

Igor Kabashkin
Irina Yatskiv
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Reliability and Statistics in Transportation and Communication

Selected Papers from the
20th International Conference
on Reliability and Statistics in
Transportation and Communication,
RelStat2020, 14–17 October 2020,
Riga, Latvia

Lecture Notes in Networks and Systems

Volume 195

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Olegas Prentkovskis
Editors

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ISSN 2367-3370

ISSN 2367-3389 (electronic)

Lecture Notes in Networks and Systems

ISBN 978-3-030-68475-4

ISBN 978-3-030-68476-1 (eBook)

<https://doi.org/10.1007/978-3-030-68476-1>

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Preface

In this volume of “Lecture Notes in Networks and Systems,” we are pleased to present the proceedings of the *20th International Multidisciplinary Conference on Reliability and Statistics in Transportation and Communication (RelStat 2020)*, which took place in Riga, Latvia, from October 15 to October 16, 2020. This event belongs to a conference series started in 2001 and organized annually by the Transport and Telecommunication Institute (TTI) in Riga, Latvia. The mission of RelStat is to promote a more comprehensive approach supporting new ideas, theories, technologies, systems, tools, applications, as well as work in progress and activities on all theoretical and practical issues arising in transport, information, and communication technologies. Results of previous editions RelStat were published by TTI Publishing House (RelStat 2001–2015) in the journal “Transport and Telecommunication” (ISSN 1407-6160), by Elsevier in the “Procedia Engineering” (RelStat 2016) and by Springer in “Lecture Notes in Networks and Systems” volume no.68 (RelStat 2018) and by Springer in “Lecture Notes in Networks and Systems” volume no.117 (RelStat 2019).

Design, implementation, operation, and maintenance of contemporary complex systems have brought many new challenges to “classic” reliability theory. We define complex systems as integrated unities of assets: technical, information, organization, economical, software, and human (users, administrators, and management) ones. Their complexity comes not only from their technical and organizational internal structure, which is built upon diverse hardware and software resources, but also from the complexity of information processes (data processing, monitoring, management, etc.) that must be executed in their specific environment.

A system approach to the evaluation of the efficiency of complex systems at all phases of their life cycle is the contemporary answer to new challenges in the use of such systems. The dependability approach in theory and engineering of complex systems (not only computer systems and networks) is based on a multidisciplinary approach to system theory, technology, and maintenance of the systems working in real, very often unfriendly, environment. Usability and dependability concentrates on efficient realization of tasks, services, and jobs by a system considered as a unity of all technical, information, and human assets, in contrast to “classical” reliability,

which is more restrained to analysis of technical resources. This difference has caused a natural evolution in the topical range of subsequent RelStat conferences, with an increased focus on dependability approaches over the classical reliability approach. Efficiency of different modes of transport; transport for smart city; reliability, safety, and risk management for transport applications; statistics, modeling, and multicriteria decision making in transportation and logistics; smart solutions, telematics, intelligent transport systems, innovative economics and education, and training in engineering are the main topics of RelStat.

The program committee of the 20th International RelStat Conference, the organizers, and the editors of these proceedings would like to acknowledge participation of all reviewers who helped to refine contents of this volume and evaluated conference submissions. Our thanks go to all members of program committee:

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Thanking all the authors who have chosen RelStat as the publication platform for their research, we would like to express our hope that their papers will help in further developments in design and analysis of complex systems, offering a valuable and timely resource for scientists, researchers, practitioners, and students who work in these areas.

Igor Kabashkin
Irina Yatskiv (Jackiva)
Olegas Prentkovskis

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Session 7. Education and Training in Engineering



DIGILOG Project: Digitally Supported and Virtual Study Practices for Modern Logistic Systems

Igor Kabashkin¹(✉), Aleksandrs Grakovskis¹, Wladimir Segercrantz², Enno Lend², Oliver Kallas², Nina Karasmaa³, Ville Turunen³, Teppo Sotanvalta³, Tarjaleena Tuukkanen³, Jaana Kullaslahti³, Birgitta Thorslund⁴, and Niklas Olson⁴

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Abstract. Digitalization of Transport and Logistics (T&L) is one of the key pillars of the European Digital Single Market strategy. Creation of the Single European Transport Area, from one hand, and development of Common European Education Area, from another hand, are the basis for DIGILOG (Digitally supported and virtual study practices for modern logistic systems) project supported by Erasmus+ programme. The DIGILOG project aims to foster interchange and cooperation between education and training systems within the frame of digitalisation of T&L under new strategy of European Union - Single European Transport Area. The partners of project are TTK University of Applied Sciences (Estonia), Häme University of Applied Sciences (Finland), Transport and Telecommunication Institute (Latvia), The Swedish National Road and Transport Research Institute (Sweden).

