and Korovyakovsky (2007, p.15) found out that such a problem of non-coordinated work between sea and railway transport is typical during severe wintertime. Trains stop at the port entrance being as so called ‘abandoned’; these are the trains that are directed to the port, but due to fact that all the tracks at the port station are engaged, they are not be accepted by the port. They are located at the nearby stations. This situation causes ‘traffic jam’. The growth of export goods in 2009 on the Far Eastern Railway coursed in the Far East region also a critical situation where a large number of trains loaded with cargos stand idle. Railway car jams, which simply forgotten for a period of economic recession, have occurred at railway approaches to a number of ports. The enhancing number of ’abandoned’ trains brought escalating of stocks in transport supply chain. The stock is mostly hold on the wheels at accumulating railway stations, which incurred not compensating losses for railway.

Moreover, some losses came from situation’s, which has been getting more common for railway operations when, ready to dispatch containers not to entrain due to lack of flat cars and at the same time on the nearest stations stay flat cars in waiting the containers. This problem has a root in Russia’s private rail freight boom. Briginshaw (2008) summarised that there are more than 2000 private rail freight operators in Russia, ranging from small owners of a few wagons to big plays with a large fleets, a few of which like ‘transoil’ Company are starting to acquire their own locomotives. When JSC RZD still dominates the rail freight market, the private operators are gaining ground rapidly-jumping from a 26% market share in 2003 to 38% in 2008, but there is frustration that liberalisation is not fast enough. Therefore, forwarding agents make a deal with the private operators and flat cars stand idle in waiting on containers and not loading by other containers. It is dramatically result in high operating costs of railway transport.

**Figure 7** Classification of the reason by influence on the developing of transit traffic through the TSR (see online version for colours)
In conclusion all listed withdraws of the TSR can be variously systematised (Figure 7). The scheme is clearly depict the reasons of absence transit on the Trans-Sib, which eased finding arrangements for managing them.

### 4 Proposed solution to the TSR volume challenge

The attraction of transit to the TSR is becoming an acute problem. Nowadays in case of this the Russian railways system is trying to eliminate one of the main bottlenecks in the Far East region. The solving of this strategic problem of current importance takes innovations. The Far Eastern Railway passing cargoes through the main southern Primorye container ports (Vostochny, Vladivostok, Nakhodka, and Zarubino) potentially could play a more significant role in the future, for both economical and environmental aspects. The cargo traffic to the Far East region demands from railway and sea transport the cooperation, fulfilment of partner obligations.

According to Balalaev and Leontev (2009), economical optimisation modal of interoperability between railway and sea transport as participants of logistical chain is as follows:

\[
F\left( \sum C_{\text{detention}}^{\text{cars}}, \sum C_{\text{downtime}}^{\text{ship}} \right) \to 0
\]

\[
\sum C_{\text{detention}}^{\text{car}} \quad \text{Total operational costs resulted from loaded car detention on preceding railway to seaport and on railway station of accumulation consignment in waiting ships arriving,}
\]

\[
\sum C_{\text{downtime}}^{\text{ship}} \quad \text{Total operational costs resulted from ships downtime in port waiting the consignment arriving.}
\]

The system of control and managing the traffic on maritime railway system should be oriented on delivering goods to the seaports at the required time in order to avoid economical losses. The model of cooperation between participants can be analysed from the view of logistics principles.

In logistic there is such phenomenon, ‘pull’ system. The success of just in time, JIT, operations not to be solely based on its idea of organising activities at just the time they are needed, but on its description of how to achieve this. It works by ‘pulling’ materials through the process [Waters, (2003), p.183]. In a traditional process, each operation has a timetable of work that must be finished in a given time. Finished items are then ‘pushed’ through to form a stock of work in progress in front of the next operation. Unfortunately, this ignores what the next operation is actually doing – it might be working on something completely different, or be waiting for a different item to arrive. At best, the second operation must finish its current job before it can start working on the new material just passed to it. The result is delays and increased stock of work in progress.

JIT uses another approach to ‘pull’ work through the process. When one operation finishes work on a unit, it passes a message back to the preceding operation to say that it needs another unit to work on. The preceding operation only passes materials forward when it gets this request. This kind of process does not have earlier operations pushing work through, but has a later operation pulling it through. There is inevitably some lead-time between an operation requesting material and having it arrive. In real JIT
systems, messages passed backwards before they are required or actually needed. Materials can also be delivered in small batches rather than continuous amounts, so JIT still has some stocks of work in progress. These stocks are as small as possible, so it would be fair to say that JIT minimises stocks rather than eliminates them.

The organisation of work on the railway with logistics principles implies the planning goods delivery with a start from consignee. It means that delivery will form in accordance with factual demand in quality and quantity of materials. In process, later operations pull the right quantity of railway cars to the very customer at the required time. The model of managing goods in supply chain mixes the seaports and railway stations in mute process where materials move through on their journey from initial customer to final supplier (Figure 8).

Figure 8 Model of managing the supply chain in transport

![Diagram](image1)

Figure 9 Model of transhipment process management (see online version for colours)

![Diagram](image2)
The process that aims to a smooth, continuous, uninterrupted flow of materials in supply chain is achievable also by second model (Figure 9).

Model of transhipment process management is that one part of consignment (cargo’s volume ‘A’) is delivered to the port before arriving of ship and the rest consignment (cargo’s volume ‘B’) is pulled into port when the ship is moored and cargo’s volume ‘A’ is cross docking.

The main task in delivery goods to the port is to measure the time of dispatching consignment from railway loading station, so that the total waiting time of vehicle handling should minimised and process uninterrupted. For each consignment, the lead-time to the seaport is checked. Then time measures in the back order. Taking into account the moment of beginning transhipment in the port, the moment of accumulating the next consignment, which depending on technique capacity of railway loading station, is calculated. The time of consignment’s delivery to the port plans on mentioned time’s components and speed of transhipment. An information system is a crucial part in supporting ‘pull’ materials through the supply chain. When a ship is approaching, the system automatically sends a message to railway system requesting a delivery of consignment.

Putting principal of logistics into practice could partly slot the statement of Karabus and Croza [Waters, (2003), p.191] ‘product should never be warehoused or stored, but should continually be in movement’. The pulling system in transport could bring seamless movement of materials on the way from railway system towards sea transport, providing reduction in stocks in transport supply chains. The reduction of delays in operational traffic from the seaport to railway requires the smooth entry from ports. The principal idea for achieving this goal based on overseas experience in the sphere where widely use phenomenon of ‘dry port’. Roso (2009, p.1) exemplifies the definition of ‘dry port’ as ‘an inland terminal which is directly linked to a maritime port’. It would be an exaggeration to claim that ‘dry port’ implementation is a straightforward solution for seaport terminal congestion or for better seaport inland access; however, it could be part of the solution. In this case the Far East of Russia similarly can create newer transport distributing centres with higher standards. With implementation of these centres the scheme of cooperation between the participants of transport supply chain will change (Figure 10).

Figure 10  Projecting supply chain in transport (see online version for colours)

According to this scheme, newer transport distributing centres will play the main link in transport chain. Railway and road operators delivering goods to seaport should finish
direct cooperation with the seaport, but establish new relationship with newer transport distributing centres. Thus, the efficiency of operates will be analyzed within this boundaries. The organising of the delivering of goods from the territory of transport distributing centres to ships can be by inward port transport (road, railway, or pipeline). The efficiency of inward port transport will be in competence of port infrastructure. With an increase in the volumes of maritime container traffic to/from far eastern seaports, their inland access is critically strained. An inland access is important for the competitiveness of seaports. The most urgent issue for the port and the cities Vladivostok, Nakhodka, and Vostochny is to deal with congestion, which there is due to inappropriate seaport inland access mainly done by road. Road arteries are already reaching their capacity. Over the next few years, the amount of freight transported on the southern Primorye’s roads is set to increase dramatically, with a significant bearing on our society, the economy and the environment. Removing the systems of distribution and warehouses out of the cities territory will partly reduce the overloading federal and local roads because of banned access trucks into the city. A shift to non-road based modes of transport can offer substantial benefits in this area. To reduce the congestion issues associated with freight transported by road the alternative feeder trains needed to be organised. Feeder train, a term for small to medium container train which provide the collecting and distribution of containers between seaports and newer distributing centres with higher standards.

Prokopev (2008) found that the mechanism of operation based on the dry port concept is going to introduced in Saint Petersburg, Novorossiysk, and Vladivostok ports. Apart from these ports, the other one’s is planning to develop from mere view that the infrastructure is the base for logistics. The quicker to build the infrastructure, the more be able to offer to cargo owners, and eventually the more competitive logistics products will be. In this case, there are listed projects in developing infrastructure at the site of seaports in the Far East region. However, in long-term perspective it would be advisable to apply the ‘dry port’ concept in improving infrastructure of other Primorsky krai, southern Primorye ports (Nackhodka, Vostochny, and Zarubino). The seaport will have a possibility to increase the throughput without physical expansion at the site.

The projecting ahead transport distributing centres with higher standards could be located near the railway stations: Nadezgdinskaya, Hmylovsky, and Makhalino. These centres will extend the gates of the seaport inland. Shippers will view centres as an interface to shipping lines. The study of the conception of investment project of Yuzhny Primorsky terminal (2007) has shown that centre near Nadezgdinskaya railway station can be considered as an interface for Vladivostok sea port. Similarly, near the Hmylovsky railway station, the centre could be an interface for Vostochny and Nakhodka seaports and near Makhalino railway station the centre for Zarubino port can be built. Implementation of the centres could provide seamless seaport inland intermodal access, smooth transport flow with one interface in the form of this project instead of two, one at the seaport and the other one at the inland destination. The same can be compare to the case of an increased level of functional integration of supply chains where many intermediate steps in the transport chain have been removed and therefore enabled so-called one-stop-shop enabling many shippers to have a single contact point on a regional or even global level.
5 Conclusions

The TSR is always contemporary for theoretical and practical examination. Senior Vice-President of JSC RZD, Mr. Boris Lapidus is optimistic in idea of increasing competitiveness of Trans-Sib and further traffic of 1.3 million containers by it per year (Briginshaw, 2009). Despite of permanent developing of the Russian transport system in the Far East region the rate of rise is still insufficient, between the transports systems of neighbouring countries and Primorsky krai there is a gap. In North-East Asia the transport system of Japan, China, and Korea are able to meet competition. These countries form the structure of international trade, offer the traffic routes, and set tariff politics.

The increase in container transportation requires a serious investment and suggestion for improvement of all parts of the intermodal transport chains. In Russia according to Ivanova (2007), current level of containerisation is low 30%, compared to 60%–70% of the world average, which means that Russia’s container market has significant growth potential. Already now, its annual growth rate is more than 20%, compared to 8%–10% of the world average. The previous research works mostly explored the maritime part and land part of intermodal transport chains separately. Nevertheless, the interoperability of these systems a prerequisite for efficiency of Russian transport system in internal and international transport logistics.

Therefore, the section of TSR, Far Eastern Railway could play a more significant role in transporting of containers passing through the main far eastern seaports. The Far Eastern Railway plays a vital role for the Far East region of Russia and has to be computable on international level. It passes almost all cargoes of TSR entered from far eastern ports Vladivostok, Nakhodka, and Vostochny to countries of EU and back to Asia. The key component in reliable work of Far Eastern Railway is in developing harmonious cooperation with sea transport.

Creating infrastructure projects of sea ports in accordance with ‘dry port’ concept and applying ‘pull’ system, as a base for robust and durable work between participants of supply chains will increase the compatibility of Far Eastern Railway, which will respectively amplify the transit traffic through the Trans-Sib. The developing newer transport distributing centres in the Primorsky krai will lessen time and cost expense for shippers in case of choosing TSR for transit goods to other countries.

Centres will play a role of a consignee on Russian territory, which will allow unshipped in bond cargo removals to this centre and make the remaining operations there. It is rather obvious that some activities like ship loading/unloading are impossible to move inland. However, there is a whole range of activities (bulk storage, customs clearance, container picking/unpicking, order picking, container load/unload, order palletised) that would be moved inland. In centres, accumulating of containers can be on the ground simultaneously with the procedures of filling traffic documents passing custom. When the amount of containers will be enough to make up a train, the train can be forward for dispatch immediately. This technology eliminates at least three days in transit time through the Trans-Siberian Railway, Vostochny port as an example. For additional reduction of transit time, it would be better to consider the container as an equipment rather than cargo. This action will lean time by three to four days. In this aspect, the crucial role is regarded to the Russian government. Acceptance of
container as equipment should be supported by issue a proclamation about joining to COTIF.

It is important that the centres will be constructed on inland territory releasing the expensive space of seaports, which increase the production of stevedoring operation and open the places in seaports for building high technological complexes. The inland territories are cost less compared to port territories. Therefore, it is safe to say that tariff for handling cargoes that is in direct dependence of leased territories price will be significantly lower. Furthermore, concentration of the logistic operation in transport distributing centres with higher standards will decrease the prime cost for intangible service.

On the assumption of creating, newer transport distributing centres with higher standards could be organised an integrated executive centre, which will be responsible for the deals with private operators. It will bring elimination of forwarding agents duties, which led to extra cost for railway operation. As a result, dispatching of container will be at the required time without extra postponement of deficit flat cars. According to Ivanova et al. (2008) analysis, flat cars will represent the second most demanded kind of wagons as container transportation market in Russia is growing at a high rate.

The idea of implementation of newer transport distributing centres is closely related to regional development of total transportation system of Primorsky krai. It results from the establishment of new businesses in the area once the necessary logistics infrastructure is in place. The creation of consolidated transport system of Primorsky krai will initiate the developing of new areas in economics in the krai, supply the steady expansion of transport infrastructure, open new vacancies in work, and tremendous increases in the revenue budget.

Primorsky krai has a potential to be the international trade junction in North-East region. This transport system should provide smooth and fast flow of cargoes from neighbouring countries. In the article, the cooperation with foreign economics was examined on the grounds of maritime excess. For further research, it would be advisable to take into account the role of land border check points in international trade. An investigation in this area could attract cargos of Asian countries via maritime and land excess, as well bring the utilisation of the TSR.

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Publication II

Korovyakovskiy, E. and Panova, Y. (2011)

Dynamics of Russian dry ports

*Research in Transportation Economics*


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Dynamics of Russian dry ports
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ABSTRACT
The transportation of cargos in containers has been intensively developing over the last decades. The world pace of growth in container transport is about 11% annually while in the Russian Federation from 2003 to 2007 the average growth was 21%. Container transportation is going to increase due to the construction of huge infrastructure projects for the Winter Olympics games in Sochi 2014, which implies the transportation of the required material flow. Foreign car assembly on Russian territory is developing, supplied by component parts delivered from Japan and the Republic of Korea, as well as from China that now bring 21.3% import container transport to Russia. About 60% of Russian container traffic passes through seaports Saint Petersburg, Novorossiysk and Vladivostok. The scenarios for increasing capacity to meet demands ahead are enhancing the productivity of seaports sites or leading to the creation of terminals in the hinterland. Although the phenomenon of dry ports is spread all over the world, in Russia none of the seaports has sufficient number of these facilities. The inland terminals of Russian seaports will be analysed from a dry port perspective. Despite the impediments, there are ecological and economical benefits that are discussed in the article. The advantages to the transport chain suggest that dry ports are a promising area for Russian seaports’ welfare.

1. Introduction
Transport infrastructure facilitates global trade development and maritime supply chains are composed of international transport services and ports and terminals (Haralambides, 2008). Container terminals are playing a significant role in global trade and have been handling continuously increasing volumes of traffic and have acted as nodes in intermodal transport. According to Ting, Wang, Kao, and Pitty (2010), terminals serve as multimodal interfaces between sea and land transportation. With the increase of containerised traffic, container terminals have started to develop in new locations in the hinterland of seaports.

In comparison to development in other world regions, the construction of inland terminals in Russia is at a very early stage of development. The principal gateways for container traffic are located in Saint Petersburg, Novorossiysk and Vladivostok. This paper analyses the development of Russian inland terminals following the arguments from Rosso (2009). According to Rosso (2009), an inland terminal can be categorised as a dry port if there is a scheduled rail connection to a seaport and customs services, as well as other container operations. However, in Russia these characteristics are not shared by all inland terminals. A lack of infrastructure development in seaport cities and existing regulations impede container port development in Russia and their inland connections.

Pettit and Beresford (2008) define inland connectivity as a powerful determinant of port performance, particularly as container ship sizes are increasing continuously which results in greater container volumes needing to be transported to and from seaports, and to and from production and distribution centres within the hinterland of the ports. Road access to most Russian seaports is reaching capacity limits and congestion causes significant external and social costs. Congestion not only limits the terminal capacity, but also generates significant air pollution and noise (Chen and Yang, 2010).

Therefore, this paper investigates how fully implemented dry ports can improve material flow and how environmental and economic benefits might be derived from dry port development in the Russian container market.

2. The peculiarities of the Russian container market
In the period from 2003 to 2008 the container market in the Russian Federation grew an average of 21%, which was significantly higher than the global average growth of 11% annually (see Fig. 1).
The amount of containerised cargoes as the total share of dry cargoes has been increasing from 12% in 2005 to 15% in year 2010 (see Table 1).

By the end of the third quarter of 2005, containerised trade made up 43.5% of imports and 5.3% of exports respectively (see Fig. 2) in terms of volume. The imbalance of containerised trade emanates from the fact that the principal Russian export cargoes are raw materials moved in bulk transport, such as oil, ore, metals and other raw material. At the same time, the importance of containerised trade in imports has been increasing since 2005 and reached almost 49% in 2010.

According to Russia’s Merchant Seaports Association (2010b), the modal split in freight transportation of export cargo to seaports is as follows: 49.2 Mt (44.87%) by rail, 50.7 Mt (46.24%) by pipeline, 5.4 Mt (4.9%) by road, and 4.3 Mt (3.98%) by inland waterways. The strength of the pipeline figure emerges from the role of petroleum and gas as the main export products, while the high relevance of rail is down to the product structure in exports, particularly the high relevance of bulk cargoes in exports. In the opposite trade direction road transport dominates, moving 5.4 Mt (51.26%), whereas rail transported 2. Mt (24.79%), pipeline 0.9 Mt (8.9%), and inland waterways 1.6 Mt (15.0%).

Road transport moves about 95% of all container traffic, from, and 79% to the seaports in the North-West region, especially Saint Petersburg seaport (Baltic Sea port) (Shatilov, 2009). In the South region road transport is particularly increasing to/from Novorossisk seaport (a Black Sea port), growing 50% in 2007. At the same time, this region has the lowest participation of rail transport in traffic to and from the port. In the Far Eastern region, in the seaport of Vladivostok (a Pacific port) about 53.2% of export containers and almost 69% of import containers were handled by rail in 2007. While the recent global financial and economic crisis is affecting current container traffic, the long-term prospects for container traffic within Russia are optimistic. The largest Russian

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According to Russia’s Merchant Seaports Association (2010b), the modal split in freight transportation of export cargo to seaports is as follows: 49.2 Mt (44.87%) by rail, 50.7 Mt (46.24%) by pipeline, 5.4 Mt (4.9%) by road, and 4.3 Mt (3.98%) by inland waterways. The strength of the pipeline figure emerges from the role of petroleum and gas as the main export products, while the high relevance of rail is down to the product structure in exports, particularly the high relevance of bulk cargoes in exports. In the opposite trade direction road transport dominates, moving 5.4 Mt (51.26%), whereas rail transported 2. Mt (24.79%), pipeline 0.9 Mt (8.9%), and inland waterways 1.6 Mt (15.0%).