The main intellectual outputs of the project are described in the paper: (1) Virtual and open cross-study curricula for digital environment of transport and logistics systems based on Carpe Diem learning design process; (2) E-learning game-based technology for training and education of transport and logistics specialists; (3) Video exercises for study of train traffic and safety management issues using simulation tools.

Main tasks, main area of activities and the main priorities of the planned study module are described in the paper.

Keywords: DIGILOG project · Digitalization · Transport and logistics · E-learning

1 Introduction

Building a comprehensive and effective learning environment is an important condition for implementing teaching and learning for the digital age. Digitalization of Transport and Logistics (T&L) is one of the key pillars of the European Digital Single Market strategy. Creation of the Single European Transport Area, from one hand, and development of Common European Education Area, from another hand, are the basis for DIGILOG (Digitally supported and virtual study practices for modern logistic systems) project supported by Erasmus+ programme. Digitalization, international approach and networking for cross-institutional study are the main priorities for development of new study modules within the frame of DIGILOG project. Enhancing e-learning and cross-curricular opportunities in universities and vocation education institutions is a way to harmonize the content of over countries, and to prepare students and trainees for working in digital and multinational environment.

The partners of project are TTK University of Applied Sciences (Estonia), Häme University of Applied Sciences (Finland), Transport and Telecommunication Institute (Latvia), The Swedish National Road and Transport Research Institute (Sweden).

In the paper the main intellectual outputs of the project are discussed:

- Virtual and open cross-study curricula for digital environment of transport and logistics systems based on Carpe Diem learning design process;
- E-learning game-based technology for training and education of transport and logistics specialists;
- Video exercises for study of train traffic and safety management issues using simulation tools.

The content of this paper is organized as follows. In Sect. 2 some important publications are reviewed. In Sect. 3 the Carpe Diem approach for T&L courses design is described. The game-based technology for training and education of transport and logistics specialists (TRELOGIC) is presented in Sect. 4. In Sect. 5 examples of video exercises for study of train traffic and safety management issues using simulation tools are described. In Sect. 6 the conclusions are presented.

2 Related Works

The digital transformation of all sectors of the economy strengthens attention to new approaches in education, focused both on the use of new educational technologies and on solving the problems of improving its quality in the context of new digital tools actively introduced in all sectors of digital economy. The new challenges posed by the pandemic are drawing even more attention to the need to create new tools for online distance learning.

Modern approaches to university education are reflected in the works of many authors, summarized in handbooks and methodological publications [1].

Authors are actively developing new online learning models [2], offering new pedagogical techniques oriented at the new digital generation of students and the new needs of the digital society [3].

Leading educators offer new tools, teaching methods and approaches for using modern multimedia opportunities to solve the problems of academic and professional education [4].

Searching for a new digital university paradigm, a detailed overview of well-known approaches to distance education, blended learning, online learning, credentialing and future learning technology infrastructures is presented in [5].

The modern learning ecosystem oriented on holistic, lifelong, personalized learning paradigm represents a contrast to the Industrial Age model of time-focused, one-size-fits-all learning [6].

This article explores similar issues in relation to the narrow field of transport and logistics professional education.

3 Virtual and Open Cross-Study Curricula for Digital Environment of Transport and Logistics Systems Based on Carpe Diem Learning Design Process

The modern transport and logistics companies active use information technologies, new digital financial instruments, big data, business analytics, smart technologies, modelling, simulations and others. Digital transformation is one of the key success factors of competition for modern logistics companies. Intensive digitalization of the logistics business should be accompanied by the corresponding development of digital competencies of specialists during their training. The challenge is to adapt the existing learning environment to the new digital business ecosystem [7]. The processes observed today at the beginning of the digital revolution resemble similar processes at the beginning of the industrial revolution [8]. In both cases, there is a faster growth of technologies in comparison with the provision of content and the required level of education required for the sustainable development of these technologies (Fig. 1).

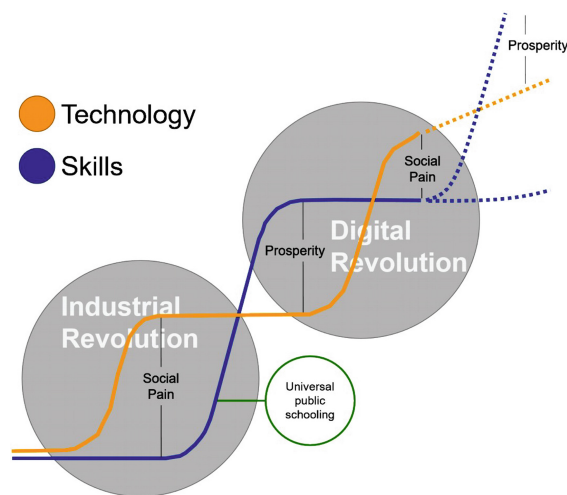


Fig. 1. Race between technology and education [8].

One task of the DIGILOG project is to develop a virtual and open cross-institutional study modules focusing on the digital environment of T&L systems for use in professional higher education that focuses on transportation management and logistics. The idea is to develop modules which will provide future experts with the knowledge and skills required by a working environment which is becoming more multinational in character and is seeing the ever increasing use of digital decision support systems and simulation tools. As transport networks in the EU, including the Baltic Sea region, are continually being harmonized and integrated, the content of the module will reflect best practices and developments both regionally and more widely.

Priorities of the planned study module are the following:

- **Digitalization.** The rapid development of digitally supported working practices has had a significant impact on performance in all sectors of the transport system in recent years, and this trend will continue in the future. The education of future graduates in transport and logistics must prepare them for work in a new digitally supported multinational working environment.
- **International approach.** Connecting Europe is the main objective of the development of core transnational transport networks. Study programs have to meet this challenge – to educate and train experts prepared to work in multinational enterprises and teams.
- **Networking and cross-institutional study.** To meet the abovementioned challenges and provide students with the knowledge and experience necessary to work on an international level, professional higher education and training providers are striving to develop innovative e-learning methods and learning environments. A virtual study environment will prepare graduates for work in other countries on multinational teams. Participation in courses at partner institutions will broaden the skills of these future experts. Module development will be based on the Carpe Diem design methodology, which can be implemented virtually. Some study module subjects require face-to-face meetings in the classroom or lab. In this case, a student can apply for support through available student mobility programs to be included in the module were selected by project partners.

Online study modules designed using Carpe Diem, a team-based, student-centered e-learning design methodology [9]. We applied the original six-step process to be implemented online webinars, face-to-face workshops and team working between the meetings. All the partners were designing their own online study modules.

The design teams first created a blueprint, which provides a general outline of the course, setting out goals and objectives, learning outcomes, and the manner of assessment. The second step was face-to-face workshop. All the teams made a visual storyboard (Fig. 2), which represent the “student journey”, showing how learning and teaching processes are actually carried out. In the third step design teams built their prototypes in the online environment, developing learning activities and digital materials. The theme of the second face-to-face workshop was reality checking: peer review and action plan. The main idea was to get constructive peer feedback from colleagues and refine the design before piloting the online study modules with the students.

The quality criteria for DIGILOG online implementations have been selected and agreed. The quality assurance of the e-learning activities is the final step of the virtual