Road transport moves about 95% of all container traffic, from, and 79% to the seaports in the North-West region, especially Saint Petersburg seaport (Baltic Sea port) (Shatilov, 2009). In the South region road transport is particularly increasing to/from Novorossisk seaport (a Black Sea port), growing 50% in 2007. At the same time, this region has the lowest participation of rail transport in traffic to and from the port. In the Far Eastern region, in the seaport of Vladivostok (a Pacific port) about 53.2% of export containers and almost 69% of import containers were handled by rail in 2007. While the recent global financial and economic crisis is affecting current container traffic, the long-term prospects for container traffic within Russia are optimistic. The largest Russian

<table>
<thead>
<tr>
<th>Year</th>
<th>Import of dry cargoes</th>
<th>Import of containerised cargoes</th>
<th>Export of dry cargoes</th>
<th>Export of containerised cargoes</th>
<th>Coasting of dry cargoes</th>
<th>Coasting of containerised cargoes</th>
<th>Transit of dry cargoes</th>
<th>Transit of containerised cargoes</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>18,401.9</td>
<td>8019.7</td>
<td>99,688.5</td>
<td>5245</td>
<td>1843.4</td>
<td>1779.6</td>
<td>1750.2</td>
<td>452.2</td>
</tr>
<tr>
<td>2006</td>
<td>21,005.5</td>
<td>10,199.5</td>
<td>98,349</td>
<td>98,044.6</td>
<td>1,011.3</td>
<td>2,292</td>
<td>1,097.1</td>
<td>103.4</td>
</tr>
<tr>
<td>2007</td>
<td>26,019.1</td>
<td>12,681.7</td>
<td>100,816.9</td>
<td>6637.4</td>
<td>2,634.6</td>
<td>2,995</td>
<td>1,807.3</td>
<td>78.8</td>
</tr>
<tr>
<td>2008</td>
<td>32,616.8</td>
<td>14,996.8</td>
<td>99,044.6</td>
<td>6647.6</td>
<td>2,705.9</td>
<td>3,048.1</td>
<td>1,444</td>
<td>56.2</td>
</tr>
<tr>
<td>2009</td>
<td>19,640.6</td>
<td>8926.1</td>
<td>11,4547.9</td>
<td>6495.3</td>
<td>3,048.1</td>
<td>3,198.2</td>
<td>1,599.0</td>
<td>60.6</td>
</tr>
<tr>
<td>2010</td>
<td>27,225.3</td>
<td>13,199.5</td>
<td>11,9142</td>
<td>7002.6</td>
<td>3,198.2</td>
<td>3,198.2</td>
<td>1,599.0</td>
<td>60.6</td>
</tr>
</tbody>
</table>

Note: Statistics that cover the third quarter of each year. Source: Russia’s Merchant Seaports Association (2008a, 2008b, 2010a).
rail freight container operator, the stock exchange listed company Transcontainer, owns 21 thousand flat railcars and more than 48 thousand containers. In 2007, Transcontainer transported 1.3 million TEU, of which 0.48 million TEU was international traffic (Osminin, 2009). With the extension of container transport within Russia, dedicated container trains have been implemented and the highest utilisation can be found in the routes from the Northern and Eastern regions destined to Saint Petersburg.

Russian Railways have presented a development plan to increase the utilisation of the Trans-Siberian Railway corridor (9244 km) by using block trains and a travel time of seven days. The main route starts from Japan and South Korea and connects the Russian inland regions through the Pacific seaports. Currently, the potential of the route is underutilized due to a number of infrastructural bottlenecks (Panova, 2009).

The development of car industry projects such as new car assembly lines by companies such as Volkswagen can be expected to boost container transport within Russia. Assemblies from Volkswagen are located in Kaluga and Renault assembly lines have been created in Moscow. It is argued that car components make up for a 25% share of all import container transports (Aervitz, 2007).

In the South, container transport is expected to increase in relation to the progress of infrastructure development in preparation for the Olympic Winter Games in Sochi 2014. In the East, one of the important drivers of container volumes originates from Chinese imports to Russia (21.3% of all import container transports in Russia). The Far Eastern Railway has announced the development of new routes connecting China, Russia and other countries of the Asia-Pacific region (Zaichenko, 2009). Currently, the Mudandjian (China)—Grodekovo (Russia)—Vladivostok seaport (Russia) is under consideration by Chinese representatives. Along this route, the grain and processed cargoes will be sent through Vladivostok seaport to Japan and the Republic of Korea.

Infranews.ru (2008) estimated the Russian container market to be at least 4.8 million TEU in 2007. These volumes were achieved from international container transit traffic and rapid improvements in container transport by rail. From 2007 to 2008 container transport on Russian railways grew from 2.1 million TEU to almost 2.5 million TEU (Pehterev, 2009). Future plans from the Ministry of Transport aim at increasing container traffic to 7 million TEU by 2012, of which 5 million are estimated to enter through Russian seaports.

The growing demand in container traffic should primarily be satisfied by the seaports of Saint Petersburg, Novorossiysk and Vladivostok. Mr. Sergey Kozlov, General Director of Far East Shipping Company (FESCO) stated that today 60% of Russian container traffic passes through these three seaports (Kommersant.ru, 2008). In the first half of 2010 container throughput in Russian seaports increased by 36.2% compared to the first half of 2009, a volume of 15.6 Mt (Worldcargonews.com, 2010b). With Russian container throughput increasing again after the economic downturn, inland terminal development has regained strong interest.

Four inland terminals are located in close geographic proximity to Russia’s principal container port of Saint Petersburg. These terminals are: Voskhod, Interterminal-Predportovy, Predportovy Distriport, and Shushary Distriport. A Logistics-Terminal in the Shushary region is currently under development and similar container facilities are planned in the Yanino and Kolpino regions of Saint Petersburg. The inland terminal Ruscon services Novorossiysk seaport and the Yuzhny Primorsky Terminal project is related to the seaport in Vladivostok (Fig. 3).
3. Characteristics of Russian ‘dry ports’

3.1. Saint Petersburg seaport

3.1.1. Interterminal-Predportovy

The inland terminal Interterminal-Predportovy is owned by the Interterminal Group, which was founded in 2001. The construction of the 21-ha terminal started in autumn 2005 in a location 4.2 km from the port of Saint Petersburg. The terminal is located in the south of Saint Petersburg, in the Predportovaya-1 industrial zone at the Predportovaya railway station (Otryalnskaya Railway). The facility is located in the vicinity of the Ring Road and Western High Speed Diameter, Moskovskoye shosse (highway) and Kievskoye shosse (1.2 km). The distance to Pulkovo Airport is 3 km (Interterminal.com, 2001). The terminal offers transhipment services between rail and road, storage, auxiliary services such as refrigerated storage and warehousing, insurance offices, and container maintenance. The Interterminal-Predportovy facility supports customs clearance for Baltic Saint Petersburg Customs. In addition, the terminal provides a number of services: container packing and unpacking, consolidation, palletizing, receiving and processing of trains, forwarding and dispatching of cargo to Russia and the Commonwealth of Independent States (CIS) countries. Over 60,000 m² storage capacity are available in heated warehouses. Further storage capacity in refrigerated warehouses is 8500 m² (24,400 euro pallets). Additionally, 48 power points for refrigerated containers and refrigerated equipment are available.

At present, the Interterminal-Predportovy facility has 6 shared rail tracks with a total length of 3.7 km. The terminal is equipped with a terminal owned locomotive, reach stackers (10, 45 tons) and forklifts (1.2 tons capacity) with a handling capacity of 3500 TEU/year in an area of 28,000 m².

3.1.2. Predportovy Distriport

The Predportovy Distriport is an inland railway terminal of the Saint Petersburg seaport. The terminal is owned and managed by the Eurosib-Terminal Company, the same company that was also involved in the development of the terminal in 2006. The terminal has an area of 4.9 ha and is located in proximity to the Saint Petersburg seaport and the Predportovaya railway station (Eurosib.hoz, 2006a) with access to the main highways Kievskoe, Moskovskoe and the Ring Road. The principal function of the terminal includes intermodal and multimodal services, transshipment between rail and road to destinations in Russia and the CIS countries. The terminal offers a range of additional services such as consolidation of sea freight consignments, consolidation of land-based freight consignments, empty container depots, clearance depot, cargo storage in reefer containers, customs-related services.
including customs clearance, insurance of stored goods at no cost to the client, advising clients on customs-related issues and assisting with customs procedures, online tracking of containerised cargoes, and container maintenance.

A heated warehouse with an area of 4500 m² offers storage capacity for 6900 pallets including a covered railway dock for six wagons and 15 bays for loading heavy-duty and light-duty trucks. The 2 ha container site has a capacity of 1500 TEU (600 TEU for handling reefer and empty units, 350 TEU for export cargoes and 550 TEU for import cargoes).

The rail tracks have a total length of 1240 m. The terminal has a fixed timetable rail connection to the Saint Petersburg seaport and a dedicated ad hoc rail service with a capacity of up to 50 TEU. Two 6-day container service and the Eurologistics Group operate a weekly container service from the Saint Petersburg Terminal at Saint Petersburg seaport. In 2010, the Eurologistics Group sold the terminal to Sovfracht-Sovtrans (Lexum.ru, 2010). In August 2010 Sovfracht organised a block-train with perishable goods from the terminal to the Vladivostok seaport. Future plans also include block-train services to Khabarovsk and Novosibirsk.

The integration of the Pulkovtsy Distripot with the common customs and information system of Saint Petersburg seaport facilitates the processing of necessary documentation. This integration provides significant advantages for customers beyond the spectrum of container services, as it contributes to a reduction in container turnaround times.

3.1.3. Voskhod terminal

The Voskhod terminal is owned by the Voskhod Company, which was established in 1991 (Albasea.ru, 2008). It is a member of the American Chamber of commerce and the "North-West" Regional Association of customs brokers since July 2005. The latter distinguishes the Voskhod from other terminals.

On an area of 12,000 m² the terminal renders customs clearance services as a customs broker. The Shushary customs station of Saint Petersburg Customs is located at the Voskhod terminal, allowing customs clearance for almost any cargo at all customs offices in Saint Petersburg: Baltic, Northwest, Ecnice, Pulkovskoye, and Saint Petersburg Customs. Furthermore, there is a possibility of carrying out customs payments via the “Customs card” system.

The Voskhod facilities, including clearance depot, container yard, and loading bay, are located in the Shushary railway yard and have road access to the principal highways (Moskovskoye, Kirevskoye highways, and the Ring Road). The terminal offers transshipment, road and rail haulage, maritime forwarding, quarantine, tracking, as well as customs clearance.

The clearance depot provides 9215 m² of storage area (300 m² for reefer containers). Services include handling and temporary storage of goods that are carried under customs transit by any applicable mode of inland transport and the obligatory security as well as veterinary and phytosanitary control agencies.

The terminal has a capacity of 7000 TEU and handling equipment includes 3 reach stackers and 3 gantry cranes. In 2008, the facility handled 190,000 TEU which is more than double the throughput in 2004 (80,000 TEU). The storage area of 15,000 m² is equipped with 2 loading rail tracks with a capacity of 28 rail cars and 28 gates for lifting-on/lifting-off various types of trucks.

3.1.4. Shushary Distripot

Eurologistics-Terminal Company opened the Shushary Distripot in 2005 (Eurosib.ru, 2006a). The terminal has rail connections to Saint Petersburg seaport (12 km) and access to Moskovskoye highway and the Ring Road. The terminal with an area of 16 ha handles 560,000 tonnes of cargo and 50,000 TEU annually. The facility provides two warehouses with a total storage area of 30,000 m². The container yard with its 2.5 ha has a storage capacity of 2000 containers.

Shushary Distripot is equipped with three loading rail tracks with a total length of 2500 m. The range of services offered at the terminal includes transshipment, road haulage, warehousing, storage, customs clearance, tracking, forwarding, and container block-trains.

3.1.5. Logistics-Terminal

The Logistics-Terminal is owned by the biggest terminal operator in Russia, National Container Company (NCC). The terminal was developed due to the necessity of increasing the capacity and logistics services of the company’s terminals at the seaports of Saint Petersburg and Ust-Luga. The construction of the terminal started in September 2007 with a planned container throughput of 200,000 TEU/annum. The distances to the First Container Terminal of Saint Petersburg seaport, the terminal of Ust-Luga seaport and Moscow are 17 km, 161 km, 620 km respectively (Container.ru, 2002).

An area of 10,000 m² is designed as a clearance depot. The storage capacity is 10,000 TEU for loaded containers and 4500 TEU for empty containers. The terminal is equipped with rubber tyre gantry cranes (RTGs), and rail mounted gantry cranes (RMGs) to handle containers. The terminal offers transshipment, storage, depot, road haulage, customs clearance, and value-added services such as loading and unloading of containers. In December 2008, the terminal was included in the Baltic Customs operations for customs clearance. Since April 2010 a new customs station, Pushkinsky, belonging to Baltic Customs, operates at the terminal. This customs station is mostly oriented toward the customs clearance of car components with a destination of the car assembles in Saint Petersburg (Container.ru, 2010). This is the first time in Russia that a seaport and Logistics-Terminal have fallen under the authority of the same customs agency, thus allowing for simplified processing of documents (Container Business, 2008a).

3.1.6. Yanino

Inland terminal Yanino started to fully operate by the end of 2010 (Portnews.ru, 2009). The terminal, with a container storage capacity of 10,000 TEU, has direct access to the rail system and private loading rail tracks as well as to the Ring Road (15 km). The terminal is run by Global Ports Investments Plc (GPI) and Container Finance Ltd Oy. GPI is a group of companies that includes terminal operators such as Petrolesport Terminal, MobileContainer Terminal of Saint Petersburg seaport, Vostochnaya stevedoring company of Vostochny seaport and two terminals located in Poland. The south-west customs station of Saint Petersburg Customs was relocated to Yanino terminal and renamed Yaninsky customs station of Saint Petersburg Customs in July 2010 (Tks.ru, 2010a).

The underlying aim of GPI is to directly link the Petrolesport Terminal (34 km) and MobileContainer Terminal (50 km) with Yanino terminal by rail to handle 500,000 TEU/annum. Currently, around 40% of the Yanino terminal territory is ready to offer a service, while the rest is still under construction.

3.1.7. The Kolpino project

The company Eurasia Logistics, a developer of terminals in Russia and the CIS countries since 2007, delivered the CreenGate industrial park project in Kolpino. The area is close to the Moskovskoye and Kolpinskoye highway and since September 2009 it is linked with the Ring Road. The CreenGate has an area of 780,000 m² of which 211,000 m² were leased by 3 logistics operators in 2008. The industrial park CreenGate includes a 4 ha container terminal with an investment of 5 million USD (Container Business, 2008b).
<table>
<thead>
<tr>
<th>Location</th>
<th>Type</th>
<th>Owner</th>
<th>Started</th>
<th>TEU per year/area</th>
<th>Territory, ha/ha</th>
<th>Customs jurisdiction</th>
<th>Equipment for transhipment</th>
<th>Custom clearance</th>
<th>Storage, m²</th>
<th>Rail service</th>
<th>Forwarding</th>
<th>Offset</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saint Petersburg</td>
<td>Inter-terminal</td>
<td>Private</td>
<td>Autumn 2005</td>
<td>20,000/10,000 TEU</td>
<td>na/2.5</td>
<td>Saint Petersburg Customs</td>
<td>na</td>
<td>Yes</td>
<td>40,500 m²</td>
<td>No</td>
<td>Yes</td>
<td>Refrigerated storage, road haulage, maintenance of containers, secure storage, quarantine</td>
</tr>
<tr>
<td>Predportovy Distriport</td>
<td>Private</td>
<td>2006</td>
<td>na/2 ha</td>
<td>4.9</td>
<td>Saint Petersburg Customs</td>
<td>3 reach stackers Kalmar, 1 reach stacker Valmet and 3 gantry cranes</td>
<td>na</td>
<td>Yes</td>
<td>24,215 m²</td>
<td>Yes</td>
<td>Yes</td>
<td>On-line tracking of containerised cargoes, insurance of the stored goods, customs depot, refrigerated storage, maintenance of containers</td>
</tr>
<tr>
<td>Vasiliev</td>
<td>Private</td>
<td>na</td>
<td>190,000/7000 TEU</td>
<td>1.2</td>
<td>Saint Petersburg Customs</td>
<td>3 reach stackers Kalmar and 3 gantry cranes</td>
<td>na</td>
<td>Yes</td>
<td>30,000 m²</td>
<td>Yes</td>
<td>Yes</td>
<td>Veterinary and phytosanitary control, tracking, refrigerated storage, customs depot, road haulage</td>
</tr>
<tr>
<td>Shushary Distriport</td>
<td>Private</td>
<td>2008</td>
<td>50,000/25 ha</td>
<td>16</td>
<td>Saint Petersburg Customs</td>
<td>1 reach stacker Kalmar, 3 gantry cranes</td>
<td>na</td>
<td>Yes</td>
<td>30,000 m²</td>
<td>Yes</td>
<td>Yes</td>
<td>Road haulage, tracking</td>
</tr>
<tr>
<td>Novorossiysk</td>
<td>Rail terminal</td>
<td>Private</td>
<td>2012</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>Sea-freight rates directly from shipping lines, rail haulage</td>
</tr>
<tr>
<td>St Petersburg</td>
<td>Developing</td>
<td>Yankee</td>
<td>1994</td>
<td>500,000/10,000 TEU</td>
<td>na</td>
<td>Saint Petersburg Customs</td>
<td>4 rubber tire gantries with a capacity of 50 tons each</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>na</td>
</tr>
<tr>
<td>Terminal near the village Staraya Logistics Terminal</td>
<td>Private</td>
<td>na</td>
<td>80,000/ha</td>
<td>na</td>
<td>Na</td>
<td>Na</td>
<td>Na</td>
<td>Na</td>
<td>Na</td>
<td>Na</td>
<td>na</td>
<td></td>
</tr>
<tr>
<td>Vladivostok</td>
<td>Rail terminal</td>
<td>Private</td>
<td>2007</td>
<td>200,000/ha</td>
<td>92</td>
<td>Baltic Customs</td>
<td>Rubber tire gantries and rail mounted gantry</td>
<td>na</td>
<td>Yes</td>
<td>24,500 m²</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Primorsky Terminal</td>
<td>Private</td>
<td>na/12 ha</td>
<td>70</td>
<td>Vladivostok Customs</td>
<td>n.a</td>
<td>n.a</td>
<td>n.a</td>
<td>n.a</td>
<td>n.a</td>
<td>n.a</td>
<td>n.a</td>
<td>Clean-up depot, maintenance, tracking, road haulage, transport security</td>
</tr>
<tr>
<td>Primorsky</td>
<td>Project</td>
<td>Private</td>
<td>2007</td>
<td>na/4 ha</td>
<td>7.8</td>
<td>Saint Petersburg Customs</td>
<td>n.a</td>
<td>n.a</td>
<td>n.a</td>
<td>n.a</td>
<td>n.a</td>
<td>n.a</td>
</tr>
</tbody>
</table>
3.2. Novorossiysk seaport

3.2.1. Ruscon Terminal

Ruscon Company, one of the leading terminal operators in Russia, has operated the Ruscon Terminal of Novorossiysk seaport since 2002. The company started business in 1995 as a forwarding agent of Novorossiysk seaport (Ruscon.delo-group.ru, 2010) and today has expanded its services to the major Russian container ports of Saint Petersburg, Kaliningrad, and Vostochny, operating rail and road transport services.

The Ruscon terminal is located 5 km away from the seaport and has an annual container throughput of 120,000 TEU. The terminal offers the following services: transshipment, storage, depot, customs clearance, as well as additional services (road and rail haulage with their own block-trains and trucking services). However, there is no customs station in the terminal.

Ruscon Company is currently planning to open a new inland terminal to serve Saint Petersburg seaport. The brown site, on the site of a former concrete plant, near Staritsy is 40 km from the seaport. The project aims to reach an annual throughput of 80,000 TEU with an investment of 19 million USD (Portnews.ru, 2008). An advantage of the project is that it would attract new business and create around 100 new jobs in the area.

3.3. Vladivostok seaport

3.3.1. Yuzhny Primorsky Terminal

In the future Vladivostok seaport will be served by an inland terminal close to the railway station Nadezhdinskaya and 36 km from the seaport. The Yuzhny Primorsky Terminal is being developed under a 2-phase strategy (The Conception, 2007). During the first phase (until 2014), 50 ha will be developed and about 70 ha will be developed in the second phase (by 2030). The development includes a 32-ha container yard and an 8-ha clearance depot. The proposed annual capacity of the container yard is 1.2 million TEU (by 2014) and 1.7 million TEU (by 2020). Loading bays will allow handling of 150,000 transport vehicles a year. An area of 14 ha is designed for 10,000 m² of warehouses by 2015. The project includes the upgrading of the adjacent railway station to a handling capacity of 11.9 million tons of cargo per annum. The terminal will be joined to a new highway, recently given development permission by Russia's Transport Ministry and the Far East regional authorities. The construction of this approximately 40 km long highway provides the shortest possible transport link between the seaports Vladivostok, Nakhodka and Vostochny (Worldcargonews.com, 2010a). The terminal will offer the following services: transshipment, storage, depot, customs clearance, consolidation, maintenance, as well as various value added services such as tracking, road haulage, and transport security.

Most of the described inland terminals serve Saint Petersburg seaport (Table 2). However, not all of the Russian inland terminals can be classified as dry ports. The UN Economic Commission for Europe defines the term “Inland Clearance Depot” which can be applied to such synonyms as Dry Port, Inland Clearance Terminal, etc. The definition of an Inland Clearance Depot (ICD) is:

“a common user facility, other than a port or an airport, approved by a competent body, equipped with fixed installations and offering services for handling and temporary storage of any kind of goods (including containers) carried under Customs transit by any applicable mode of transport, placed under Customs control and with Customs and other agencies competent to clear goods for home use, warehousing, temporary admission, re-export, temporary storage for onward transit and outright export” (UNECE, 1998; p. 105).