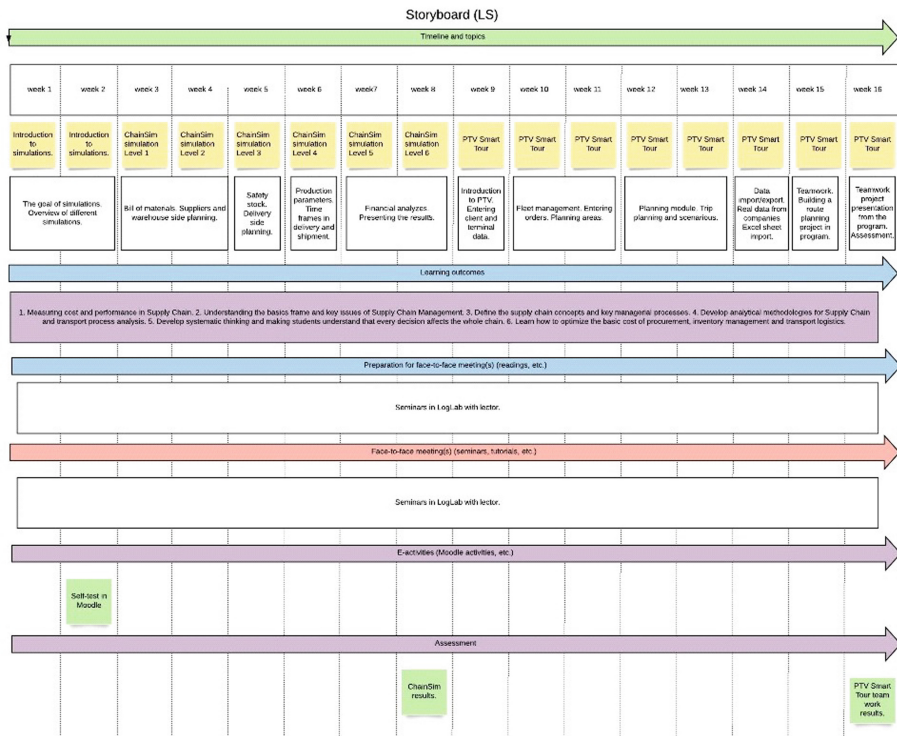


Fig. 2. An example of visual storyboard.

institutional cross-study process. 10 criteria have been used for peer reviewing and during designing online study modules. This makes it possible to use criteria when gathering the student feedback during the pilots.

Following study subjects were selected by partners.

- Supply chain management simulation (TTK, 3 credits). Simulations tools are nowadays widely used as decision supporting systems for improving efficiency of transportation and logistics management and warehousing. Advantages and disadvantages of use those systems are widely studied. The paper [10] has systematically analyzed existing research and illustrated use of them on the transportation and logistics cases in the Baltic Sea region. ChainSim simulation [11] helps to understand principles, theories and practices of material requirements planning and supply chain management, critically evaluate and link those to various aspects of performance (financial measures as well as physical inventory aspects). Simulation can be paused, whereas real life cannot. Pausing allows more time for students to assess the situation. ChainSim is an online-based educational simulation in which the student will manage the supply chain of a small manufacturing company. It can be played individually or in teams. TTK has outlined the study subject for curriculum of experts of logistic and transport management.

- Effective warehouse design and process simulation (TTK, 3 credits). The general purpose of the subject is to provide theoretical knowhow, practical exercises and simulations about warehouse layout, managing warehouses and warehouse equipment. After passing the subject each student know how to set up different types of warehouses, knows how to run them and how to evaluate the performance and activities. Warehouse simulation software CLASS [12] is simulation model allows users to design, test and redesign complex warehousing solutions in a virtual computer environment by changing many different parameters and measuring their impact. It is a great opportunity for the Students to test their ideas of warehouse layout design and operational management. Use of the model was tested on international online piloting event of the DIGILOG project.
- Professional Competence of Transport Managers (TTI, 3 credits). This subject oriented on requirements of the European Regulation No 1071/2009 which established common rules for road transport enterprises. The presence of a certificate of professional competence indicates that its owner has the knowledge necessary to manage transport operations in any European country.
- Game based multi-criteria decision making for T&L competence development (TTI, 3 credits). This subject is described in the next section of this article.
- Passenger traffic railway markets are opening to competition, case of Finland (HAMK, 3 credits). Opening the national railway market, that has until now been based on a state monopoly, to competition is a challenging task for all European countries. In this subject preparation for competition through elements involved in the opening up of the Finnish railways to competition is examined and experiences of other EU-countries in the introduction of competition to railways and tendering are discussed.
- Train driving exercise for train dispatchers (VTI, 4 credits). This subject is described in the Sect. 5 of this article.

4 E-Learning Game-Based Technology for Training and Education of Transport and Logistics Specialists

TRELOGIC is software package designed for the training process of new and already working specialists with the aim increasing their skills in the T&L area at various levels in the different types of educational establishments (training centers, colleges, universities). The simulation tool might be used as a tool for distant learning using the opportunities of e-learning that allows considerably increasing the contingent of trainees from other EU countries.

There are seven typical steps in the process of multi-criteria decision making:

- to define alternatives for transportation;
- to define criteria of efficiency;
- to define relative importance of each criteria;
- to define a scale for measuring the levels of each criterion;
- to determine the impact of each criterion for each alternative action for the established scale;

- to establish the combined impact of the different criteria for each alternative;
- to define the best alternative.