Roso and Lévéque (2002, p. 50) defined a dry port as “an inland intermodal terminal directly connected to seaport(s) with high capacity transport mean(s), where customers can lease/pick up their standardized units as if directly to a seaport”. The features listed in given definitions of dry ports are not fully satisfied in Russian inland terminals. Firstly, the infrastructure of the seaport cities is weakly developed. Secondly, an absence of collaboration between customs, transport companies and terminal operators hinders the implementation of dry ports. Varvarenko (2008) stressed the fact that in Europe, containers are delayed in container terminals because they are waiting to be picked up by the consignee while in Russia containers are in demurrage because of waiting for customs clearance.

Previous research (Noteboom and Rodrigue, 2009; Rosa and Rosselli, 2009; Caballini and Gattorna, 2009; Roso and Lumidsen, 2009; Ng and Gujar, 2009; Croie, Marthe and Krugell, 2009) suggests that the aforementioned examples of Russian inland terminals are developing in accordance with common terminal concepts in Europe.

Despite the fact that seaports experience similar problems with handling containers, the issues are evolving in different local
conditions. For example, the seaport of Saint Petersburg operates in a region with four customs areas. The multiplicity of customs areas complicates the implementation of the dry port concept and necessitates a clear methodology to identify dry ports in this region (Fig. 4). Moreover, the specific characteristics of the North-West region bring the necessity of creating additional regulations for dry port development. For the first time, Russian regulations that prescribed the rules of collaboration with dry ports were issued on 18 March 2010. The act No. 510 regulating dry port operation is in place since 29 July 2010. In accordance with the law, the founder of a dry port has to be a port terminal operator or has to directly cooperate with the port terminal as a clearance depot (Tkiciu, 2010b). Furthermore, seaport and inland terminals have to be under the jurisdiction of one customs station or customs for full implementation of dry port principles (Ross and Lumsden, 2009). This is regarded as a main prerequisite for smooth operation between a seaport and a dry port, as it enables the simplification of customs procedures.

In accordance with the Russian law related to dry ports, only the Logistics-Terminal within the North-West region of Russia is included in the jurisdiction of Baltic Customs (seaport customs). Therefore, the terminal and seaport of Saint Petersburg fall under the jurisdiction of Baltic Customs. The other mentioned inland terminals serving Saint Petersburg seaport fall under the jurisdiction of Saint Petersburg customs (hinterland customs). This contradicts the concept of facilitation of container transport under the dry port concept. Thus, the Logistics-Terminal is the only inland terminal that achieves the status of a dry port.

4. Analysing options of dry port development in Saint Petersburg

In order to explore the potential positive impacts of dry port development, the port of Saint Petersburg is used as a case study. The largest Russian container port is restricted in its infrastructure development necessary to cope with the predicted increase in container throughput. This is due to its proximity to the city of Saint Petersburg. Therefore it presents a relevant case in order to determine the effect of dry port implementation. The current port area of the FCT, Petroleosport and MobiliDc terminals is “locked” in a semi-ring of apartment blocks that allow no further extension of the port. FCT is the biggest Russian container terminal, starting its operation in 1998. The evolution of container throughput in the FCT terminal is shown in Fig. 5, showing that after 10 years of operation more than one million containers were moved in 2008.

Ng and Gujjar (2009) in their research on the Port of Gothenburg, Sweden revealed that ports specifically gain from dry port development if they face capacity constraints. In the Saint Petersburg seaport, the current lack of development space suggests that the port has the potential to expand its capacity by implementing the dry port concept.

Already the Logistics-Terminal can be considered as a dry port under existing Russian policy. This terminal can support the daily rail and road traffic to and from FCT (see Table 3).

In the following, the handling capacity for the port of Saint Petersburg is calculated.

The capacity of the container terminal is represented by the formula:

$$E_t = \left( N_d \times t_a + N_s \times t_b \right) \times \left(1 - \alpha\right) + \beta \times N_d \times t_a \text{ container/place}$$

(1)

where $N_d$, $N_s$, $N_d$ = amount of delivered, picked and defective containers, $t_a$, $t_b$, $t_a$ = retention cycle of delivered, picked containers respectively, in days. $\beta$ = coefficient represents the necessity for extra depot space for damaged equipment, $\beta = 0.03$. $\alpha$ = coefficient represents the direct loading from ship to train, $\alpha = 0.1$.

$$E_t = (1762 \times 8 + 865 \times 7) \times (1 - 0.1) + 0.03 \times 62 \times 8$$

= 18150 container/places

The handling capacity is calculated as follows:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Delivering</td>
<td>113</td>
<td>1647</td>
</tr>
<tr>
<td>Picking</td>
<td>42</td>
<td>825</td>
</tr>
</tbody>
</table>

Table 3

Daily container throughput of the first container terminal.
\[ I_{n} = \frac{E_{r}}{t_{r} \times (1 - a)} \text{ containers/day} \quad (2) \]

where: 
- \( t_{r} \) – uniform retention cycle of delivered and picked containers, days.
- \( E_{r} \) – 18150
- \( a \) – 0.1

The capacity of the maritime First Container Terminal can be enhanced by physical expansion at the site, additional levels of container storage area or creating a dry port Logistics-Terminal. These three options are compared below in order to identify the optimal decision.

4.1. Physical expansion at the site

In order to increase handling capacity of the seaport terminal and keep the current retention cycle, it is possible to release territory occupied by office buildings, a service centre and non-functional warehouses. A released area of 6230 m² stores up 425 containers. In the case of storing containers up to 3 levels, 1275 containers will be located in this area. Additional capacity of the storage area is

\[ E_{k} = (637 \times 8 + 637 \times 7) \times (1 - 0.1) \]

= 8599 container/places

Handling capacity of the terminal with an additional storage area equals

\[ I_{n} = \frac{18150 + 8599}{7\frac{7}{8} \times (1 - 0.1)} \]

= 3962 containers/day

Thus, the seaport terminal will be able to handle 1,446,330 containers annually.

4.2. Additional levels in container storage area

To increase seaport terminal capacity on condition that the retention cycle is kept the same, the containers can be stacked higher. In accordance with terminal features, it is possible to add a 5th container level in sectors 6, 7 and 9 of the terminal. Hence, the handling capacity of the terminal will rise by 988 containers per day made up of 658 arrived containers and 330 picked containers. Therefore, seaport terminal capacity equals:

\[ E_{k} = (1762 \times 8 + 658 \times 8 + 865 \times 7 + 330 \times 7) \times (1 - 0) \]

+ 0.03 \times 62 \times 8

= 24967 container/places

Handling capacity of the terminal will reach

\[ I_{n} = \frac{24967}{7\frac{7}{8} \times (1 - 0.1)} \]

= 3698 containers/day

Annual terminal throughput arises to 1,349,770 containers per year.

4.3. Dry port logistics-terminal

Implementation of an inland terminal outside of the traditional hinterland of the seaports allow for increased handling of container volumes due to quick releasing at the container terminal berths, simultaneously freeing them for new shipments and improving turnaround times.

On the basis of organizing scheduled arrival of trucks and trains for picking or delivering containers, the handling capacity of the seaport terminal will be

\[ I_{n} = \frac{18150}{5 \times (1 - 0.1)} \]

= 6722 containers/day

This means that First Container Terminal will be able to handle 2,453,530 containers a year. This alternative provides for the enhancing of seaport terminal capacity by 2.5 times. Consequently, the servicing of First Container Terminal by a dry port will greatly improve the efficiency of Saint Petersburg seaport.

5. Conclusions

The contribution of this article lies in the analysis of the Russian container market and the thorough research on the dynamics of domestic dry ports. The dry port phenomenon has spread all over the world. An effective chain of inland terminals is a vital criterion for seaport performance. However, neither in the busy North-West region, nor in other parts of Russia, are there seaports with a sufficient number of dry ports. In accordance with the latest Russian act No. 530, the Logistics-Terminal of Saint Petersburg seaport is considered as a pilot of the dry port concept. It is safe to say that Russia is experiencing positive trends in creating inland terminals for serving, notably, Saint Petersburg, Novorossiyisk, and Vladivostok seaports.

There are three scenarios for enhancing the productivity of seaports: physical expansion, changing the container yard management or creating terminals in the hinterland. In this article, these alternatives are applied to the First Container Terminal of Saint Petersburg seaport. If a dry port is created, the seaport’s capacity will be increased by 2.5 times compared to 1.5 with the seaport’s physical expansion. An option of extra levels in container storage will bring less efficiency at the seaport than the aforementioned alternatives.

In light of current ecological issues, the dry port concept mitigates likely challenges. Dedicated trains between seaport and the Logistics-Terminal could substitute for trucks, which will reduce air pollution. Contemporaneously, truck congestion at the Saint Petersburg seaport will be reduced, along with associated operating costs. Congestion apart from that in Saint Petersburg is experienced in other Russian seaport cities because of issues with distributing containers from the seaports. Newly issued legislation will stimulate the implementation of dry ports because it facilitates the integration between the seaport and the dry port which, in turn, makes the construction of the inland container facilities feasible for Saint Petersburg and other Russian seaports.

Elin (2010) has shown that five years ago in Europe, more than 200 similar facilities similar to dry ports used to operate, and in the USA over 570, while in Russia the first legislative act on the topic of dry ports came into force only recently. However, there are many gaps in the Russian market to fill with dry ports as, after the economic crisis, the amount of cargo passing through seaports could grow exponentially. Despite the complex barriers to progressive processes and technologies based on dry port implementation, there is no doubt that the amount of dry ports will increase in Russia as time goes by, because seaports are developing in circumstances of highly competitive markets and tighter ecological issues.

References

Publication III


Perspective reserves of Russian seaport container terminals

World Review of Intermodal Transportation Research


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Perspective reserves of Russian seaport container terminals

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Abstract: The increase of flows in the container supply chains is largely driven by the growth in demand for container transportation. In order to meet the demands of clients, an ongoing improvement of the transport chain structure is underway. The successful development of container maritime terminal requires a corresponding growth of capacity of inland terminal infrastructure, like roads and railways, establishing vital links between entities. As such, the paper presents an empirical analysis from the technical, economical, operational, and ecological perspectives of Russian seaport container terminals that depend on dry ports construction. The justification of dry ports implementation as a main reserve, whereby the major seaport terminals’ productivity is enhanced, is investigated with simulation approach, which allows to compare the performance of the chain under varying conditions.

Keywords: Russian seaport container terminals; dry ports; intermodal transport chains; simulation.


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1 Introduction

The level of containerisation in the world is on average 50–60% of the total traffic volume of general goods, and in some European ports containerisation is more than 90% (JSC RZD, 2011). Russia lacks behind the leading countries in terms of containerised cargo. In 2010, only half of the imported goods to Russian seaports were in containers; whereas their growth to level of 2009 was outstanding and reached +43.4% (Russia’s Merchant Seaports Association, 2011).

The demand for container deliveries can be met by the development of container transport systems; first and foremost, inland freight terminals (i.e., dry ports). The insufficient capacity of warehouses and transhipment centres within the marine terminal tend to result in road congestions that block traffic around seaport cities. Vega (2010) stresses that this critical transport situation is generated by the increase of the sizes of containerships, which are the biggest transportation mode for carrying containers: the processing of large containerships leads to overloading throughput at the seaports, as well as adding the burden to transport nets involved in servicing ports.

According to Braemar’s Seoscope’s research division, orders of containerships are increasing at a dramatic rate. Statistics show that in 2011, 52 containerships with a capacity of 10,000 TEU were ordered. TEU is a unit for measuring the capacity that equals the dimensions of an ISO-container with a length of 20 feet (FEU is a 40-foot long ISO-container, 2TEU = FEU). “The list of ordered containerships includes the 20 x 18,000 TEU Triple E ships ordered by A P Moller Maersk; 10 x 14,000 TEU ships ordered by NOL; 14 x 13,000 TEU ships ordered by OOIL” (Worldcargonews.com, 2011a). The creation of 22,000 TEU ships in the future may influence the risk of traffic congestions on roads which lead to the seaports.

For optimal and effective management of rising freight traffic, terminal centres have been developing since the sixties. These centres were created not far from the area of cargo concentration and appeared for the first time in France, notably Sogaris and Garonor beside Paris. Their construction was the result of government policy on the improvement of the transport flows within the cities, where conditions deteriorated after the war (Sharapov, 2011). In the 80s–90s, the process of vast implementation of the freight centres in France, Germany, Italy, Netherlands, Belgium, and Great Britain was accompanied by the variance of terms describing the same concept (Roso, 2009). The concept implies the existence of technical and technological equipment that allows transhipment and other logistic operations to be performed.

In 2001, the Economic Commission for Europe introduced the term ‘dry port’ (Roso, 2009). This term exists in English and French languages while in Russian, the term ‘inland terminal’ is used instead. Dry port means an inland terminal characterised by developed rail infrastructure, buildings’ equipment, and customs offices, which provide services to clients as if at the seaport. According to Roso (2009), the dry port is directly connected with a seaport by high-capacity transport modes.
Based on overseas researches and practical data, this article sheds light on the dependence of Russian seaport container terminals from the perspective reserves of dry port implementation. The paper is logically structured with the subsequent sections: in Section 2, the dynamics of inland terminals’ development in foreign countries and in Russia is reviewed. In Section 3, the research methodology is being introduced. Empirical part in Section 4 reports research findings that begin from the analysis of the regions where dry ports have been evolving, after which their importance in terms of seaport container terminals well-being has been aggravated to factors of their implementation in container transport chains. The gained findings are applied in Section 5, where the justification of the construction of the dry ports are considered as a main power reserve of Russian seaport container terminals, and proved by the computer simulation. The hypothesis of their positive impact on productivity and leanness of the marine transport chain is investigated under varying conditions in simulation experiments. Specifically, the research compares the performance of seaport, in the case of increasing handling equipment or internal truck fleet, or both alternatives in one experiment, and implementation of dry port in supply chains. The rational scenario for improving the efficiency of the Russian seaports measured on observation of inbound and outbound container flows, as well as by the lead time of containers that are processed in the current system vs. new dry port system simulated in computer experiments. Section 6 concludes the study, and suggests avenues for further research.

2 Literature review

The development of the seaport container terminals depends on the capacity of land transport arteries, primarily, the approach roads and railways, as well as inland terminal infrastructure. In the world practice, major seaports that cannot be extended at the site, due to the lack of free spaces within seaport container terminals, are supported by the dry ports (e.g., inland terminals facilities, railports, inland ports).

Eight years ago, the US accounted for 570 inland ports (Elin, 2010). By 2009, the number of dry ports developed in India reached approximately 200 (Ng and Gujar, 2009). Three years later, there were more than 50 dry ports in China (Chang and Notteboom, 2012). In 2012, 10 European countries, such as Denmark, France, Germany, Greece, Hungary, Italy, Luxembourg, Portugal, Spain, and Ukraine represented 60 dry ports (Haralambides and Gujar, 2011).

Twenty-eight Swedish intermodal terminals, which were assumed to handle unitised goods or have direct connection by rail to a seaport, were surveyed by Roso et al. (2006). In 2010, the shuttle system of Port of Gothenburg in Sweden included 26 dedicated services to 23 dry ports (e.g., railports) (Almotairi et al., 2011). The development of shuttle services is supported by the port authority who is interested in an attraction of marine cargo flows. The port authority of Rotterdam by acting as a landlord in inland nodes is involved throughout the development of dry ports in Netherlands (Van den Berg and Langen, 2011). Conversely, in Hamburg, Germany, the port authority itself is not actively involved. Probably, that is why in the Southern hinterland for the port of Hamburg, where dry ports and logistics facilities are increasingly being placed, the land-use planning became problematic (Flämig and Hesse, 2011).

In Russia, the tendency to build dry ports (i.e., ‘inland freight terminals’) for releasing coastal lands has been started spreading since nineties, but the European Standards have
been met only by some terminals located beside the cultural capital of Russia, St. Petersburg (Korovyakovsky and Panova, 2011). Due to insufficient domestic practical experience in the complete implementation of the phenomenon of the dry port, the topic has not been widely explored by main Russian researchers of transport logistics (Derebus et al., 1980; Kogan et al., 1991; Malikov and Juravlev, 2007; Lukinsky, 2008; Balalaev and Leontev, 2009).

Meanwhile, the concept of dry ports is ubiquitous in the world practice and therefore received a lot of international research coverage (Slack, 1990; Roso et al., 2006; Notteboom and Rodrigue, 2009; Garnwa et al., 2009; Ng and Gujar, 2009; Cronje et al., 2009; Caballini and Gattorna, 2009; Macharis et al., 2009; Behrends, 2011; Chang and Notteboom, 2012).

3 Methodology

The research applies simulation experiments to investigate the dependence of seaport container terminal productivity on the dry port, as well as qualitative analysis from economical, technical, operational or ecological perspectives of the seaports that goes hand in hand with implementation of dry ports. The qualitative discussions are based on the collection of empirical materials: a review of journals, periodical collections, case studies (e.g., First Container Terminal, Petrolesport that supported by dry port of ‘Logistika-Terminal’ and ‘Logistic Park Yanino’ respectively), and the concept of integrated development of the container business in the holding company ‘Russian Railways’, among other research publications related to the subject area. As the reliable data is a prerequisite for the right and meaningful conclusions from the research, the data collection was drawn from the Rosstat, Eurostat, and Russia’s Merchant Seaports Association. Due to collected data, the firm understanding of current state and trends of seaport terminals concerning the necessity of dry ports development has been addressed. The remained analysis (e.g., the power reserves of seaport container terminal provided by dry port) was undertaken with a help of simulation that becomes a practical and useful approach for imperial investigates and measure of supply chain performance (Closs et al., 1998; Wu and Closs, 2009).

According to Van de Voorde and Winkelmans (2002), the software rather than the hardware of seaport development will be the determining factor in future trends in port competition. Henesey (2006) used a multi-agent-based simulation approach to improve productivity (e.g., ship turn-around times) by applying certain stacking policies at the marine freight terminal. Roso (2009) and Henttu et al. (2010) utilised simulation to calculate emission savings and the cost which can be achieved by using a dry port for servicing seaports in Sweden and Finland. In order to evaluate the efficiency of a ship-berth link, in the port of Pusan, Dragović et al. (2006) proposed two models with a simulation approach and queuing theory. The economic performance of a container terminal design based on the extended operational simulation model was provided by Veenstra and Lang (2004). Parola and Sciomachen (2005) presented a discrete-event simulation modelling approach related to the logistic chain as a whole applied at Northwestern Italian port system. For the port of Antwerp, Macharis et al. (2009) simulated the introduction of new intermodal barge terminals and estimated their impact to the network. More delayed overview of the container terminal simulations, including
review of academic container terminal models was conducted by Angeloudis and Bell (2011).

The choice of simulation, as a tool for performing analysis within the current research, was made due to the following reasons: the impossibility of providing the experiment on a real object (i.e., seaport, as a part of the supply chain); the difficulty of constructing an analytical model (the system has a causal relation, non-linear dynamics, and stochastic variables); as well as the need to analyse the behaviour within the system over time.

The experiments were designed in software called AnyLogic (Xjtek.ru, 2010). For the simulation, a method that was developed by Geoffrey Gordon in 1960 was selected (Gordon, 1978). By nowadays, the method of discrete-event simulation has been received a broad scope – from logistics and queuing systems to transport and production systems (Martinez et al., 2001; Moon and Phatak, 2005; Saranen, 2009; Goti et al., 2011; Lattila, 2012).

### 4 Factors of dry ports’ utilisation by seaport container terminals

The research on factors, initiating the seaport terminals to utilise dry ports, was started from the analysis of the regions where dry ports have been evolving. An examination of the regions was performed on the data provided by the Russian analytics agency that contacted with 1,535 manufacturing companies. The data collected among the companies helped to reveal the most developed regions of Russia (Figure 1).

**Figure 1** Geographic regions of Russian operations’ (see online version for colours)

The developed regions (Central, Volga, and Ural Federal Districts) are landlocked from the sea. Therefore, import cargo (primarily containerised) is usually supplied to the industrialised regions through the North-West, Caucasian, and Far East Federal Districts.
of Russia where the largest container seaports are located (i.e., seaports of St. Petersburg, Novorossiysk, Vladivostok, Vostochniy respectively). In 2012, Russian seaports handled approximately 5.1 million TEU (M TEU), of which 49.8% of cargo volumes were in the seaport of St. Petersburg, 13.8% in Vladivostok, 12.9% in Novorossiysk, and 7.8% in Vostochniy (Russia’s Merchant Seaports Association, 2012). Leaders of seaport container terminals are correlated with the mentioned seaports. In St. Petersburg there is ‘First Container Terminal’ (1.159 thousand TEU), ‘Petrolesport’ (541.12 thousand TEU), in Vladivostok seaport is the ‘Vladivostok MTP’ (338.89 thousand TEU), in Vostochny seaport is ‘Far East Stevedoring Company’ (254.3 thousand TEU), and in Novorossiysk is ‘Novoroslesexport’ (188.66 thousand TEU). The above-mentioned container terminals make up the top list of the biggest Russian seaport container terminals.