The methodological approach used of the game-based training method TRELOGIC involves a 6-step learning process:

1. Game based case study. The formulation of a practical problem, to find the source of data for its solution.
2. Formulation of alternative routes for the delivery of goods within the frame of case study. Search of the necessary data.
3. Formulation of criteria for choosing the best route.
4. Study opportunities of the Logistics Performance Index as an interactive benchmarking tool created to help professionals in logistics identify the challenges and opportunities they face in their performance on trade logistics.
5. Study the Analytic Hierarchy Process (AHP) as method for multi-criteria decision making.
6. The practical use of the AHP method to solve the problem formulated in the case study on the base of developed software tool. Individual and group expert application of software.

The practical problem that students are offered to solve is formulated as follows. A container block train from China should arrive in Sweden (Container Terminal Frihamnen of the Stockholm port) for further distribution. Terminal-logistic centre of the Moscow region is the first transit point of the route. Then there are three alternatives to achieve Stockholm through Riga (Latvia), Paldiski (Estonia) or Rauma (Finland).

There are three alternative routes (Fig. 3):

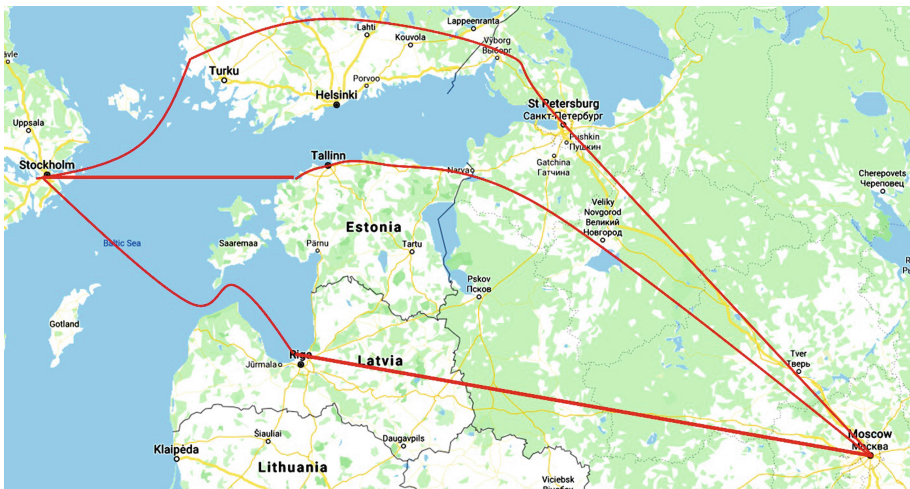


Fig. 3. Alternative routes of case study.

- Moscow – port Rauma (Finland) – Stockholm;
- Moscow – port Paldiski (Estonia) – Stockholm;
- Moscow – port Riga (Latvia) – Stockholm.

Taxonomy of key performance indicators (KPI) for this model can be described by set of parameters shown at the Fig. 4 with suggested quantitative metrics for both - quantitative and qualitative KPIs [13].