The dry ports are mostly located around named seaports and connected with the leading seaport container terminals. To define the importance and the specific location of the dry ports are used to support seaport terminals functioning, the four main groups of factors are further to be discussed.

4.1 Technical factors

In 2010, globally the volume of cargo in containers handled at marine terminals increased by 14.5% from the level of 2009 to 560 million TEUs (Worldcargonews.com, 2011b). In Russia, the annual growth of container cargo handling was fixed almost in all main container seaports and their marine container terminals (Russia’s Merchant Seaports Association, 2011, 2012). Annual capacity of ‘Petrolesport’ in Saint Petersburg is set to increase to 1.4M TEU and eventually to 2.3M TEU. In Vostochny, capacity of the terminal operated by Vostochnaya Stevedoring Company (VSC) is to be increased to 2.2M TEU (Worldcargonews.com, 2013). Therefore, to process rising containers volumes, the development of the seaport terminals’ capacity is required.

However, the extensional development of the seaports holding the main marine container terminals is restricted due to various reasons. For example, the seaport of Novorossiysk is surrounded by the mountains of the North Caucus (Strana.ru, 2009). For the seaports of St. Petersburg and Vladivostok, the location of territories within the urban infrastructure resulted in a lack of free space for their future development as well. The insufficient capacity of the St. Petersburg seaport became detriment, and led to the shift of value-added import cargo to the seaports of Baltic States and Finland. In 2008, approximately 15% of Russian import cargo was handled in Finland (Ruutikainen and Tapaninen, 2009). Hilmola (2011) stresses the important role of transit transports to Russia for the ports of Kotka and Hamina, that is to say, roughly one-third of handling amounts (in practice more than 1/3, “since not all imported items continue directly to Russia, but are taken first to Finnish warehouses, and are not, therefore, necessary registered in the seaports as a transit”, p.33).

In Russia, this situation causes loss of potential revenues and a decrease of market share. The lack of land, required for the construction of warehouses or stacking yards at marine container terminals, is the reason for lower incomes of container terminals to operate within Russian seaports. For instance, less than 20% of container flows are processed at the marine terminals of St. Petersburg seaport while the remaining cargo leaves the seaport without additional services, preventing to create service revenue for the operators (Gov.spb.ru, 2010). World experience shows that the growth of value-added
services, such as staffing, packing, consolidation, weighing, and labelling of cargo, increases the income derived from each container by two to three times.

The lack of lands that hinders to perform the additional services can be partly solved by increasing the height of containers’ stacks. However, the efficiency of this alternative is limited by safety height restriction of container stacks. The maximum quantity of loaded and empty containers in a container stack was calculated, with an allowance for their technical characteristics, physical and mathematical equations. Results prove that a stack of loaded containers is lower in height than a stack of empty containers (Niswari, 2005).

Moreover, it was found that the safety height of the stack of loaded containers is the same for TEU and FEU among the main container seaports (Table 1). The reason behind that is the calculation performed on the ground of GOST 20260-80 (1990, p.2.4.2 Stacking) for the containers produced by the Russian company Abakanwagonmash. Therefore, the maximum height of a container stack was restricted by the container strength/resistance, which for each of four container struts (type 1AA and 1CC) is 848 kN (Vagonmash.com, 2010). Thus, the height of loaded container stacks were checked in terms of the strongest force on the lowest twist lock of the bottom container, while the calculation of the number of empty containers in a stack was made on the basis of safety (SPandS, 2003) and the wind force that dramatically defers from the region to the region of Russia (Building code 2.01.07-85, 2005). That is why the heights of empty containers’ stacks vary at seaports of Russia due to their dependence on the strength of winds rather than the durability of the container (see Table 1). However, the calculations don’t allow for the rules on stacking heights that exist in the researched seaports.

<table>
<thead>
<tr>
<th>Type of container</th>
<th>Name of the seaport</th>
<th>St. Petersburg</th>
<th>Novorossiysk</th>
<th>Vladivostok</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loaded FEU</td>
<td></td>
<td>6</td>
<td>9</td>
<td>5</td>
</tr>
<tr>
<td>Loaded TEU</td>
<td></td>
<td>8</td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td>Empty FEU</td>
<td></td>
<td>9</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>Empty TEU</td>
<td></td>
<td>9</td>
<td>7</td>
<td>5</td>
</tr>
</tbody>
</table>

In general, the increase of the height of container stacks could be an additional alternative for improving the seaport container terminal’s capacity, which suffers from limited yard spaces, although this option is not always applicable in practice.

4.2 Economical factors

The value of the rates for loading and unloading operations depends on the rents of stevedoring companies for the usage of sea lands. The expensive lands of seaport terminals and their high lease payments often cause higher tariffs for stevedoring companies (Seaports Press, 2009). Despite the high tax rates for the land use, the operators will rather decide to increase the cost of their services only in the case of unprofitability of their business. In accordance with the existing land laws, such a
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solution may be obvious. The tax for the usage of publicly owned land for transport infrastructure has been increased to 1.5% of the cadastral value (Rg.ru, 2010a). The introduced rate of payment for the use of land by transport organisations deprives them of the economic sense, as it many times exceeds the profit of companies. For operators of marine terminals, the tax burden will continue if amendments of the tax code are not taken into consideration.

As these changes are not yet made, the alternative to reduce lease payments that negatively affects tariffs for services may be the construction of the dry ports. In fact, the creation of dry ports allows to shift operations not related to the transhipment with sea transport to inland territories that are less expensive compared to marine lands. On the low-cost territories of dry port, the value-added services will be provided with lower prices. Examples of these services would be storage, customs’ control, inspection, processing of documents, loading/unloading of containers, the formation of packages, transportation of parties, and consolidation of cargo units.

The location of the dry port at the hinterland not only reduces the cost of logistics services and increases an attraction of customers, but also provides the realisation of Russian regulation projects on removing the freight terminals from the city centres to the outskirts. One of the Moscow government projects imposes limits on lorry’s traffic within the city. It was issued on the 17th of November 2010 and proposed to ban lorries with more than 1.5 ton lifting capacity on the Ring Road during 7 am to 10 pm (Rg.ru, 2010b). In the recent times, the project on limiting truck traffic on the Ring Road in Moscow was corrected by its Mayor Mr. Sobyanin, and agreed to be put into practice in the new version, since March 2013. On March 1, the Ring Road to be closed for heavy-duty trucks from 6.00 to 22.00; and from May 1 to October 1 (in connection with the gardening season) the limit to be operated for two hours longer, notably from 6.00 to 24.00 (Rg.ru, 2012).

In St. Petersburg, the complicated transport situation can lead to the acceptance of similar regulations to those implemented in Moscow. Therefore, further implementation of dry ports in the North-West Federal District of Russia creates conditions for effective solutions to transport problems: the development of the required infrastructure and a gradual removal of freight terminals from the central urban lands rather than the introduction of ban legislations.

4.3 Operational factors

The problem of lack cooperation between rail and sea transport is constantly discussed (Hämäläinen and Korovyakovsky, 2007; Panova, 2011). The issue is of great theoretical and practical significance, and requires the development of principles and methods of coordinated work among participants of the supply chain, especially for the winter time. From the beginning of November, the increase of traffic and adverse weather conditions result in so-called railcars congestions. The problem of abandoned trains on the approaches to marine terminals has been snowballing for at least 30 years (Rzd-partner.ru, 2005). Why hundreds of trains are abandoned at the railway approaches to the number of ports?

As it was previously mentioned, one of the main reasons was force majeure circumstances (i.e., difficult ice conditions in South, Far Eastern, and North-West basins
of Russia). The insufficient cooperation between sea and railway transport has almost been experiencing the same problems from year to year, e.g., condensed shipments at the ports and unavailability of marine stevedoring companies to work in winter.

When the loading of ships comes back to normal, weather conditions begin to stabilise, and other problems often arise (e.g., the rate of unloaded wagons is significantly restricted due to the lack of cargo handling equipment, and insufficient number of workers who was seriously affected by the previous cold weather).

According to the information, provided by Mc.Md (2011), at the end of December 2010, on the Oktyabrskaya railway approximately 20 abandoned trains were detected on the adjacent railways, leading to the seaport of St. Petersburg. Particularly, 11 trains were halted at the rail station ‘New Port’, which serves the 1st and 2nd harbour sections of St. Petersburg seaport, and seven trains at the ‘Avtovo’ train station that serves the 3rd and 4th harbour sections. More than half of the abandoned trains accounted for the container trains (e.g., 13 trains, of which seven abandoned container trains at the ‘New Port’, and 6 at ‘Avtovo’).

The main cause of the abandoned trains at the train station ‘Avtovo’ was a declined productivity of Russian container terminal called ‘First Container Terminal’ that locates at the 3rd harbour section of the port. With the potential capacity of the terminal of 260 rail cars per day, the actual unloading capacities in December were utilised to 115 railcars per day. Failure to use the terminal’s capacity and its processing power was icing of container yards and the overloading of the terminal storage yards.

Therefore, the discrepancies between the loading and unloading capacities of the railways and seaports are aggravated during winter time that resulted in the abandoned trains. In the short term, it is unlikely to avoid cases of the abandoned trains on the approaches to the seaports. The problem requires the long-term development of models for the coordinated construction of the infrastructure, preferably dry ports, after which the interconnected technologies of flow control between seaport and railways would be possible to organise in accordance with the rhythms of shipments.

**Figure 2** Emissions by sectors of economics

- Mining in Russia/Services in Europe
- Households
- Industry
- Energy
- Transport
- Other

*Source: CER (2008) and Rosstat (2008)*
4.4 Ecological impacts

Sometimes, seaports that host marine terminals cannot be extensively expanded at the site due to ecological issues (e.g., Ust-Luga seaport). This seaport is surrounded by reserves and a wildlife sanctuary. Moreover, near the seaport, the villages of Krapolie and Lugytsy are situated. These places are the dwelling regions of the small ethnic group called Vod. Since 13th of October 2008, by the resolution of Russian Government, the ethnic group was added to the list of indigenous people of the Russian Federation. After the population census in 2010, it was recognised that building of Ust-Luga seaport has been crowding the small native population of nine people (Zsarskoselskaya Newspaper, 2011).

In addition, the location of the seaports (i.e., St. Petersburg, Vladivostok, and Novorossiysk) within the urban infrastructure causes the overloading of adjacent roads and city streets that negatively influences the quality of the air. Transport causes approximately one-quarter of all EU CO₂ emissions (CER, 2008). In Russia, transport accounted for 11% of emissions, in the year 2007 (Rosstat, 2010) (see Figure 2). In 2010, the emission from transport in Russia increased to 13%.

Currently, people are more cautious about their carbon footprint. Therefore, sometimes even shippers can ask for their goods to be carried by using a more environmentally friendly mode of transport. Their requirements can be met by train transportation (Panova, 2010). Roso (2009) suggests that in the circumstance of traffic congestion on the roads, leading to seaports, the usage of an environmentally sensitive manner for transportation would be advisable. The considerable shift of lorries from the road could be provided by the construction of dry ports because the seaport would be directly connected to them by rail. Therefore, the utilisation of the dry ports would mitigate road traffic congestions, and alleviate adverse factors in which marine terminals of the seaports operate. All the previously described factors, influencing the expansion of the seaport with the usage of dry ports, were summarised in Figure 3.
Figure 3  Factors of the seaport terminal utilisation of dry port

It appears that the leading force for using dry ports in the container transport chain is the technical factors, followed by economical, operational, and ecological impacts. That is to say, the inability of extensive development of the seaport at the site in the circumstance of rising container flows. To make this assumption feasible, the computer simulation was conducted.

5 Simulation of seaport terminal development scenarios

To justify the positive impact of the dry port on productivity of the marine container terminal, a computer simulation was performed. It allowed a complex system to be explored on the basis of the simulation model of sea container terminal, working with the current technology and with the new dry port system.

Modelling of marine container terminal is produced in several successive stages:

- planning of technical equipment of the terminal
- the layout and placement of equipment
- realisation of technology of the terminal by means of software
- evaluation of terminal’s productivity in various scenarios.

5.1 Research environment

Formalisation and algorithmic tasks for the model were performed on empirical data about container terminals located in the seaport of St. Petersburg. In general, the sea container terminal of the seaport was divided into major functional areas (see Figure 4):

- ship-to-shore zone, in which the transfer of containers between vessel and the dock at the port is made
- storage zone is where export and import containers are stacked, and loading/unloading of trucks are performed
• hinterland zone competence covers customs clearance and loading / unloading wagons.

**Figure 4** A background animation scheme of the marine terminal’s functional zones (see online version for colours)

The analysis of sea terminal’s technology showed some differences in processing of import, export, and empty containers. Import containers are removed from the vessel and placed into a storage area beyond to the pier. After leaving the area of customs’ inspection and clearance of supporting documents, the containers are collected from the storage area to be placed on the internal truck for their further delivery at the destination. Export containers appear on the terminal within a few days prior to arrival of the vessel and stacked in a storage area close to the dock, but not at the berth of a terminal. After customs’ operations, export containers are loaded on internal trucks and moved to the working area of the quay cranes for loading them in the space provided at the hatch of the containership. The differences in the serving of various categories of containers (export, import, and empty) affect the height of their stacks. Due to the fact that ships arrive in predictable time intervals to the seaport, export containers are stored in five or six high stacks without the risk that the container located at bottom of the stack, will be needed to be picked up before the top container (e.g., pickup sequence problem). Access to imported containers should be more or less arbitrary because containers are collected from the port by clients in unpredictable times. Therefore, the maximum height of import containers’ stacks was adopted as four levels in height in order to avoid unnecessary shifting.

In relation to the zones’ layout, considerations about equipment were made. The layout of the port equipment was allocated by the principles of its binding to the functional areas of the terminal, which are linked with each other by means of internal trucks. The marine operations consist of loading containers on ship and unloading them to the dock, which to the maximum extent determines the speed of cargo handling of the whole sea terminal because all inbound and outbound containers must go through a ship-to-shore area. Due to this fact, the area is often called as the dominant system at the terminal, and the choice of transport equipment is made by the principle of its highest capacity. To perform operations in this zone, the quay cranes have been selected. This
type of equipment is normally used for loading and unloading operations of the vessel. In practice, during the conclusion of the agreement on the use of the terminal, the ship owners stipulate the allocation of a minimum number of cranes to serve the ship that enters the seaport (usually one quay crane for the container ships of the first generation, two quay cranes for vessels of the second generation, and three quay cranes for the larger vessel) (Stepanov, 2008). In the model, the quay cranes provide performance of 55 cont./h. Their amount in the model varies from 1 to 2 per vessel depending on the scenarios of the marine terminal work.

The storage area implies the performance of the following operations: stacking of containers that anticipate the paper processing, and the arrival of the vehicles. These types of warehouse operations are considered as the buffer processes between ship-to-shore zone and delivery/receive area, which locates at the hinterland. In the storage area, the operations are carried out by reach stackers and rubber-tired gantry (RTG) cranes. RTG cranes are in use at one-third of the terminals with a storage area, admitting up to more than 10,000 TEUs at one time (Stepanov, 2008). In the model of marine terminal, the storage area of 10,400 TEUs is considered. The containers are stacked in the blocks parallel to the ship-to-shore line. The length of each block was prescribed to 20 containers, and the width of six rows. Between adjacent blocks, passages are arranged. Width of the container stacks under the RTG is six rows plus travel line for the vehicle. Reach stackers and RTG can stack 4–5 containers high. Operating speed of RTG adopted as 7 km/h with the performance of 20 cont./h. At a terminal with two quay cranes, each of which overloads 25 cont./h, usually there are 6 RTG and 6–8 internal trucks for intra-transport operations are used (Stepanov, 2008). In the terminal described by the model, there are two quay cranes with performance of 55 cont./h, six reach stackers and 5 RTG cranes to perform storage operation. The ship (train) service and the performance of the movements of containers between processing areas of the terminal eight units of internal trucks are allocated.

In the area of customs’ inspection, two front loaders are employed as transport in operation. Compared to reach stackers, front loaders cannot stack containers highly, and have a particularly poor efficiency when dealing with large distances between the start and end positions of containers’ locations. However, these factors are not typical for the area of inspection. Meanwhile, the advantage of front loaders is their low cost. As a rule, it is 100 000 dollars less than the purchase price of reach stackers with the same capacity (Stepanov, 2008). The productivity of both types of forklifts (reach stackers and loaders) is considered as 15 containers per hour with an average speed of 20–30 km/h. For the maintenance of rail transport in the hinterland, there are two rail-mounted gantry (RMG) cranes have been deployed. Since the passage of RMG cranes is broader than for the RTG cranes, operating speed of the trolley and its portal is higher (9 km/h). Performance of rail mounted gantry cranes equals to 25 cont./h. Organisation of cargo handling operations with the usage of the employed machinery is made by the principle of all round clock working hours for the modelled container terminal.

5.2 Discrete-event modelling

For the simulation environment, the software AnyLogic was chosen (Xjtek.ru, 2010). The software is distributed to 15,000 users in 60 countries around the world. AnyLogic was developed by the Russian company of XJ Technologies, headquartered in St. Petersburg with branch offices in Europe and North America. The product is called AnyLogic, as it
supports all three methods of simulation (system dynamics, discrete-event simulation, and agent-based modelling), and the combination of these methods within one model.

A simulation model was developed with discrete-event approach, the idea of which suggests to think about the system being modelled as a process, i.e., the sequence of operations being performed over entities (Grigoryev, 2012). Therefore, the method of discrete-event simulation allows to abstract from the continuous nature of the event. In fact, it helps to design the chain of processes within the seaport consisted of major events, such as overloading, movement of the container, and stacking. A discrete-event model of a marine terminal of the seaport is presented in the form of the standard blocks of Enterprise Library.

The performance of handling equipment and time of cargo processing is characterised by a triangular distribution law. Time of trucks’ arrival at the terminal is exponentially distributed, while the arrival time of trains and ships – uniform distributed.

The analysis of the marine container terminal is upon the basis of inbound and outbound container flows that are processed in four scenarios: increasing the number of handling equipment, procurement of internal trucks, doubling the amount of handling machines and internal trucks fleet, and adding the dry port to the transport logistics chain. It should be noted that the implementation of the dry port in the transport chain can reduce the detention time of containers in the Russian seaports because containers are immediately transported from the seaports under customs control to the dry ports. In other words, containers would be ‘pushed’ out from the seaport straight after the unloading, so as to release coastal spaces to accept the next group of containers from the ship ahead. With the traditional ‘push’ system (Waters, 2003), once the batch of containers is ready (i.e., train is formed in the seaport) it departs. The containers are delivered to the dry port where they sit until a remote client arrives to collect them, or until they are transported to the company. Therefore, the average time that the import container spends at the marine container terminal has been taken into account, and analysed on the ground of the performed experiments.

5.3 Results of the simulations

The results of the five conducted experiments were determined by random nature of the processes. Based on the collected statistics from the model, the following conclusions were made. An increase in handling equipment resulted in an enhancement of capacity by 15% compared to the first experiment with initial technical equipment. The purchase of additional internal trucks in the third experiment led to a 13% capacity growth. These changers in each of the experiments brought approximately 3–5% reduction of average time that every import container spends at the seaport (i.e., lead time includes the period from the delivery of containers by ship until their collection by ground modes of transport (rail, road). Thus, the additional productivity of the terminal makes the lead time shorter. However, a better productivity of the marine container terminal implies the requirement for expansion of spaces at the seaport that, for example, is limited in St. Petersburg.

The last statement was clearly depicted at the fourth experiment with the model. The simultaneous increase over the number of handling equipment and fleet of internal trucks within one experiment resulted in a system error called ‘lack of space at container storage area’, after which the computer simulation terminated. This fact confirms the validity of the construction of dry port in the circumstance of growing container flows and the shortage of free space at the seaport.
What is more important is that the outcome of a maximum increase in the marine terminal’s capacity (about 31%) was recorded in the fifth experiment with a dry port included in a container transport’s chain. Along with the productivity increase, the average lead time for the import containers also became more efficient. Compared to the initial system, the average time for each import container was reduced by 8% in the new dry port system.

6 Conclusions

The criteria of the seaport efficiency are tariff policy, capacity, as well as the quality of hinterland access to the seaports. In the circumstances of the rising container flows towards seaports, the hinterland access has been becoming overloaded. The difficult situation on the roads adjacent to the seaports is considered in Europe as one of the main factors for the expanding of seaport container terminals capacity via construction of dry ports, because an improvement only from the sea side is insufficient for the increase of the seaports’ competitiveness, and the whole container transport chain (Roso, 2009). Likewise, the high attention of foreign politicians to the ecological issues, and road congestions became a catalyst for the dry port development.

The exploration of Russian dry ports serving the seaport of St. Petersburg, Novorossiysk, and Vladivostok showed that the determining reason for seaport container terminals’ development with a usage of dry port is the technical group of factors, that is to say, the inability to expand seaport when the container traffic is booming. This hypothesis was proven by computer simulation. The investigation of simulation experiments revealed that the construction of dry ports is rational for the conditions of the Russian seaports researched in this paper. A dry port is straightforward solution for the shortage of coastal lands, providing an increase in seaports’ capacity at a maximum rate along with reduction of a lead time compared to other alternatives.

Despite the inevitable factors that influence the construction of dry ports in Russia, their location is mostly aggregated nearby the sole seaport of St. Petersburg. Meanwhile, the other seaports (e.g., Novorossiysk and Vladivostok), which also face the shortage of space at the site, do not show the healthy pace in application of dry port concept. To accelerate the progress of the dry ports’ construction in Russia, the impeding reasons behind this process should be identified in further researches. The most important impediment can be named: the financing and risks investments that dry ports have to experience. These issues need to be addressed in order to smooth the bumpy road for the development of Russian seaport container terminals by the construction of dry ports.

Acknowledgements

The assistance in finalising the article is to be indebted to the reviewers of the journal.

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Perspective reserves of Russian seaport container terminals


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Publication IV


Deregulation of the Russian Railway Freight Market – Learning from Empirical Results

*International Journal of Logistics Systems Management*

Vol. 16, No. 4, pp. 341–364.

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Deregulation of the Russian railway freight market – learning from empirical results

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Abstract: Railway transport has confronted various changes during the last decades. Although the trend of deregulation spread worldwide in 1990s, Russia belongs to countries which have not totally liberalised market. Russian railway market has developed significantly since 2001 and today there are almost 2,000 companies offering railway services. However, the traction market’s deregulation process is still incomplete. The market is confronting notable changes during the coming years. This research’s main objective is to evaluate the progression of deregulation in the Russian railway freight market, highlight the confronted market entry barriers and reveal the national peculiarities. Research findings strengthen former knowledge and fortifies the Russian railway freight market has many national characteristics. As the main traits was noted importance of personal relations and close linkage with politics. Although market has many operators, undertakings are mainly leasing companies providing rolling stock for their customers. When considering the barriers to entry, as main hindering factors were regarded rolling stock, bureaucracy and needed capital. These follow the same path which has been noted in previous studies; Although Russian railway freight market has strong national peculiarities, the barriers to entry are the same like in Europe.

Keywords: barriers to entry; deregulation; national peculiarities; railway freight transport; railway operator; Russia.


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1 Introduction

Railway freight market has confronted various changes during the last decades. Among the most significant modifications has been market deregulation, which has attracted researchers worldwide (see for example, Hilmola et al., 2007; Jensen and Stelling, 2007; Ludvigsen and Osland, 2009; Mäkitalo, 2007; Szekely, 2009a; Woodburn, 2007). Already decades ago economists realised the effeciveness in the traditional mode of government regulation, and commenced to seek ways to replace regulated monopoly with competition (Pittman, 2007). However, all countries have not interfaced with this trend, but have still completely or partly regulated railway freight market. One of these countries is Russia, which has a long tradition in railway industry. The first railway was introduced in 1700s, and the first steam locomotives were built in 1833–1835 (Haywood, 1969). Since, the market has expanded to enormous dimensions. Today the Russian Railways Company (Rossiiskie Zheleznyie Dorogi, RZD) employs over 976,000 people and owns and operates 85,200 track kilometres, covering Russia’s all nine time zones. (RZD, 2012a)

When considering the development of railway deregulation, the USA was the first country to deregulate the railway market in 1980 via the Staggers Rail Act (Jahanshahi, 1998). Few European countries followed the path in late 1980s; however, the main trend of deregulation achieved the European Union in the early 1990s. Behind the scheme of things was the remark, that in order to guarantee the free movement of goods, the mindset should be extended to transport activities. The first steps towards deregulation were taken via Directive 91/440 and White Papers published in 1992 and 1996. Railway Packages introduced in 2001 (First Railway Package) and 2004 (Second Railway Package) continued the path towards the railway freight market deregulation: The European Parliament achieved a decision in 2004 to deregulate the European Union railway freight market on 1st January 2007 (Directive 91/440/EEC, 1991; European Union, 2012; White Paper, 1996). The regulatory changes have sustained via Third Railway Package (Commission of the European Communities, 2004), which main intention was to deregulate the international passenger transport in the European Union. The Directive got legal force on 1st January 2010, which opened the cross-border passenger rail markets. Although various countries have also liberalised the national passenger market, European...
Deregulation of the Russian railway freight market

Union has not set a directive influencing on national level (CER, 2012; Commission of the European Communities, 2004). However, railway sector holds very important role in the strategic long-term visions and plans. In the circumstances of reducing oil dependency and emissions radically by year 2050, the transportation will nearly solely lie on the wider use of railway sector (as well as inland waterways where the transport mode is available).

Russia is often regarded to have influences from various deregulation trends. In the USA, deregulation was vertically integrated, stating operators owned also the infrastructure (Hilmola and Szekely, 2006). Situation is totally different in Europe, because based on the European Union’s legislative demands, infrastructure is separated from operations and infrastructure is handled by an own organisation (Laisi, 2009). Japan can be placed between earlier examples: infrastructure and freight operations are separated, whereas passenger transport utilises vertical integration (Szekely and Hilmola, 2007). Although traction is still under monopoly in Russia, private companies are able to offer wagon leasing services. Numerous companies have entered the Russian railway freight market; currently there are around 2,000 private operators (Grantham, 2008; Kamalov, 2009; Railway Gazette International, 2009a). According to RZD, the major companies are not intended to hinder the competitors’ actions; RZD hopes this encourages the private operators to consolidate. As a result of competition, customers are expected to get increased flexibility and improved service quality (Railway Gazette International, 2009a).

After China joined the World Trade Organization (WTO) in 2001, Russia remained the largest nation without the membership (Rutherford and Tarr, 2010; Zhao and Wang, 2009). The situation changed in August 2012 once Russia gained the membership after 17 years’ negotiations (WTO, 2012). Various studies have estimated the possible influences the membership would have (see for example, Balding, 2010; Åslund, 2010). The main estimations have evaluated that the full membership might increase Russia’s involvement in the world trade, improve the overall investment environment and develop the market of transport services. However, Ernst & Young (2012) estimated the membership will increase the railway transports volumes of production by 0.24%, while the other transport modes will decline: road, 0.03%; pipeline, 0.31%; sea, 2.37; and air 2.41%. Because the WTO membership is expected to change especially the market environment in railway transport, it is essential to understand the characteristics of the Russian railway freight market. Furthermore, the market is not widely studied in English literature. According to studies, a lot of information is available in Russian. Therefore, there exists a lack of English data concerning the world’s largest country’s main transport mode, railway. As Russian railway market is living the era of transformation, future might provide interesting business opportunities for international companies. Although market’s 2,000 operators are mainly small companies leasing and owning dozen wagons, some international operators are doing rather well. Especially Finnish companies have entered the market decades ago, understandably due to close cooperation between Finland and Russia. Therefore, examples of international companies operating in the engrossing market do exist. However, Russia is different from Europe, which might locate problems for newcomers. Therefore, understanding the Russian market is a key to success. This paper tries to tackle the gap. The objective was to examine the confronted market entry barriers and the special characteristics of Russian railway freight market. The study familiarised with the secondary data and brought it to empirical level by
investigating experts’ opinions holding various positions in railway industry. The main purpose was to clarify the Russian railway freight market’s national peculiarities and evaluate the market operators’ viewpoints. The aim was also to define the future possibilities and discuss the changes which are expected to happen in few years time. By developing the study’s main objective, research questions were developed. The main research question was followed by sub-questions, providing the required data to support the research purposes. Therefore, the main research question of this study is:

- How the deregulation has proceeded in Russian railway freight market?

Furthermore, two sub-questions were developed:

- What have been the major market entry barriers when entering the Russian railway market?
- What are the main national peculiarities in Russian railway market?

This paper is structured as follows: In Section 2 the process of deregulation in Russian railway freight market is reviewed. In the following Section 3 research methodology is being introduced; in order to gather genuine data, various actors in connection with railway market were interviewed. Empirical part in Section 4 reports research findings and describes the market situation from the various actors’ point of view. The findings are discussed in Section 5, where Russian railway freight market is seen to have several national peculiarities. Furthermore, the theoretical and practical implications are discussed. Section 6 concludes the study, and suggests areas for further research.

2 Literature review

Transport is vital industry for Russia (see for example, Hilmola et al., 2010; Korovyakovsky and Panova, 2011). Especially important is the role of railway market; Pittman (2011, p.2) notes “The Russian economy relies on the Russian freight railways to an extraordinary degree.” The history of Russian railway market dates back to 1700s, when the first tramway was built by and for the mining industry. However, as the beginning of railway era has often been stated 1830s. The first steam engines were built by E.A. Cherepanov and his son M.E. Cherepanov in 1833–1835, and outside the mining and metallurgical industries the first railway connection started passenger operations between St. Petersburg and Tsarskoye Selo in 1837 (Fink, 1991; Haywood, 1969; RZD, 2012b). The construction and operation of railway ‘Tsarskoye Selo’ gave invaluable experience for the creation of the next ‘Nikolaevskaya’ railway between St. Petersburg and Moscow which celebrated its 165 anniversary in 2011 (RZD, 2012b). The opening of St. Petersburg-Moscow railway connection marked the start for building the Russian railways network of national importance during the following centuries. Already in 1917 railway was politically and economically the most important industry in Russia. Railway was the lifeline of Russian army, sometimes the only transport possibility between the cities and the backbone of delivering raw materials and industrial goods. (Rosenberg, 1981).

At the beginning of 20th century after the formation of the Union of Soviet Socialist Republics (USSR), the Soviet Railways started the history in 1922. Their work was
Deregulation of the Russian railway freight market

discontinued with the collapse of the Soviet Union in December 1991. During the collapse length of Russian railway network fell by 78,500 kilometres that were departed to the former republics (RZD, 2012h). The sharp decline in traffic was the result of a general economic collapse, which deprived the railways real volumes of freight traffic (RZD, 2012h). Therefore, on 26th December 1991, the new government of the Russian Federation adopted the Resolution called ‘About urgent measures for the stabilisation of the Russian railways, and social support for the employees in 1992’. As part of the Russian Government, the Ministry of Railways was formed on 20th January 1992, in order to operate the railways within the Russian Federation (RZD, 2012c). At that time, Ministry of Russian Railways was like other natural monopolies (e.g., Gazprom, The Unified Energy System RAO UES), that accounted for a huge non-market sector of the Russian economy (Korotkevich, 2004). According to the Federal Law No. 147 ‘About natural monopolies’ given on 17th August 1995 (Garant, 2012), a natural monopoly means the state of commodity market, where the demand is more efficient to meet in the absence of competition due to technological peculiarities of production (e.g., the substantial reduction in production costs per unit by increasing the volume of production). Goods that are made by entities of natural monopoly cannot be replaced by other goods, and therefore the demand for these goods is less dependent on changes in prices. Yavlinsky (2005) defines natural monopolies as the government agencies that have economic activity in areas where private market organisation of such activities is either impossible or leads to prohibitively high costs of production. Natural monopolies, which inherited huge assets from the Soviet period, control the financial flows that are comparable to the large articles of the federal budget. That is why the legality and effectiveness of the use of the funds are important for economic policy and the economy as a whole. These huge organisations also have extremely low transparency, low efficiency, and high prices of their products and services (Yavlinsky, 2005). Therefore, for the government, the reform of natural monopolies was one of the most serious problems in terms of possible painful consequences for the population (growth rates, salaries, etc.) (Korotkevich, 2004).

During the last decade the Russian railway market has confronted significant structural changes (see for example, Friebel et al., 2007). In 2001, the Ministry of Railways launched comprehensive three-stage Railway Structural Reform Programme, which was developed in cooperation with the government and published on 18th May 2001 as Decree No. 384 (RZD, 2012a). At the end of 2003, the resolution on separation of regulatory and economic functions of the Ministry of Railways was adopted by the Decree of the President of the Russian Federation. Thus, the public company of ‘Russian Railways’ was founded (RZD, 2012c). The assets (for example, all rail tracks, rolling stock, stations, dispatch systems, electrical devices, communication networks, etc.) and economic functions were transferred to the RZD from the Railway Ministry starting from October 2003 (see Figure 1).

As presented in Figure 1, in the new model the Federal Agency for Railway Transport and the Federal Service for Transport Supervision subordinate to the Ministry of Transport. RZD is 100% owned by the Government of the Russian Federation (RZD, 2012h). In accordance with the concept of administrative and structural reforms of the railways, regulatory functions were transferred to the Ministry of Transport (Roszheldor and Rostransnadzor), while the economic functions to the company of Russian Railways.
Figure 1  Restructuring of the Russian Railways

<table>
<thead>
<tr>
<th>Before</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regulatory functions</td>
<td>Ministry of Transport</td>
</tr>
<tr>
<td>- The development of public policy and the publication of regulations</td>
<td></td>
</tr>
<tr>
<td>- The functions of law enforcement, state property management, and provision of public services.</td>
<td>The Federal Agency for Railway Transport (Rouznadoz)</td>
</tr>
<tr>
<td>- Accreditation of testing laboratories (certifying, certification bodies).</td>
<td></td>
</tr>
<tr>
<td>- The control and supervision over observance of legislation of the Russian Federation in the field of traffic safety, operation, transport crime prevention, and emergency response.</td>
<td>The Federal Service for Transport Supervision (Roustransnadzor)</td>
</tr>
<tr>
<td>- Issuance of permits (licenses) to legal entities and individuals to carry out certain activities, and (or) actions.</td>
<td></td>
</tr>
<tr>
<td>Economic functions</td>
<td>JSC &quot;Russian Railways&quot; (JSC RZD)</td>
</tr>
<tr>
<td>- Transportation of cargo and passengers, including provision of services for the locomotives, cargo handling activities; maintenance, protection, storage of goods; freight forwarding activities; operation of logistics centers;</td>
<td></td>
</tr>
<tr>
<td>- The production, maintenance, repair, and maintenance of railway rolling stock;</td>
<td></td>
</tr>
<tr>
<td>- Maintenance of railway infrastructure;</td>
<td></td>
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<tr>
<td>- Conducting research, development, design, surveying, and construction activities;</td>
<td></td>
</tr>
<tr>
<td>- Provision of telecommunications services, information, marketing, and other services, including construction, maintenance, and repair of communication; the development of automated information systems; organization of exhibitions and presentations;</td>
<td></td>
</tr>
<tr>
<td>- Provision of services in the social sphere, including organization of children's railways, educational activities, construction, operation, maintenance of the buildings and facilities for social, cultural, sports, recreation, and household utilization; organization of recreation and spa treatment.</td>
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Figure 2  Liberalisation of Russian railway market

Source: Gorbunov et al., 2012; RZD, 2012d, 2012e, 2012f

As described earlier, the reformation of the Russian Railways was launched in 2001. At the beginning it was divided into three phases, which are depicted along the horizontal line in Figure 2. The first phase (2001-2003) tended to establish RZD and develop the regulation laws for the reformation [the result of the preparatory Phase 1 (2001–2003) of Russian railway reform was represented in Figure 1]. The tasks of the second phase (2003–2005) were establishment of multiple subsidiaries and phasing out cross-subsidies from freight operations to passenger services (Pittman, 2007; RZD, 2012a). An integral
part of Russia’s railway reform process was to separate freight and passenger operations. However, it has been problematic to achieve, due to high degree of subsidising; high freight rates and profits have supported the loss-making passenger services (Broadman, 2000; Railway Gazette International, 2006). Phase 3’s (2006–2010) main objective was to increase competition (Pittman, 2007; RZD, 2012a). Government’s objective was to do this by partially privatising the Russian Railways and by selling shares of subsidiary companies of RZD to the private owners. In 2010, RZD received one billion roubles of dividends from the daughter companies and in 2011 almost 22.4 billion roubles. This was due to the fact that 75% of First Freight Company was sold to the private owner of Independent Transport Company of UCL Holding (Biztass, 2011).

When considering the worldwide trend of separating the functions, sometimes the activities are separated from the infrastructure operation only in organisational sense, and single parent company still owns the companies. Encouraging competition in such a situation requires the infrastructure owner to allow entry of third party operators, under the conditions regulated by the government. In such a situation, infrastructure firm might discriminate the newcomers. This is often noted in transition and developing economies, due to the fact regulatory bodies may lack resources and enforcement power to prevent such an occasion to happen. Such a situation is customary in economies like Russia, where principles of conforming to law are emergent and tenuous. In that case, vertical integration is seen as a proper solution; transactions are rather done within-firm than between-firm (Pittman, 2007). Russia has utilised within-firm model (see Figure 2).

In the beginning of 21st century, RZD was quite frequently accused for monopolistic practices, but gradually it has lost the role of monopolist and monopsonist on the railway market. Currently, the number of owners of rolling stock is close to 2,000 along with 158 subsidiary companies of RZD (Gorbunov et al., 2012; RZD, 2012d) (see Figure 2). The impetus for the liberalisation of the Russian railway market was the division of a single tariff fare into two components: fare for wagons (15%) and fare for the infrastructure (85%). This made it possible for private companies to lease wagons on market terms (Stupin, 2011). The separation of infrastructure from operations stimulated the development of competition on the market. However, in the field of railway infrastructure the state ownership still dominates. RZD owns 99% of rail network in Russia (Fert, 2012). The exceptions are a number of railway lines operated by private companies, for example, JSC Norilsk Mining Company, Gazpromtrans, JSC Railways of Yakutia, JSC Yamal Railway Company, and JSC Golden Link. These are industrial railway lines which are not available for public transportation and are used exclusively to serve a particular industrial, logistics or military site. On the main or public rail networks the traction is provided by RZD (Mironenko, 2010; Stupin, 2011). However, at the moment the company Globaltrans owns 56 locomotives, which are used in closed circular routes. In the ongoing liberalisation of the locomotives, the company plans to buy 100 locomotives from 2012 (Finam, 2012).

In contrast to infrastructure sector, the segment of rolling stock is entirely liberalised. The wagon fleet is focused on balance of established private companies. Structure of the Russian fleet of freight wagons on 1st September, 2011 was as follows: 9.6%, RZD; 35%, subsidiary and dependent companies of RZD; and 55.4%, the property of other companies (Polyakova, 2012). Due to investments in the acquisition of new rolling stock, the number of freight wagons increased from less than 4,000 wagons in 2000 to 89,000 in 2011 and reached over a million in 2012 (Gorbunov et al, 2012). Decentralisation of
economic decision-making resulted in rapid growth of rolling stock fleet and increase in traffic volumes. The plans of enhancement of freight volumes were fully implemented. The share of rail transport in the freight traffic of the country has increased from 42.5% in January–October 2010 to 43.2% in January–October 2011, and excluding pipeline transport, to the share of 85.2% (Yakunin, 2012). However, the utilisation of rolling stock was not improved and considerable amount of medium and small companies’ clients could not access wagons (Interfax, 2012). The president of RZD Yakunin (2011) considers that this awkward situation originates from complex failures: high price of wagons and the delay in adoption of new legislation for private rail fleet regulation.

In order to improve the market even further, the developments are continuing. Russian Railways has launched the fourth phase reformation period until the year 2015 to improve the competition among private companies in the market (RZD, 2012e) (see Figure 2). The target model for railway freight market until 2015 was approved by the Government of the Russian Federation in January 2011. It defines the structure of the freight traffic and the available models of competition, as well as formative principles of government regulation and funding of the industry in the five-year horizon (RZD, 2012g). Target market model provides:

1. preservation of RZD as a network-wide freight carrier and the owner of the infrastructure
2. development of the rolling stock market operation
3. development of competition in freight traffic in the experimental mode by creating a regulatory and economic conditions for the formation of local cargo carriers
4. improvement the state tariff regulation
5. development of network contracts as a law based system which regulates the maintenance and modernisation of the infrastructure between the owner of the infrastructure and the state.

These solutions have minimal transformation and technological risks. They also have considerable economic potential. The new solutions are required for further development of an efficient market of railway transport services and industry development (RZD, 2012g).