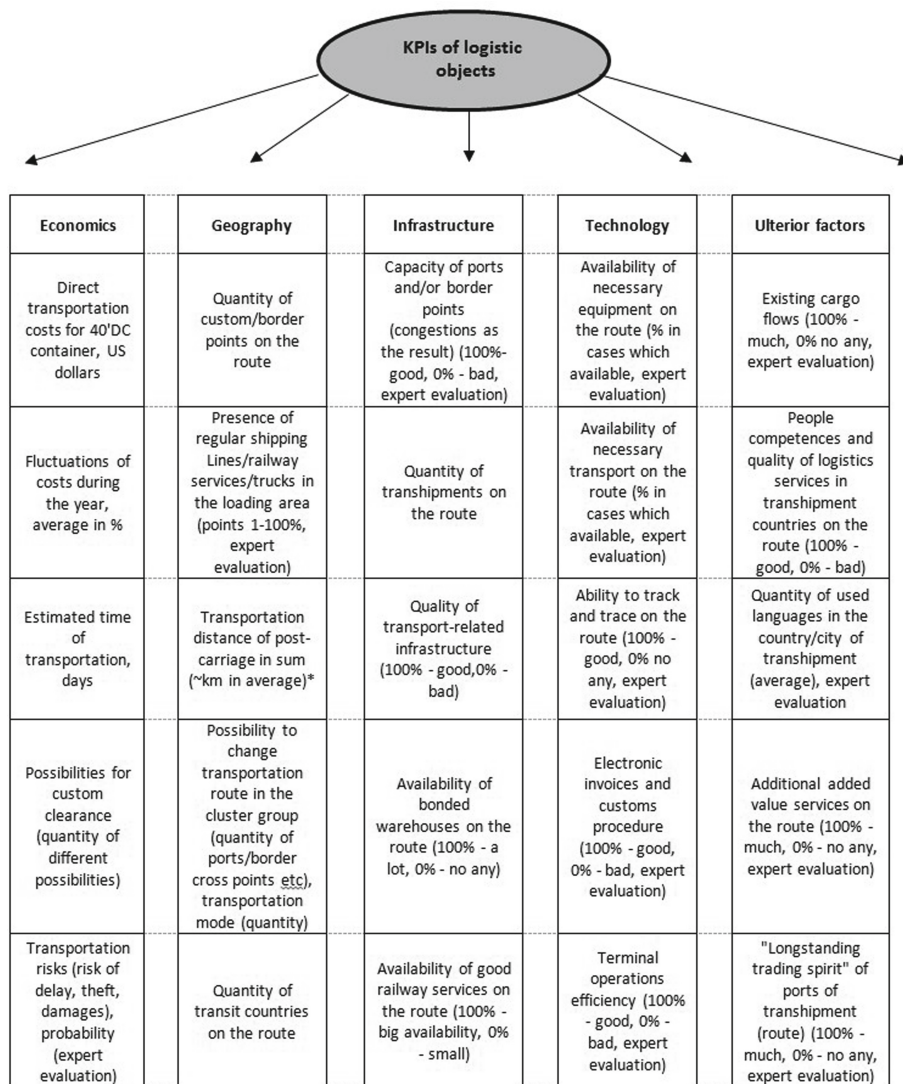


Fig. 4. Taxonomy of key performance indicators for selection of best alternative transit route.

Students should analyse these factors in order to evaluate which of the factors for the case under consideration will be more influence in pairwise comparison. Study opportunities of the Logistics Performance Index (LPI) as an interactive benchmarking tool created to help professionals in logistics identify the challenges and opportunities they face in their performance on trade logistics [14].

The analytic hierarchy process (AHP) is a structured technique for organizing and analysing complex decisions, based on mathematics and psychology [15]. It represents the most accurate approach for quantifying the weights of criteria. Individual experts' experiences are utilized to estimate the relative magnitudes of factors through pair-wise comparisons. Each of the respondents has to compare the relative importance between the two items under special designed questionnaire.

AHP is a multi-criteria model that provides a methodology for comparing alternatives by structuring criteria into a hierarchy, providing for pair-wise comparisons of criteria at the lowest level of the hierarchy to be entered by the user, and synthesizing the results into a single numerical value [16].

The TRELOGIC is AHP method based software tool for practical use to solve the problem formulated in the case study. The learning process takes place in two stages:

- Individual expert application of software. Using the software TRELOGIC, each student compares each alternative route by all criteria and gives them an expert assessment.
- Group expert application of software (face-to-face or webinar).

At the second stage, the following procedures are performed:

1. Discussion with other participants of the game individual expert assessments and the transportation routes recommended by the TRELOGIC tool for each expert.
2. Discussion in the group the differences in expert assessments and the reasons for their differences.
3. Selection of the best transportation route using the advanced AHP algorithm taking into account the decisions of all experts participating in the game using the TRELOGIC tool.
4. Forming the result of a group peer review.
5. Discussion with other participants of the game result of group expert decision and the transportation route recommended by the TRELOGIC tool for group expert decision.
6. Discussion the extent and reasons for the discrepancy between the results of the group assessment of experts and their individual assessments.

The described approach allows in the learning process to simulate real decision-making processes in transport and logistics companies based on real data that underlie expert decisions in this area.

5 Video Exercises for Study of Train Traffic and Safety Management Issues Using Simulation Tools

As rail seeks to maintain its environmental lead in transportation, in the framework of the study module, VTI has developed video exercises. The exercises will help students understand how train traffic and safety management issues are tackled in a realistic operational environment using simulation tools. The exercises will also support subjects developed by the other partners by building bridges with the other objectives of the DIGILOG project.