However, the achievement of positive effects in any development requires careful analysis of the problems and barriers. Since the deregulation’s progression worldwide (see for example, Laisi, 2011; Laisi et al., 2012; Szekely, 2011) railway freight markets’ barriers to entry have grabbed researchers’ interest. According to recent studies (Laisi, 2009; Ludvigsen and Osland, 2009; Mortimer et al., 2009; Mäkitalo, 2007; Szekely, 2009b) the main entry barriers in railway freight market are acquiring the rolling stock, needed investments and bureaucracy. However, country peculiarities do exist. Brewer (1996) noticed the level of infrastructure access charges creates obstacles in the UK, while in Germany the railway undertakings noted competition as a strongest barrier. Due to large amount of competing undertakings, other railway undertakings’ actions are regarded to hinder the market entry. In some countries incumbent’s actions were noted to complicate the entry process (Mäkitalo, 2007; Simola and Szekely, 2009). Another interesting topic is national peculiarities. According to recent studies, although countries have common characteristics (see for example, Laisi, 2009; Ludvigsen and Osland, 2009; Mortimer et al., 2009; Mäkitalo, 2007), national peculiarities do exist. The UK’s
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liberalisation process was described as short-term failure, because railway infrastructure company Railtrack failed to operate the market efficiently. This led to serious problems (Hilletofth et al., 2007; Szekely, 2009a). In Sweden, several railway undertakings entered the market by operating short rail connections, which were discharged by the incumbent due to the unprofitable nature. By doing some changes new entrants were able to make the connections profitable (Jensen and Stelling, 2007; Laisi, 2009). In Poland, the incumbent refused to sell old rolling stock to new entrants, and new operators had to acquire wagons and locomotives from countries like Romania, Czech Republic and Morocco (Laisi, 2009). In Hungary, the old incumbents were collaborating against new entrants (Szekely, 2009b). However, because of the European Union’s intention to harmonise the member countries’ markets, some minor peculiarities might become invisible (RailNetEurope, 2012). Partly due to unified factors, railway operators are increasing the degree of cross-border cooperation (Laisi, 2009; Szekely, 2009b).

Alike in European Union, internationalisation is noted also in Russia. Recently Russian operators have signed agreements with foreign companies to start international cooperation. For example, in 2010 the German operator DB Schenker BTT and Russian TransContainer signed a set of agreements on cooperation in organising container transport between Europe and Russia. The parties agreed to set up a container depot in Riga, Latvia. The main objective was to improve the efficiency of container freight traffic from Europe to Russia and vice versa (RZD Partner International, 2009). Furthermore, Finnish national railway operator VR and Russian Freight One Company established a company called Freight One Scandinavia, which main intention is to replenish Finnish-Russian railway freight supply and offer more versatile transport prospects (Linked, 2009). The main reason behind several joint agreements with international operators is the future’s changes in Russian railway market: as is already noted, RZD owns only a small volume of wagons, because the main number of wagons is transferred to possession of new railway operators. One of such companies is Second Freight Company, which was established in 2010 (Railway Gazette, 2010).

3 Research methodology

When researching subjects which main intention is to provide novel data, qualitative case analysis is often noted as a recommended way to gather information (Eisenhardt, 1989; Flyvbjerg, 2006). Among the ways to accumulate data is case study, which is widely used in various sciences (Flyvbjerg, 2011; Yin, 1981), including also topics related to logistics (Häkkinen and Hilmola, 2005). Due to the fact that this study’s main objective was to understand and evaluate the progression of deregulation in the Russian railway freight market by evaluating comments of several respondents, the data needed was qualitative. Merton, Fiske and Kendall introduced theme interview in 1956, and described it as a compound of open and structured interview, where the focus is on certain themes rather than separate questions. Although interviewee can decide the order of questions based on discussions (which can facilitate the interviewee to give more extensive answers), identical themes are handled in all interviews (Hirsjärvi and Hurme, 2010). During the last decades theme interview has commonly been used in business economics research (Koskinen et al., 2005). Based on these reasons, the data for this research was gathered via semi-structured theme interviews. The wide range of themes and therefore questions
provided a solid basis for gathering the needed data. Altogether the research introduced five themes:

1. company background
2. entering the markets
3. infrastructure
4. Russian railway freight market
5. European Union.

Because study’s aim was to evaluate the viewpoints of various interviewees, one of the main objectives was to understand what the data meant for people (Hirsjärvi et al., 2004; Krippendorff, 2004). Due to this reason concentration was on content analysis. Analysis is noted as an interaction between researchers and data (Strauss and Corbin, 1998); on the other hand, research problem and analysis are often convergent (Hirsjärvi et al., 2004).

Due to extensive size of the chosen market (Russian railway freight market has almost 2,000 railway undertakings), a diverse interviewee base was chosen. As a background was utilised the listing of railway companies in Russia (see for example, INFOline, 2012). Often the operators have been divided into four different groups, based on the size of the company. Our objective was to interview few companies from each group. Furthermore, because the main objective was to evaluate and understand the market entry barriers as well as the main national peculiarities, few Finnish companies operating and/or doing business in Russia were included in the study. Due to great amount of market actors, around 20 companies from each group were chosen as a research sample. Contact letter was sent via e-mail, and it presented the research. If no feedback was received in one week time, companies were contacted via phone calls. Once the interview time was agreed, the questionnaire was sent in order to give some time to prepare for the interview. All interviews were recorded and transcribed, where after summaries were sent to interviewees for revision. This ascertained the research reliability and eliminated the possibility for human errors, mainly misunderstandings.

After all interviewees were met, results were gathered by confirming the anonymity. Available data was carefully evaluated. Few companies gave additional information via e-mail, which enabled to gather data concerning the main research themes from all respondents. Altogether were met 15 experts representing 11 organisations. Among the participants were representatives from Railway University, Finnish and Russian national railway undertakings, two big scale operators, three smaller wagon leasing companies and three representatives from main industries. All interviews were conducted in 2010.

4 Empirical research results

The era of structural changes in Russian railway freight market started in 2001, when the Railway Structural Reform Programme was launched. While railway market was divided into governmental and operational functions, RZD was established. Although RZD has a monopoly in traction market, two types of railway undertakings have entered the market. The first group is the companies transporting own cargo (for example, mining companies), while second group includes small-scale companies leasing wagons. Currently there are around 2,000 undertakings that have mainly entered the market since
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2008. These companies can be divided into four main groups, based on the number of wagons. The first group includes governmentally owned operators, which own more than 100,000 wagons. Second group consists of operators who are significant players and own more than 10,000 wagons. The third group includes operators owning 1,000–4,000 wagons. In the last group belong operators with few dozen wagons.

According to recent studies (Laisi, 2009; Ludvigsen and Oslund, 2009; Mortimer et al., 2009; Mäkitalo, 2007; Szekely, 2009b) the main entry barriers in railway freight market are acquiring the rolling stock, needed investments and bureaucracy. However, country peculiarities do exist. This is also noted in Russia. According to this research, the main market entry barriers in Russian railway freight market are rolling stock, bureaucracy and needed capital, including both the investments and knowhow (see Figure 3). Other barriers to entry vary between the companies. Even though establishing a company was regarded rather easy, confronted problems and barriers interrelate with company’s size and intended size of operations. If company’s objective is to acquire only dozen wagons, the problems are different than buying hundreds or thousands of wagons. When considering bureaucracy as a barrier to entry, the amount of red tape situations were highlighted to complicate the industry. Knowledgeable personnel were esteemed important especially when dealing with bureaucracy. According to two interviewees Russian railway freight market’s closed nature creates a barrier: Especially for international companies it might be extremely difficult to enter the market, if they do not have any help from Russians. Reason behind is that railway market is strategically important industry. International companies might find it impossible to buy needed services, for example many wagon repair companies are owned by RZD and they have no time-slots to repair other undertakings’ wagons.

Figure 3 Barriers to entry in Russian railway freight market, number of answers (see online version for colours)

Although Russian railway market is globalising annually, there are still several national peculiarities (see Figure 4). As the main peculiarity unfolded cooperation and especially the importance of personal relations; representatives from 11 railway undertakings observed it as the main special characteristic. According to interviewees, close relationships ensure smooth functions in the market. This concerns all functionalities: Needed documents, rolling stock maintenance and arrangement of traction. Good relations are gained via decade’s cooperation and personal connections to old colleagues.
Another theme which unfolded several times is the railway freight market’s linkage with politics. Many of the interviewees highlighted: Railway market in Russia is ‘country in country’ or ‘state in state’. This is due to market’s size and RZD’s importance. Size was also mentioned as a peculiarity, as well as market’s reliability/functionality. Although the network is extensive, its functionality is high-class. The development was observed by several interviewees, as the number of complaints has decreased substantially during the last years. Furthermore, functionality reflects the market’s operations. Although temperature might reach –50°C degrees, railway network is operating. As other peculiarities were stated for example tariff system (and its complexity), market’s transparency and large amount of operators.

Figure 4 Russian railway freight market’s peculiarities, number of answers (see online version for colours)

Based on the research results the Russian clients are really demanding. Therefore, some companies utilise customer service as a competitive weapon. Clientele has become more price-conscious during the last years, and they are ready to invest in good and accurate service. This reflects the operators’ personnel: employees often have academic degree from railway universities, and have decades working experience. Hereby operators ascertain the high level of both tacit and explicit knowledge. When considering the level of competition, all participants noted both intermodal and intramodal competition occurs in Russia. Road transport is regarded as the main competitor, due to its flexible nature. In addition, inland waterways were mentioned. Due to country’s location, sea transport was noted as a competitor only in transport to/from Far East. Although market has around 2,000 operators, due to the fact generality of those are small companies operating dozen wagons, intramodal competition is regarded to occur only between the larger actors. Despite the fact that intrinsic rivalry do exist, companies describe the cooperation is close between the market players. Although RZD was acknowledged for its good cooperation with other market acts, some observed cooperation inside RZD is lagging behind.

Despite the fact that the Russian railway freight market is perceived challenging, it proffers several possibilities for new railway operators. Acquiring an existing railway company was remarked as the best way to enter the market. By utilising this method, new entrant would gain not only the rolling stock, but also the explicit and tacit knowledge, which were noted important in this inconsistent market. Especially an operator which would serve a small niche could have changes to become successful. However, market is undergoing a transformation, wherefore future is unknown. Due to unstable situation,
operators are analysing the situation on weekly basis, verifying the actions are best available alternatives. Although operators are having more and more international relations, according to participants the Russian railway freight market will not attain European Union’s level of deregulation and harmonisation during the next decade.

5 Practical and theoretical implications – developments after the study

This research revealed interesting aggregates. Although Russian railway freight market is expected to be different, the number of factors surprises. Tariff system and close linkage between politics and railways are known. ‘State in state’ and ‘country in country’ utterances delineate the picture: Railway market frames an own entity. Railway network is the lifeline of the Russian Federation, because by railway can be travelled to places, which cannot be reached by any other land transport mode. This might explain why the amount of English literature is limited. However, Russia is internationalising annually, proffering an interesting market for international companies. Nonetheless, one must keep in mind the Soviet Union collapsed only less than two decades ago, creating various national peculiarities which must be noted before entering the market.

Although the magnitude of relationships in Russia is widely known, according to this research it is one of the cornerstones in the business. Certainly business can be done externally, but this hinders the actions. More documents are needed, wagon repair takes longer time and it is harder to organise unloading times. Therefore, due to the introspective nature of the market, most profitable way to enter is to acquire an existing railway freight operator. By acquiring an existing company, in addition to gaining a wagon fleet, purchaser derives explicit and tacit knowledge, which are noted as precious factors in such a versatile market. Furthermore, market’s size creates problems. Operators rarely have steady transporting clientele around the country, wherefore wagons might end up to destinations where no return cargo is available. Returning empty wagons was noted one of the key questions in the industry: In this economic situation cost-effectiveness is vital in order to keep the business alive.

Various researchers have noted the main market entry barriers are needed investments, acquiring of rolling stock and bureaucracy (see for example, Laisi, 2009; Ludvigsen and Osland, 2009; Mortimer et al., 2009; Mäkitalo, 2007). Same factors were revealed also in this study; rolling stock, needed capital and bureaucracy were regarded as the main factors hindering the market entry. Bureaucracy mainly relates to red tape situations as well as the fact, that it is rather hard to enter the market without a Russian counterpart. Although situation has improved during the last decade, endless documents are still commonplace. In Poland, the situation was noted similar: Acquiring rolling stock was highlighted as the main barrier to entry, while in other European countries (for example, Sweden) bureaucracy is often regarded as the main hindering factor (Laisi, 2009).

Russian railway sector confronted significant changes in the beginning of 21st century. Among the main developments was the reform programme, which started in 2001. In order to stop an active aging of rolling stock fleet, RZD decided to attract private investments through the liberalisation process. When considering the consequences can be noted that the purpose of investment was successfully achieved (RZD Partner, 2012). Currently in the Russian railway sector are operating around 2,000 companies. However,
the main rolling stock fleet is managed by no more than 250–300 companies, while other companies prefer to rent wagons and receive payment for the activity (Interfax, 2012). The main volumes are carried by 15 large-scale companies. Among those are the First Freight Company, the Independent Transport Company owned by Vladimir Lisin, Second Freight Company, Globaltrans and NefteTransService. These companies account for around 44% of the total cargo volumes and those own about the same proportion of the total rolling stock fleet. According to Interfax (2012), at the moment there are four major groups of players, very different in terms of strategy development. In the first group are professional operators with a universal rolling stock fleet (open top wagons). Examples are the First and Second Freight Companies, as well as Globaltrans. The second group consists of professional operators with a dedicated fleet of rolling stock, such as Transoil, NefteTransService, SG-Trans, Rusagrotrans, Refservice and Transcontainer. The third group of carriers is the transportation departments of industrial holdings. Those work in close cooperation with metallurgy industry, mining and production of fertilisers (e.g., MMK-Trans, Independent Transport Company, Severstaltrans, Gazpromtrans, etc.). The fourth group is composed of small independent companies. They might become the objects of absorption by larger players (Interfax, 2012).

Despite the increase of private owners of rolling stock, the access to the wagons has been problematic for some companies. The level of meeting the needs of large shippers is estimated at the level of 60%–70%, while for small businesses only 30% (Press RZD, 2012). In the future the performance of rolling stock is planned to be increased by creating a pool or exchange wagons, an information platform, which would facilitate the transportation planning. So far, a single platform for the collection of applications from shippers was implemented only for RZD, while the other operators have not yet been consolidated (Interfax, 2012). Moreover, to improve the situation with providing shippers by empty open top wagons, since autumn 2011 RZD started to rent open top rail wagons from First Freight Company and Second Freight Company. These companies transferred the wagons to the management of RZD, so that RZD could manage the wagons as their own and give shippers the wagons by the tariffs installed by the government. This situation on the market will remain until the development of centralised management and implementation of new technologies for dispatch of rolling stock will be adopted. However, the other owners of open top rolling stock do not want to transfer the management of their rolling stock fleet to the Russian Railways, considering the established price for rent is not appropriate to the market conditions.

Most of the operators have not agreed to hand over the park at a rate of 25 Euros per day per car because the average market price of the wagon per day is 40–45 Euros (Gallyamova, 2012). That is why Russian Railways asked the Government of the Russian Federation to abolish state regulation of rates for rental cars, which are used to transport goods involved in the decision of the Government. According to RZD, the company should receive the right “to change the tariff for the transportation in the case of the rented cars, depending on the situation with the provision of rolling stock.” (Press RZD, 2012). The Ministry of Economic Development and the Russian Railways submitted proposals for adjustment of the tariff book No. 10-01, which establishes the rates. It is offered to restate the fare for wagons in the light of market conditions and tariff corridor and cancel the current fare, which is fixed and do not fluctuate (RZD Partner, 2011). Thus, the regulators have yet to determine the rules of the game on the wagon market, which has been going on for a long time. In comparison with the rail market, the traction market is in the initial phase of its development.
Many interviewees highlighted in order to have a well functioning market, improvements are needed. This has happened because since 2010 a lot of development programmes etc. have been implemented. For example, in early 2011 the Russian Government extended the period of plans for another five years, which main objective is to approve the plan of activities. In particular, during 2011–2015 the liberalisation of traction market is expected to become complete (RZD Partner, 2012). In the ongoing liberalisation of the locomotives, Globaltrans plans to buy 100 locomotives in 2012 (at the moment the company owns 56 locomotives, which are used in closed circular routes) (Finam, 2012). At the same time, RZD is planning to buy own locomotives (RZD Partner, 2012). According to Railway Development Strategy in the Russian Federation until 2030, the need for locomotives will increase up to 23,397 units during 2010–2030. Furthermore, one of the main objectives is to develop logistics and further integrate with the global markets which also have national significance. Russian Railways do not hurry to part with the status of the freight carrier on the backbone routes (RZD Partner, 2012). However, in the next coming years RZD plans to develop a new form of network charges, so-called network contract, at several sites in the Russian Federation, including Siberia and Karelia (Delkuz, 2012). The usage of such agreements (e.g., network contract for one to two years) is hoped to be reality by the end of 2012. In close future, the company expects to use long contracts (five to ten years) which will govern its relations with the state in providing infrastructure for transportation. Additionally, RZD has already made contribution to the development of logistics technologies. On 11th November 2011 the intermodal train left Nakhodka, travelled through Trans-Siberian Railway and arrived to St. Petersburg on the 18th November. In other words, it took only six days and 16 hours that is even less the time that was proposed in the programme called Transsib for seven days (Yakunin, 2011). The mainstream development objectives for Russian railway market are fulfilling the needs of niche markets by utilising high technology innovations and manufacture specialised wagons. In addition, rolling stocks’ cost parameters need to be upgraded. Therefore, one of the main targets is to design and manufacture diesel locomotives with improved economic and environmental safety parameters (Belousov et al., 2008).

Although Russian market is often noted as old-traditional, during the last decade the internationalisation has entered the market, including railway industry. The initial public offering of Globaltrans, country’s second biggest freight operator, took place in spring 2008. It was a success and company is listed on the London Stock Exchange (Grantham, 2008; Stupachenko, 2009). All these factors strengthen Russia’s position as one of the economic superpowers in the world. Therefore, Russia has a lot to offer also for international companies. Due to Russia’s significant natural resources, the amount of freight export is expected to grow in the future (RZD Partner International, 2009). Railway is the main transport mode of natural resources and it provides business opportunities for international companies (CIA, 2012). As the attitude towards foreign companies becomes positive, possibilities to enter the market increase. According to Lukov (2009), RZD’s main intention is to attract freight to the railway. Therefore, RZD does not fear competition. On the contrary, strengthening the railway network ensures significant improvement in transport provision in many regions (Railway Gazette International, 2009b).
6 Conclusions

This study has provided insights into the Russian railway freight market. The main purpose of the study was to evaluate the barriers to entry, and to scrutinise how the deregulation process has progressed in Russia. Additionally, study revealed the experts’ viewpoints towards Russian railway freight market’s national peculiarities. Study contributes to existing knowledge by providing interesting outcomes from market, which has not been widely studied in English literature. Russia joined WTO in August 2012, which might have significant influences on the trade between the other countries and Russia. Therefore, it is essential to understand the characteristics of the country.

Russian railway freight market has confronted and is undergoing a significant transformation. Although the process started already in 2001 when RZD was established, a lot has happened in a decade. Three stages of the Reform Programme are fulfilled, which has dramatically changed the market. The fourth phase is ongoing, and further changes are expected. When compared to several other countries in the world which have deregulated the railway freight market (for example, the USA, Japan, European Union etc.), Russia is lagging behind. Offering railway transport services is possible, and around 2,000 companies have entered the market by providing leasing services and such. However, the major fleet of rolling stock is managed by 250–300 companies, while rest of those prefer to rent wagons and receive payment for the activity. Interestingly, traction is only provided by the national railway undertaking, RZD. The situation is expected to change in near future, which will transform the whole market structure. Therefore it is vital to scrutinise the market and understand its way of functionality. Once the main market entry barriers and national peculiarities are known, forthcoming is easier to confront.

This research revealed the transformation process has been ongoing for few years already; presumable, no one knows what will happen in future. However, by scrutinising the market and by understanding its way of functionality and the main peculiarities, forthcoming is easier to confront. This was the main objective in this paper. Russian railway freight market was evaluated via literature review, where after genuine data was gathered by interviewing representatives from the market. By including various types of actors, research was able to unfold a versatile picture about the market. As the main market peculiarities were ensued the importance of personal relations and the close linkage between politics and railway freight market. Furthermore, reliability/functionality, the size of this extensive country as well as traction and tariff system can be noted as especial characteristics. Although market is different, various similarities came forward. As main market entry barriers were noted coincident factors than were revealed in earlier studies, namely rolling stock, needed capital and bureaucracy. Internationalisation is increasing also in this nuanced country, which is often seen as suspicious and even parlous. However, time has changed: Currently Russia offers plenty of business opportunities for railway operators. Acquiring an existing railway company was regarded to offer most straightforward way to enter the market, due to already existing rolling stock and tacit and explicit knowledge.

This paper has significant value for academia as well as for practitioners. As previous, although rather few, works have mainly concentrated on literature analyses, this paper provides interesting outcomes by introducing standpoints of various experts. Additionally, the fact that sample includes few representatives from Finland (a member country of the European Union), highlights how the foreigners see the market. Study
Deregulation of the Russian railway freight market illustrates new information for companies who consider entering the Russian railway freight market, as well as governmental bodies and other stakeholders who want to understand the characteristics of this interesting country.

Although results provide rather interesting outcomes, few limitations should be kept in mind. Research sample consists of several types of organisations and market actors, but still the viewpoints might not represent the whole market. Because all interviewees were located in Moscow or St. Petersburg, the representatives from other parts of the country were not included which might influence on the results. Based on these limitations, due to the fact that research evaluated only a sample of 15 representatives from 11 companies, it would be interesting to redo the research in few years time with a larger respondent base. By including actors from other countries operating with Russia could unfold new insights, as for example companies from the Baltic States have trade with Russia. Additionally, by interviewing representatives from all different wagon owner types and manufacturers etc. could adduce more versatile information. Because the market is now in transition process, study should be repeated in few years’ time.

Acknowledgements

Constructive and value adding comments from referee are gratefully acknowledged.

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Deregulation of the Russian railway freight market


Appendix

The semi-structured questionnaire

1 Company background

- History
- Organisational chart
- The knowledge of Russian railway freight market and issues related to market entry before actually entering the markets

2 Entering the markets

- Before entering the markets
  - Why company decided to start operations in Russia?
  - What kind of preliminary preparations were made?
  - Where you gathered information concerning the market entry?
  - Did you have rolling stock/other needed infrastructure (warehouses, terminals)? How you organised it?
    - Where you purchased rolling stock?
      - New/second-hand
      - How many units your company owned in the beginning?
  - Where you gathered the personnel?
    - Previous experience in railway operations
    - Company’s qualifications for staff members
    - Training
  - Did you have collaboration with other freight operators, especially with governmentally owned companies?
  - How other actors in the market took your market entry?
  - How the governmental institutions took your market entry? (For example, matters related to needed documents, licenses etc.)

- Entering the markets
  - What kind of expectations you had before entering the markets? Did the expectations come true?
  - How you entered the markets? Were certain strategies used?
  - What kind of problems or difficulties you faced when entering the markets?
Deregulation of the Russian railway freight market

- Especially the role of governmental organisations in safety certificate and operating license + rolling stock approval + capacity allocation
  - Kindly describe the main market entry barriers
  - What kind of positive matters you faced when entering the markets?
  - Resources, employees’ skills and certificates requested by governmental authorities
  - Did you have collaboration with other freight operators, especially with governmentally owned companies?
  - Kindly describe cooperation with
    - TransContainer
    - First Cargo Company
    - Overall with RZD
    - Did your company have a ready clientele?

- The situation today
  - Kindly name the company’s strengths and weaknesses
  - What are the main problems you are facing?
  - Has the Russian market’s pricing policy changed during the years?
  - Has the cooperation with customers changed during the years? If yes, how?
    - Do you offer services only to certain customers or are all companies accepted?
    - Do customers ask for door-to-door services?
  - Do you have collaboration with other freight operators?
    - Kindly describe cooperation with
      - TransContainer
      - First Cargo Company
      - Overall with RZD

- Future
  - Do you think some improvements are needed? If yes, what kind of improvements?
    - Innovations
    - Future prospects; collaboration with other freight operators, especially with governmentally owned companies?

3 Infrastructure
- Cost distribution/access charge
- Kindly describe the Russian railway network (condition, extent, functionality)

4 Russian railway freight market
- Kindly describe the Russian railway freight market
  - Main differences to Finland
Did the European Union railway freight market deregulation affect the Russian market?

Cooperation with
- First Cargo Company/Transcontainer / RZD

How smoothly tractions are organised?

Russian railway freight market’s transparency / objectivity
- Functionality of
  - Ministry
  - Infrastructure
  - Market requisite
  - Government (needed documents)

Competition
- Intramodal competition
- Intermodal competition
- Amount of operators in Russian railway freight market
  - Is someone dominating the market?
- Do companies use marketing as competitive weapon?
- Do companies launch new products/services?
- What do you think about Second Cargo Company’s decision to enter the market? Will it change the competitive combination? If yes, how?

Changes in the tariff system during the years
- Has the price structure changed? If yes, how?

Customer relationships
- Customers’ demands
- Contract lengths
- Cooperation’s extent
- Is customer service seen important?
- Customers’ knowledge about the market and its structure
- Environmental questions

Railway freight market’s future in Russia

European Union
- Has the European Union affected on your business? If yes, how?
- What kind of possibilities/problems EU creates to the market?
Publication V

Justification and Evaluation of Dry Ports Investments in Russia

Research in Transportation Economics
Vol. 51, pp. 61–70.

Elsevier retains copyright of the paper
Justification and evaluation of dry port investments in Russia

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A R T I C L E  I N F O
Article history:
Available online 4 August 2015
Keywords:
Investments
Risks
Public–private partnerships
Dry ports
Seaports

A B S T R A C T
The hinterland infrastructure (e.g. dry ports that tend to bond railways, seaports, warehouses and roads) is one of the vulnerable points of the national economics. In the deficit of financial resources, the modernisation of the current assets and realisation of the new major projects are possible through public–private partnerships (PPFs). Notably, the attention is focused on the options for dry port development. A decision is made on the suitable investment mechanism from two alternatives – whether to include or not the enterprises of Russian Railways (JSC RZD) in the financing of the PPF project. To a greater extent, the deterministic model of net cash flows, including project risks assessed by several capital budgeting techniques, showed that the economic potential of concessions in Russia can be considered as high.

1. Introduction
Capital investments have always been the driver of a country’s economy (Aganbegyan, 2014; NACD, 2014; Esipova, 2011; Bamster & Berechman, 2003, Strasz, 2006). The following examples can be taken into account in support of this statement. In order to spur the stagnant Spanish economy from the recent crisis, the country seeks to attract additional foreign direct investments (FDIs). The central government provides financial support and tax benefits for activities such as new infrastructure projects, preferably in the transport industry. These spheres are considered to be the priority sectors with regard to their growth potential and their effect on the nation’s economy on a large scale. In addition, in 2009, the National Anti-Crisis Plan of the Czech Republic proposed a growth of the investments in the transport infrastructure. Their primary aim was to mitigate the adverse effects of the global crisis (Kuznetsov & Khesin, 2013).

In the United States, the proposed response to the economic crisis was the investment in public infrastructure, intending to expand the economy’s long-term productive capacity (Heintz, Pollin, & Garrett-Peltier, 2009). In Japan, to jump-start the economic development of the country, it was decided to accelerate the construction of a new high-speed rail system for 3–5 years (Pletnev, 2015). Similarly, in order to overcome the ramifications of the crisis in Germany, the infusion of investments in the infrastructure was regarded as one of the ‘cushion’ measures (Scharnagel, 2009).

In light of the current financial situation in Russia, Mr. Yakunin, the president of JSC ‘Russian Railways’ (JSC RZD), also opposed austerity measures on the investment. Mainly, despite existing difficulties, the reduction of financing geared towards the modernisation of the transport infrastructure (Pletnev, 2015), increased recent geopolitical tensions because of the conflict in eastern Ukraine, which remains a major threat to the global economy, influenced the business environment in Russia. Reportedly, Russian banks are still able to issue short-term debt. However, with the European sanctions, it is unlikely to make up to the shortfall in longer-dated bonds, which historically have been the backbone of deals. As a result, some shortcomings in the investment in infrastructure may arise (Aganbegyan, 2014; Eurofer, 2014).

The political uncertainty continued to burden economic activity more in some countries than the others did. Meanwhile, the investment climate in Russia has been improving, if one examines it from the retrospective of recent decades, and focused on a long-term perspective. According to the United Nations’ reports, within Southeast Europe and the Commonwealth of Independent States (CIS), the Russian Federation has always occupied a dominant position in FDIs, both inflows and outflows (UNCTAD, 2006). In a survey of Japanese manufacturing transnational corporations by Japan Bank for International Cooperation (JBC) (JBC, 2006), the Russian Federation was ranked sixth, following the economies of four Asian countries and the United States. In a recent research,
Russia was found to be the third most attractive country for investors after the United States and China. Meanwhile, beyond oil and gas-targeted spheres for the investments, the attraction of the capital inflows in other businesses also requires serious attention: first and foremost, in the development of seaports and their hinterland infrastructure (e.g. dry ports; Roso, 2009; Henntu & Hilmola, 2011; Rodrigue & Notteboom, 2012; Monios & Wilmssmeier, 2012; Roso, 2013; Ambrosino & Sciamacchina, 2014) because of the leading importance of the sea transport in the international traffic and the rapid growth of cargo transportation in containers (Toussy, Minderheld, Perrin, & Notteboom, 2011; ‘K’ line; Panova & Koryovaykovsky, 2013; Yap & Lam, 2013; Ramos, 2014). The economies of countries that resorted to sea transport as the means of global trade are considerably strengthened by the investments in the maritime, inland terminal and warehousing infrastructure.

For example, in China, to which most of the manufacturing operations were offshore, the mainland ports handled >100 million twenty-foot equivalent unit (TEU) by sea (Fransoo & Lee, 2013). Therefore, to cope with the growing traffic flows, by 2012, there were 50 dry ports constructed, however, resulting in overall overcapacity (Chang & Notteboom, 2012). In Sweden, where sea transport is used for 50% of the country’s international traffic (Port of Gothenburg, 2014), the construction and locations of dry ports were reasonably planned. Their development was determined by the analyses of goods flow, and mainly, by geographical factors. Notably, the economic activities and population are concentrated in the eastern part of the country, whereas the central maritime ac-

tivity is on the western coast (Roso, Wossnau, & Olandersson, 2006). Probably for that reason Sweden is one of the examples of outstanding dry ports’ evolution in Europe (Bergqvist, Falkemark, & Wossnau, 2010). Backing the idea of shifting relatively large goods flows generated by the seaports from roads to railways, the dry ports facilitate sustainable progress in the hinterland regions. The share of rail transport in the volume of cargo transportation in cooperation with the leading port of Gothenburg is rapidly rising. That is from 28% in 2005 (Roso et al., 2006) to 46% in 2013 (Port of Gothenburg, 2014).

In Russia, the terminal and warehouse infrastructure has always been treated as secondary facilities for the industry, transportation, construction, and for all other sectors of the economy (Abdikerimov, Eisev, Nikolashin, & Sinitsyna, 2013). The lack of funding for the infrastructure projects strains the economy, leading to a reduction of budget revenues in the transport business (e.g. export of transport services). On the contrary, in many logistically advanced countries, these activities significantly contribute to the gross domestic product (Ng & Gujar, 2009; Castillo-Manzano, González-Laxe, & López-Valpuesta, 2011; Ng, Padilha, & Pallis, 2013; Chen, Chang, Kousoumy, & Zhang, 2014).

World experience shows that the negative effects of the deficit of the investments are lessened by the involvement of private sectors in the development of the infrastructure (i.e. dry ports), through the public–private partnerships (PPPs) (Bergqvist et al., 2010; Rodrigue, Debrée, Fremont, & Gouenval, 2010; Hacalhodes & Gujar, 2011; Van der Berg & Langen, 2011; Wilmssmeier, Monios, & Lamberts, 2011). Similarly to overseas cases, in Russia, the investment burden, which is related to the formation of the inland rail infrastructure of seaports, can be mitigated via the PPPs. This scheme has been proposed with an allowance for the current economic conditions, which are not deprived of uncertainties and risks (Kontakionis, Karantanos, Reeves, McKee, & Struckler, 2014; Looney, 1986; Pollin, 2003; Ryan et al., 2010).

This reason, this article intends to tackle the gap, that is, unlock the full potential of the Russian business environment to advance the infrastructure in the hinterland of the seaports, transferring the improvement of the service to the clients within the whole supply chain. Therefore, this article answers the following research questions: (1) How to make investment appraisal calculations of the dry port projects based on PPPs in Russia and (2) Why different schemes (e.g. with and without the participation of Russian Railways) have been considered for the national market.

The outline of this article is as follows: Section 2 provides an explanation of the methodology employed in the article. Section 3 includes a literature review on the investment mechanism of PPP in dry ports, and capital budgeting techniques, which are suitable for the domestic market. Section 4 illustrates empirical evidence from Russia. Section 5 explains a deterministic model of cash flows, costs and results, as well as the consequence values of the payback period (PP) and net present value (NPV), depending upon project risks. Section 6 contains concluding comments, that is, the preferred scheme of project implementation in terms of the participation of railway transport stakeholders.

2. Methodology

In order to answer the aforementioned questions, several research approaches, which complement each other, were used, for example, qualitative and quantitative methods (Silverman, 2011). The data for the ambiguous generalisations were collected via analyses of the multiple- and single-case studies of dry ports’ development via PPPs in different countries (e.g. Sweden, Spain, India, New Zealand, Turkey and Australia). Meanwhile, the national market has yet to gain experience in investing in inland terminals via PPPs. In order to better understand the peculiarities of the Russian market, with regard to PPP scheme utilisation, the literature review in the native language was conducted.

Contact with the experts from the field was also provided to mitigate the criticism of the quantitative research as a ‘quick fix’ of the problem. For gathering reliable data, the semi-structured interview method was applied (Wilson, 2014). The case company became JSC Russian Railways’ (JSC RZD), because the estimation of the investments is focused on the PPP schemes with or without the participation of the Railway Company in the financing. Key persons related to the development of the terminal and warehousing infrastructure were interviewed in meetings held in St Petersburg, Russia. The interviews were conducted in a conversational manner by means of a prepared list of predetermined questions (Appendix A), offering participants to stress the main issues, according to their opinions. The answers showed reasoning of JSC RZD representatives, concerning the key issues of the aforementioned questions.

According to Briman and Bell (2011), the applicability of the PPP scheme for the Russian market was justified by the deduction process that entails the theory testing. In order to design the model, statistical analysis of data was performed to gain access to the tariffs’ indication and cost of the facilities in the primary and second-hand markets through linear and exponential approximations.

The validity of the results is strengthened by the outcome of the experiments of investment appraisal calculations that are similar to feasibility studies conducted in the transport sector.

3. Literature review

In Russia, two-thirds of the investments are devoted to the extraction and processing of oil and the pipeline transport sectors. FDIs are concentrated in projects with short payback periods: in the
The national and foreign private sectors find investments in a railway industry to be less attractive because of long PPs. For example, the investments in the Transport Corridor (Trans-Saharan Railway) and Baikal–Amur Mainline will pay off in approximately 50 years (Forbes.ru, 2013). Pankratov and Antonovskiy (2012) underline that the government can benefit when the infrastructure projects are developed via PPP. In this case, the concerned private company may take the responsibilities of controlling the quality of the project realisation, as well as its cost and commissioning periods. In the United States, the development of transport corridors via PPP is commonplace (e.g. intermodal Alameda Corridor and multi-state intermodal project of Transport Corridor from Norfolk (VA) to Columbus (OH)) (Monios & Lambert, 2013).

As a rule, the dry ports are located along the developed transport corridors. Similar fundamental rail co-location approach should be taken in Russia to build the required terminal and warehousing infrastructure with the use of PPPs. Perhaps, dry ports might be developed adjacent to the seaports of St Petersburg, Ust-Luga, Novorossysk and Vladivostok, connected by the Trans-Siberian Railway (Panova, 2011).

The current situation on the transport market demonstrates the potential interest of railways to increase its service to the Russian container seaports. At present, the road component predominates (63.6%) the rail transport (21.6%) in the import flows of seaports. Moreover, the share of road transport in the transportation of incoming dry cargo of seaports (import) increased by 70% during 2009–2013. At the same time, the freight traffic by railways has increased by only 16% (Fig. 1).

It is evident from Fig. 1 that the volume of imported dry cargo, which is transported by road, has increased in the recent years with respect to the indexed year of 2009. On the contrary, the volume delivered by railways since 2010 had a sharp decrease (17% by 2011), and the slight growth in 2013 did not return the volumes of previous years. In the future, subsidiaries of Russian Railways can further expand their share in handling the seaport’s container flows by the use of the concept of dry port.

In many countries, different parties interested in the development of dry ports collaborate under the PPPs of dry ports. Their joint working is generalised by ‘inside-out’ and ‘outside-in’ models of Wilmmeier et al. (2011), Monios and Wilmmeier (2012) and Ross (2013). In Russia, both the models can be merged to comply with the desired cooperation from the following interested parties. Seaport actors are willing to expand in the hinterland (‘outside-in’) and representatives from the inland side are planning to move outside (‘inside-out’).

The inclusion of the different parties in the investment projects of dry ports varies across countries. However, some similarities are recognised through the analysis of the PPPs in some European countries, as well as in New Zealand, India, and Turkey (i.e. case studies) (Table 1).

Table 1 illustrates the importance of understanding the organisation of PPPs. In particular, the representatives of the railway sphere are included in many terminal and warehousing projects. The same idea has been underlined by Bergqvist and Monios (2014), showing that the main investors are the rail network owner, terminal infrastructure owner and terminal operator. Rodriguez et al. (2010) also stress that, in the investigated market of North America, major actors in the development of inland ports are rail operators, real estate promoters and managers. Moreover, world experience, similarly, proves that usually, public actors, who want to act as landlords, are continuously involved in daily operational and commercial situations (Bergqvist & Monios, 2014).

Apparently, JSC ‘Russian Railways’ has to play a more active role in the development of dry ports. So far, the absence of an explicit regulation for PPPs makes the private investors reluctant to participate in the projects (Ivanov & Chernogorovskiy, 2013). In order to facilitate the implementation of dry ports via PPP within the system of Russian Railways, the decision-making techniques need to be addressed correctly (Khristolyubova, 2013).

Many capital budgeting decisions are made by considering the following criteria: NPV, PP, internal rate of return and discounted payback period (DPP) (Souza, 2012). The PP is the simplest and widely used criterion in practice to recognise the time, when an investment requires paying for itself (Drury, 2009). However, it does not incorporate the time value of money (Pyles, 2014). The NPV is considered as theoretically superior to all the capital budgeting decisions (Dymowa, 2011), but it is based on the assumptions of certainty of the project life. Therefore, the application of PP and NPV alone cannot be sufficient for making decisions on the capital investments. In many instances, a project’s useful life is exposed to risk, because of changes in political, technological and regulatory factors. These risks can be indicated by the additional performance criterion, DPP (Bhandari, 2009).

In Russia, a variety of risk factors require managers to focus on proper capital investment’s appraisals that ensure project profitability and liquidity. The only criterion that satisfies both is the DPP (Bhandari, 2009; Northcott, 1992). Meanwhile, despite the benefits of DPP in the decision-making process, textbooks and articles give insufficient information about this phenomenon. The appropriate nature of DPP in risk assessment seems underestimated. Meantime, on the basis of the reliabilities of the different decision-making criteria (PP, DPP and NPV), all of them are proposed for the appraisal of capital investment of the PPP project of a dry port. In order to consider the project risks that can be shared among the interested parties of the PPP, both risk-adjusted discount rate and sensitivity analysis are applied to the developed model of the net cash flows. The sensitivity analysis counterbalances the simplicity and coherent insufficient accuracy of the risk’s allowance by the risk-adjusted discount rate (Saltelli, Tarantola, Campbell, & Koebi, 2004; Galvin & Srinivasa-Blank, 2012; IMF, 2005; Doma-33)

Fig. 1. The arrival and departure of dry cargo flows of seaports by mode of transport.

Russia has gained considerable experience in financing large-scale projects by involving private investors via PPPs. However, on the basis of interview responses, in the railway sphere, the
absence of an adequate regulatory base hinders the use of this mechanism. Currently, legislative regulation of PPPs in the sector is ensured by the Federal Law ‘On Concession Agreements’, which was adopted in 2005. The Civil Code of the Russian Federation (1994) allows using concessions in the form of a build–operate–transfer (BOT) concession contract. According to this type of concession, a private party or consortium agrees to finance, construct, operate and maintain a facility for a specified period and then transfer its facility to a government or other public authority.

However, with regard to rail infrastructure, there are some legal restrictions that can be considered as barriers. The ‘On Concession Agreements’ does not allow expropriating rail infrastructure, and private investors are forced to invest in state ownership. The latest revision of the Federal Law on ‘Concession Agreements’ from 25 April 2012 contains a principle that facilitates the use of life cycle contracts in the form of concession agreements. This innovation can only be appropriate for road objects and is not legally enshrined for railway facilities.

Meanwhile, Transport Strategy of the Russian Federation for the period up to 2030 presumes that the proportion of off-budgetary sources in the transport sector will cover 60% of the total investment in infrastructure. However, only a limited number of private companies have shown interest to invest in transport infrastructure because of the very long PP. The interviewees mentioned the two privately owned dry ports of St Petersburg seaport: (1) Logistic Park Yantarn, which is connected to the ‘Petrolesport’ marine terminal, and (2) ‘Logistics Terminal’, which is linked to the First Container Terminal.