The main learning outcomes of video exercises:

1. By completing this exercise, the students will get an increased understanding of the train driver's reality based on some different scenarios.
2. The students will achieve knowledge about forms to fill in together with the train driver at various situations, such as shunting and controlling the turn-outs.
3. The students will also improve their skills in communication with the train driver.
4. For this exercise, a total of 8 videos were recorded in a simulator environment with a train driver who "think out loud" to facilitate the understanding of his actions.
5. The films were recorded in a train simulator developed by VTI (the Swedish Road and Transport Research Institute) and used by several actors who conduct rail related education or rail traffic.

The simulator emulates, in some cases, the Regina train, which is one of Sweden's most predominant passenger trains launched in the late 1990s, and in others, trains with TRAXX locomotives which is a popular locomotive found at several large freight operators. Use of the video exercises in the study process were tested during the online piloting events.

6 Conclusions

In the paper the aim and main activities of DIGILOG (Digitally supported and virtual study practices for modern logistic systems) project are discussed. Digitalization, international approach and networking for cross-institutional study are the main priorities for development of new study modules within the frame of DIGILOG project. Enhancing e-learning and cross-curricular opportunities in universities and vocation education institutions is a way to harmonize the content of over countries, and to prepare students and trainees for working in digital and multinational environment. The DIGILOG project aims to foster interchange and cooperation between education and training systems within the frame of digitalisation of T&L under new strategy of European Union - Single European Transport Area.

The main intellectual outputs of the project are described in the paper:

- Virtual and open cross-study curricula for digital environment of transport and logistics systems based on Carpe Diem learning design process;
- E-learning game-based technology for training and education of transport and logistics specialists;

- Video exercises for study of train traffic and safety management issues using simulation tools.

References

1. Fry, H., Ketteridge, S., Marshall, S. (eds.): Handbook for Teaching and Learning in Higher Education: Enhancing Academic Practice, 3rd edn. Taylor & Francis, New York (2009)
2. Picciano, A.G.: Theories and frameworks for online education: seeking an integrated model. *Online Learn.* **21**(3), 166–190 (2017)
3. Bates, A.: Teaching in a Digital Age. Guidelines for designing teaching and learning (2016)
4. Scholz, T.: Learning Through Digital Media: Experiments in Technology and Pedagogy. Scholz. The Institute for Distributed Creativity (2013)
5. Siemens, G., Gašević, D., Dawson, S.: Preparing for the digital university: a review of the history and current state of distance, blended, and online learning. Athabasca University, University of Edinburgh, University of Texas Arlington, University of South Australia (2015)
6. Walcutt, J.J., Schatz, S. (eds.): Modernizing Learning: Building the Future Learning Ecosystem. Government Publishing Office, Washington, DC. License: Creative Commons Attribution CC BY 4.0 IGO (2019)
7. Lend, E., Segercrantz, W.: Modernizing of the rail transport curriculum and study process. In: TRANSBALTICA XI: Transportation Science and Technology 2019: Proceedings of the International Conference TRANSBALTICA 2019, 2–3 May, Vilnius, Lithuania (2020)
8. Ehlers, U.-D.: Future Skills – Future Learning. Future Higher Education, Karlsruhe (2020)
9. Salmon, G.: E-tivities: The Key to Active Online Learning, 2nd edn. Routledge, London (2013)
10. Lättilä, L.: Improving Transportation and Warehousing Efficiency with Simulation based Decision Support Systems. *Acta Universitatis Lappeenrantaensis* (2012)
11. ChainSim: Distance learning simulation for educational institutions. <http://www.chainsim.com>. Accessed 10 July 2020
12. CLASS – software for warehouse design and simulation. <https://cirruslogistics.com/products/class/>. Accessed 10 July 2020
13. Kabashkin, I., Luchina, J.: Development of the model of decision support for alternative choice in the transportation transit system. *Transp. Telecommun.* **16**(1), 61–72 (2015)
14. Logistics Performance Index. The World Bank. <https://lpi.worldbank.org/about>. Accessed 10 July 2020
15. Thomas, L.: Transport planning with multiple criteria: The analytic hierarchy process applications and progress review. *J. Adv. Transp.* **29**(1), 81–126 (1995)
16. Brunelli, M.: Introduction to the Analytic Hierarchy Process (2015)

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