The seaport of Ust-Luga is reportedly considered as a national project (located in the vicinity of St Petersburg), and hence the development of rail approaches to the seaport is extensively supported. However, the high cost of the land adjacent to the seaport was reported during the interviews as a main delimiter for JSC RZD.

JSC RZD is involved in the development of the terminal and warehousing infrastructure in support of this seaport. One of the interviewees stressed the development of the terminal logistics centre (TLC) called ‘Hovrino’ that can be attributed to the term of the dry port. It is an important investment project, which demonstrates the successful development of infrastructure through PPP, involving JSC ‘Russian Railways’.

The TLC ‘Hovrino’ is partly started earlier because of the opened container terminal with a capacity of ~7000 TEU and two rail tracks of 1600 m each, working in a 24/7 schedule. In January 2014, the first container train with a speed of 120 km/h used the main line. The train arrived at Hovrino, which is located in the northern part of Moscow, from the seaport of Ust-Luga. The transit time of these weekly container trains is ~28 h, including the delivery of the container to the clients in Moscow. This project with the total territory of 40 ha located in railway right-of-way (ROW) land will be entirely put into action by the end of 2015. Three other TLCs are supposed to be opened in 2016: (1) ‘Lublin’ (70 ha) in the southeast of the capital, (2) ‘Kunstevo II’ (20 ha) in the west of the city, and (3) ‘Seversky’ (25 ha) in the north-east of Moscow, respectively.

The construction of TLC ‘Kunstevo II’ is expected to be provided by JSC RZD and its subsidiary JSC ‘TransContainer’. It is worth noting that ‘TransContainer’ was called by the interviewees as the
potential investor of dry ports. However, leading attention was paid to the Directorate for management of the terminal and warehousing infrastructure of JSC RZD as the prominent investor. The final decision on the participation in the PPP project is made by the parent company of JSC ‘Russian Railways’. In addition, the terminal of the logistics company called ‘Eurosib’ was mentioned. The terminal ‘Predportovy’ was commissioned in 2006. It is located 6 km from the St Petersburg seaport, and is adjacent to the Predportovaya railway station. The terminal area is about 5 ha with a container yard of 2 ha and storage capacity of 1500 TEU.

For ‘Eurosib’, the terminal ‘Predportovy’ was a pilot project that was realised in cooperation with JSC RZD. However, it became the synonym for Euroterminal. As a result, this terminal was sold to the group of ‘Soyfracht-Soviemtrans’. Consequently, the only terminal of ‘Eurosib’ that was left in St Petersburg is located in Shushary. However, even this terminal is actively distributed among various tenants, who rent parts of the Eurosib’s terminal, and the company itself no longer operates it. According to the research, the success of the project of the dry port depends on the competition between the railway and road. In most cases, the transportation by road is cheaper than railway. Moreover, at the beginning of the operation of the project, the transportation of goods by railway will not be as profitable as expected, because of the tariff policy, which does not fully reflect the differentiation of infrastructure by the level of capital intensity.

In general, JSC RZD is interested in the development of rail infrastructure for the terminal logistics centres (TLCs) located within Russian Railways, and hence, in the documents of the company, the process of the development of the network of TLCs is described in detail, including the responsible enterprises and deadlines. The interviewees reported that the company would build the required and sufficient terminal and warehousing infrastructure, if there were enough funds. Reportedly, if the terminals and rail approaches are built, then the project is fully registered on the balance of JSC RZD.

If the TLC is transferred to the balance of Russian Railways, then the land-use issues should be resolved naturally. If areas/territories, where the TLC is located, are not owned by Russian Railways (not ROW), a permit from their owners should be obtained. Russian Railways gets permission to use the land for the TLCs from the local administrations within different regions. The issues related to the earth’s use, as a rule, are easily resolved by municipalities. There are cases where the property is on someone else’s land or the so-called ‘foreign’ areas, and sometimes vice versa. In both instances, contracts should be made for the lease of the land. Quite often, JSC RZD takes all facilities that have been built by the private investor on its own balance. Afterwards, it transmits the facilities to the private enterprise to rent or provide a loan (free use) of the object. In theory, main rail lines can also be transferred to the balance of JSC RZD, and the investor can rent them; but in reality, such examples are not known by the experts till date.

The reason behind this situation was mentioned previously: The principles of PPP for a railway industry have still not been developed at any level (federal or regional). Therefore, all is defined, as a rule, by the particular contract and extra-contractual relationships that are nowhere prescribed or written.

The development of the infrastructure projects undoubtedly increases the revenues of the cities, and benefits the social environment. Eventually, the associated regions receive an impetus for surplus development (e.g. created jobs and paid taxes). In practice, this may be a particular section of the business plan dedicated to regional development.

In conclusion, the realisation of the projects is not deprived of the risks. The examples could be as follows: risk of saturating the market by logistics services, the risks of a decrease of the tariffs for transportation and transhipment operations, the risk of reducing container flows because of their shift to other directions, crisis and inflation. These risks are analysed by the consultant company once the projects are irrevocably accepted for development, and thus, the risk assessment does not change the favourable decision on the project realisation.

5. Deterministic model of PPP investment appraisal calculations

Deterministic model of net cash flows may include the benefits and costs related to capital, financial and operational activities. More often, these activities determine the efficiency of the infrastructure projects, for example, roads (Kazaklu & Narkievskaya, 2013). On the basis of the aforementioned assumptions, the following cash flows are considered:

a) Investment cash flows are associated with activities that include investments for the construction of the dry port.

b) Financial cash flows are related to banking operations, obtaining credit and loans and issue and sale of securities with foreign currency transactions. These cash flows should be considered individually for each project (not included in the designed model).

c) Operating cash flows are associated with the operating activities that encapsulate inflows and outflows.

Inflows are revenues from activities such as transportation, handling and storing of containers and additional operations (e.g. the use of wagons and containers, shunting operations, customs clearance, and weighting). Maximum revenue is expected to be received for a site at the end of the prescribed period [0, T], that is, by the residual value of the land. The savings from operating costs are added to the inflows (e.g. the degree of the reduction of losses that was the case before the construction of the dry port because of the deficit of storage yards). In addition, the building of the dry port, higher inflows in the seaport are expected. This is because the seaport can receive and process more containers per year in the same area at a better turnover, without any technology upgrades. Outflows of the operating activities are operating costs, which are related to the operation of the dry port, including rail approaches to the seaport. These cash flows involve prime costs for lifting operations with the containers; costs of shunting services; expenses associated with the presence of wagons and locomotives under the operations at the dry port and the costs of operating the trains, locomotives, their maintenance, energy consumption and salary of the trains’ employees, wagon inspectors, who check the technical conditions of the wagons within the trains that arrive/depart from the dry port. In addition to the operating costs (inflows and outflows), there are taxes on tariffs, revenues and property.

In the calculations, the outflows are subtracted from the inflows, excluding the total depreciation, as it is one of the sources of financing of the investment project. Depreciation is included in the revenue rate of transport of goods, and is accounted to the railways. In order to account for the time difference values of cash flows, the discounting factor was used. In the described project of a dry port, the discount rate is composed of two parameters: (1) the guaranteed rate of return on equity and (2) the refinancing rate of the Central Bank of the Russian Federation and the average level of risk.

The approximate rate of risk adjustments of not receiving the expected income from the project was considered to be low. A 2% risk level was chosen to depict the group of risks of uncertainty of container traffic volume and the timeliness period of...
commissioning. In addition, the risks of 10% reduction of sales prices and stable prices for the land were included in the calculations.

The economic appraisals have been made based on the following assumptions. Because the development of a dry port implies the implementation of the main railway lines, which connect the dry port and the seaport, the project will be of potential interest for both the seaport and railways. Hence, 30% of the investment flows in the construction of the railway was allocated to the private rail enterprises. Then, the infrastructure is transferred to the balance of the 'Russian Railways'. The other potential investors are proposed to be Sberbank of Russia (36%) and Global Ports (34%).

It is important to note that these organisations are only suggestions are proposed to be Sberbank of Russia (36%) and Global Ports (34%). It is important to note that these organisations are only suggestions of this research, and not necessarily real (but are potential ones).

According to the proposed potential investors of the dry port project, Table 2 was constructed.

Table 2 shows that the participation of the enterprises of Russian Railways in the investment of the mainline rail approaches, and their 30% share will provide 10.6% of the total investments in the project of the dry port.

The cash flows from the investments of the companies were divided into three parts in the settlement period of 20 years, with the construction starting in 2015. Thus, the investments account for steps 1, 8 and 10 (2015, end of 2022 and end of 2024, respectively). The investment funds were allocated according to the increase of the processing capacity of the dry port that triggered the change of its technical conditions in stages.

It should be noted that the designed dry port is located at the RWP of railways. According to the contract, the facilities of the dry port, including the terminal and approaches to the seaport, are transferred to JSC ‘Russian Railways’ after 20 years. The transferred facilities are assessed at the prices on the date of transmission. In the future, the private party will rent the facilities or receive the loan (free use) of an object.

In the given example, the value of land is calculated in allowance for the market price of the facilities on the primary and second-hand markets. The prices on the date of the expected horizon of investment (20 years, by the end of 2034) are computed by linear and exponential approximations. The calculations revealed that the prices in Rubles have increased faster (1.7 vs. 2.6 times). Thus, the trend was outlined in accordance with the price change on the primary market of the apartment costs in US dollars per metre squared. In general, the price trends on the second-hand market were even more volatile. The rate of increase of sales prices was calculated based on the expected yield indexation, and also by using exponential approximations.

According to the initial data, the PP, a valid indicator of time, was calculated. Because of the development of the dry port in phases, the PP was found for each phase. For example, the investments of the first period will be recovered in 6 years, whereas the total investments will be paid off within 9 years. The PP was also calculated with regard to the risks related to the sales prices and land costs. These types of risks were computed based on the assumptions that the sales prices will decline by 10% and land costs will be stable. In this scenario, the inflow operating cash flows was negatively affected, whereas the investment outflow was positively affected by the stable price of the land. As a result, the PP of the first phase of the investments increased to 7 years. However, the PP of the whole project remained the same (9 years), because of the lump sum of investments (1070.2 Ml Roubles), which was made in the eighth year.

In addition to the PP, the second decision-making indicator, DPP, was calculated. The DPP was found for the same scenarios as for the PP, and in addition was worsened by risks related to uncertainty of container traffic flow and the time of facility commissioning. Consequently, the DPP increased to 11 years.

The third criterion, NPV, was found in relation to the risk-free environment. This scenario was considered as a base for other alternatives. The correlated changes in NPV for various risk factors were identified (Table 1).

It is evident from Table 1 that, the NPV (base scenario) equalled 4250 Ml RUB in risk-free conditions. The change of factor 1 (stable prices of the land) and factor 2 (the risk of reduced sales prices) resulted in the reduced NPV (4193.5 and 3549.6 Ml RUB, respectively).

In addition, the influence of factor 3 (risks of container’s traffic volume and the timeliness period of commissioning) on the NPV was calculated (3149.3 Ml RUB) simply through the risk-adjusted discounting rate.

All factors were checked for the elasticity. The figures of elasticity show the significant influence of factor 3 (12.95) compared with factors 1 (0.34) and 2 (1.74).

It should be noted that the value of the NPV (3149.3 Ml RUB), which was calculated by the risk-adjusted discounting rate (factor 3), significantly differs (26%) from other scenarios. That is evident from the NPV (4250.3 Ml RUB), as well as from the NPV that was found in the sensitivity analysis. In particular, the influence of factor 1 resulted in a 1% change of NPV from its base value, whereas factor 2 increased NPV by 16%. Therefore, the outcomes show the low accuracy of the risk-adjusted discounting rate method.

The coefficient of elasticity of -1 means the inelasticity of NPV to the increase in price of the land. As a result, the factor received a rating of 2. The elasticity of factor 2 is >1. Accordingly, NPV is elastic to the change of sales prices, as each percentage change factor leads to further changes in NPV. Hence, factor 2 has a higher rating of 1 with its influence on NPV.

It should be noted that the investments pay off only from the net income, but also as a result of depreciation. Depreciation was included in the revenue rate of transport of goods, and in both schemes was accounted to the railways. For that reason, the results of calculations became more optimistic (Table 4).

In the first option of Table 4, the private company of Global Ports has fewer required investments (32% of the total investments). In the second port, rail companies are deprived of the income as they do not hold investments in the project of the dry port. However, they take all expenses from existing operations and depreciation

<table>
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<th>Name</th>
<th>Railway approaches to the seaport from the dry port</th>
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<th>Private investments Total</th>
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</table>
costs once the main rail approaches to the seaport are transferred to the balance of Russian Railways. In the given case, the transfer is performed after the commissioning of the dry port project. Therefore, the peculiarities of legislation inevitably make JSC RZD involved in the daily operations. In these circumstances, the first option of Table 4 is more rational for JSC RZD to choose. The arguments are the lower level of expenses because of the incomes from the transportation of marine containers to/from the seaport and the value-added services provided in the terminal when it is operating.

6. Conclusions

The Government of the Russian Federation, as well as many other governments, provided the right to fulfill the logistics services to the private companies. Because of the reformation of the transport spheres, in recent days, the enterprises gain rich experience in the operation of railways (Lani & Panova, 2013; Alexanderson & Rigas, 2013) and seaports (Cullinane & Song, 2002; Ferrari & Musso, 2011). In the given conditions, the use of PPPs in the field of transport construction allows the government to strengthen its capacity of providing better services. The aim is achieved by the attraction of the funds, including foreign investments and the expertise of the private sector. Similarly to the public sector, businesses receive clear responsibilities in the implementation of the proposed mechanism of the partnership.

The cooperation of public and private sectors in the dry port concept has a positive effect in the researched countries. Sweden typifies a favourable outcome. In 2010, the shuttle system of the Port of Gothenburg included 26 services dedicated to 23 dry ports (e.g. rail ports) (Almotairi, Flodén, Stefansson, & Wensimus, 2011). With the liberalisation of Spanish railways, the private operator Continental Rail has gained several benefits. For instance, by working with the dry port, it has captured all of the Maersk traffic from Valencia seaport to Coslada inland terminal (40% in 2010), according to Monios (2013). By the use of the concept of dry port, subsidiaries of Russian Railways can also expand their share in handling of the seaport’s container flows. The study shows that the potential growth is from the current 22% and the existing growth rate of 6% to the volumes comparable to road transport (64% and 70%, respectively).

The analysis of the development of dry ports via PPPs in European countries, as well as New Zealand, India and Turkey (i.e. case studies), showed the remarkable similarities between the organisational aspects of PPPs. In particular, the representatives of the railway sphere are included in many terminal and warehousing projects. It attracted our attention that foreign experience shows the inevitable involvement of public parties, which want to act as landlords, in daily operational and commercial situations (Bergqvist & Monios, 2014). Apparently, JSC ‘Russian Railways’ has to play a more active role in the development of dry ports.

In order to justify the benefits of the participation of Russian Railways’ enterprises and other private companies in the investments of rail infrastructure, this article represents a deterministic model of net cash flows. The proposed description of investment cash flows, operating cash flows, including inflows and outflows, as well as peculiarities of their calculations, facilitate the appropriate decision-making on the project developments.

The JSC RZD, if included in the project, will receive the profit immediately after the beginning of the dry port’s exploitation. Consequently, this option will allow covering operating costs. On the contrary, if acting as landlords, the operating costs will be insufficiently counterbalanced (Table 4). The participation of the enterprises of Russian Railways in the project will also guarantee the assistance for private companies that can gain the profit from the exploitation of the created dry port.

The exclusion of railway companies from the project will negatively affect their budget (i.e. as not gaining benefits from the operation, but receiving operational costs from rail infrastructure). Moreover, the budget of the private partner will be influenced, requiring more investments from the private partner; for example, Global Ports, when JSC RZD is not included in the project.

Hence, the scheme of the PPP with investments’ shares of JSC RZD in the dry port projects is considered as the most appropriate investment mechanism. This alternative is beneficial for both railway companies and other private investors.

In addition to the essence of railway projects’ participation in the PPPs and the relationships among parties in the investment process, which are reflected in the deterministic model, the possibility of risks’ allowance is considered. The reasons behind this motivation were the peculiarities of the PPP that is, the possibility of sharing the risk among the partners, and the nature of the Russian market, which is not deprived of the risks. The evaluation of risks during the feasibility studies can help to achieve the overall goal of the project by transferring several project risks to the private sector.

The variety of risk factors requires the managers to focus on the capital investment’s appraisals that ensure project profitability and liquidity. The only criterion that satisfies both is DPP. Therefore, for the Russian environment, the importance of the DPP criterion should not be underestimated. It should be considered comparable to the NPV capital budgeting decision, which is applied for perfect and efficient markets, where the project’s useful life is less exposed to risks.

Meanwhile, both DPP and NPV lack the possibility of proper measurement of uncertainties, if the figures are found from the deterministic point of view with the use of a risk-adjusted discounting rate. In this case, the investors can elaborate on the point estimate figure of the time horizon during which investments pay off or the fixed character of the cumulative NPV. Accordingly, the described capital budgeting technique should be counterbalanced by the sensitivity analysis. By varying the risk factors, the relationship between the parameter of risk and decision-making criteria can be easily identified through the elasticity. For example, the coefficient of elasticity of the risk factor 1 (stable prices of the land) of -1 means the inelasticity of the project performance to this factor when compared with the risk factors 2 and 3. Meanwhile, factor 2 (change in the sales prices) or 3 (risks of container’s traffic volume and the timeliness period of commissioning) received a higher rating. As a result, each percentage of

<table>
<thead>
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<th>Table 3</th>
<th>Elasticity of NPV to the risk factors.</th>
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<tr>
<td>Factors</td>
<td>Change</td>
</tr>
<tr>
<td>1</td>
<td>4100.5 M RUB</td>
</tr>
<tr>
<td>2</td>
<td>3540.6 M RUB</td>
</tr>
<tr>
<td>3</td>
<td>3140.3 M RUB</td>
</tr>
</tbody>
</table>
Table 4
Comparison of the investment schemes of dry port's construction (with and without the participation of Russian Railways Company).

<table>
<thead>
<tr>
<th>Investors</th>
<th>Implementation of the project with the participation of Russian railways, Mln Roubles</th>
<th>Implementation of the project without the participation of Russian railways, Mln Roubles</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Costs</td>
<td>Effects</td>
</tr>
<tr>
<td></td>
<td>Investments</td>
<td>Operating costs of all approaches to the seaport from dry port</td>
</tr>
<tr>
<td>Shchelkovo</td>
<td>319.1 (30%)</td>
<td>39.2</td>
</tr>
<tr>
<td>Global Ports</td>
<td>361.0 (36%)</td>
<td>30.1</td>
</tr>
<tr>
<td>JSC 'Russian Railways'</td>
<td>227.2</td>
<td>880.6</td>
</tr>
<tr>
<td>Total</td>
<td>986.6</td>
<td>227.2</td>
</tr>
</tbody>
</table>

Note: The number of block trains equals 10 with an average round trip time of 8 h. The train includes 41 rail platforms with three containers for each wagon. On the grounds of the calculations, the net cost of TEU container transportation by railway equals 9083 Roubles: (227.2 + 76.2) / 10 = 9083 Roubles, whereas the cost of the box (without reference to the size of a container because of the use of the box factor 0.59, showing the proportions of 70% of TEU and 30% of TEU containers handled at the terminal) is 15396 Roubles: (227.2 + 76.2) / 10 = 15396 Roubles. The costs in the table are given with allowance for the discount rate of 11% (discount factor = 0.124).


PPE – Forty Foot Equivalent Unit

Appendix A

Questions and themes of the semi-structured interview.

1. General attitude towards the development of dry ports

2. Influence of the Railway Ministry on the process

3. Opinion on the role of the Ministry of Transport on the process

4. What are the strengths and weaknesses of the project?

5. What is the relationship between the various interest groups?

6. Does your company benefit from the project?

7. Will your company benefit from the project?

8. If not, why?

9. Will your company benefit from the project?

10. What was your major concern in the project?

11. What was your major concern in the project?

12. What is your opinion about the potential impact of JSC Russian Railways on the project?

13. Can PPP be considered as an acceptable scheme for the future venues, the research needs a probabilistic description of the risk assessment of the investments in the construction of a dry port (PPP)?

14. Would you collaborate with the private sector?

15. Which part of the project (rail approaches, terminal and warehouse facilities) do you consider the most important?

16. Possible distribution of interests and risks

17. Which actors are capable of participating in the project? Infrastructure?

18. Would you participate in the project?
7. Uncertainty and risks associated with the project

- The risks on the project feasibility study stage considered in your company?
- What is implied under the risk?
- Uncertainty in specific
- Untimely implementation of the project

Others

Please describe the methods and tools that you use to manage the risk.

References


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