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STRATEGY FOR RESEARCH DEVELOPMENT IN THE UNIVERSITY. CASE STUDY OF TRANSPORT AND TELECOMMUNICATION INSTITUTE

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The paper represents Transport and Telecommunication Institute research programme for period of time 2016-2020. Developed research programme should insure sustainable development of TTI as research institution and should raise research capabilities of the organization by planning and further implementation of the collaboration activities with national and international partners. The analyses of main technology development in the area of TTI research activities, framework for development of research programme, the structure of key TTI strategies and main directions of TTI research activities are described in the paper sides.

Keywords: Research strategy; University; research activities; outputs

1. Introduction

One of the strategic objectives of Latvian National Development Plan 2020 (Pkc.gov.lv, 2015) is to have advanced research and innovation and higher education. The most progressive of world universities aspires to be 'third generation' (3GU), but it requires a new approach to strategy program development. Objectives of high education establishment (HEE) in the 3GU era are in contributing high quality teaching and research to the higher education system of the world, and in exploitation of know-how (Wissema, 2009).

Research is one of the key activities of the modern university. Leading universities in the world are actively working on their research strategies (Oxford University, 2016; University of Portsmouth, 2015; University of Lincoln, 2011; University of Manchester, 2011; Newcastle University, 2016; University of York, 2015; University of Glasgow, 2015; Cardiff Metropolitan University, 2014; University of Sydney, 2016; Monash University, 2015; University of Toronto, 2012 and others).

This paper represents Transport and Telecommunication Institute (TTI) main directions of Research Programme for period of time 2016-2020. The scope of the Research Program is the enabling of stimulating and strengthening the research capacity of TTI and the raising of the profile of the research staff and their institution, by providing knowledge in the field of Information Communication Technologies in Transport and Logistics (Yatskiv *et al*., 2015).

In part 2 the external factors contributing to the need to develop a Research Strategy and framework for development of research programme of TTI were discussed. The contents of three pillars, which will integrate research capabilities and programme strengths of TTI and enhance capacity to respond to the academic and societal challenges, are presented in part 3. Developed Research Programme should insure sustainable development of TTI as research institution and should raise research capabilities of the organization by planning and further implementation of the collaboration activities with national and international partners.

2. TTI Research Strategy

2.1. Analysis of the external factors affecting at the development of a Research Strategy

The strongest external factor contributing to the need to develop TTI Research Strategy was the fiercely increasing international competition, especially in the natural and technical sciences. Such international competition for highly qualified researchers at all levels, from doctoral students to professors, as well as national and European competition for project funding, was seen to force institution

to look for areas in which their competitive advantage is or could be strongest and where they already provide or could hope to achieve critical mass.

The need to focus on areas where critical mass and internationally competitive research strengths come together was seen to be a necessary condition for competitiveness. Institutional leadership and some individual researchers also expressed the need to develop a more strategic approach and institutional support for dialogue with external private business partners, not only as employers of their graduates but also as potential supporters of their research projects and the general research cause. In Latvia this need was associated with the question of balancing activities in the new market economy process.

The first part of TTI Research Strategy includes analyses of main technology development in the area of TTI research activities. During the process of the research programme preparation the top strategic technology trends released by the leading analytical centres was analysed (Gartner Research Methodologies, 2015; Spender, 2015; Top 10 Strategic Technology Trends for 2015, 2015; Sareen, 2015; TOP 10 Technology Leaders, Influencers and Visionaries 2015; Increasingly, Robots of All Sizes Are Human Workmates, MIT Technology Review, 2014; Augmented Reality gets to Work, MIT Technology Review, 2014; Guide to Research and Innovation Strategies for Smart Specialisation, 2012; and others).

The main trends in technological development can be good illustrated with Gartner hype Cycle (Gartner, 2014). The Hype Cycle is a branded graphical presentation developed and used by IT research and advisory firm Gartner for representing the maturity, adoption and social application of specific technologies.

Each Hype Cycle (Fig. 1) drills down into the five key phases of a technology's life cycle (Gartner, 2014):

- Technology Trigger-A potential technology breakthrough kicks things off. Early proof-of-concept stories and media interest trigger significant publicity. Often no usable products exist and commercial viability is unproven.
- Peak of Inflated Expectations-Early publicity produces a number of success stories—often accompanied by scores of failures. Some companies take action; many do not.
- Trough of Disillusionment-Interest wanes as experiments and implementations fail to deliver. Producers of the technology shake out or fail. Investments continue only if the surviving providers improve their products to the satisfaction of early adopters.
- Slope of Enlightenment-More instances of how the technology can benefit the enterprise start to crystallize and become more widely understood. Second- and third-generation products appear from technology providers. More enterprises fund pilots; conservative companies remain cautious.
- Plateau of Productivity-Mainstream adoption starts to take off. Criteria for assessing provider viability are more clearly defined. The technology's broad market applicability and relevance are clearly paying off.

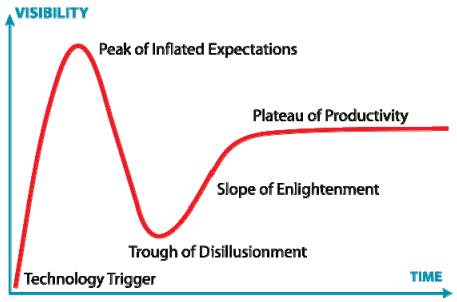

Figure 1. Hype cycle (Gartner, 2014)

The "Hype Cycle" by the technology analysts and consulting firm Gartner illustrates what technologies are currently located on the peak of expectations. Often is then clear that the obstacles to the development or implementation are higher than thought. But after the „Trough of disillusionment" was passed and the applicability of the technology grows, so do the expectations again.

The Hype Cycle for Emerging Technologies report (Gartner, 2015) is the longest-running annual Hype Cycle, providing a cross-industry perspective on the technologies and trends that business strategists, chief innovation officers, R&D leaders, entrepreneurs, global market developers and emerging technology teams should consider in developing emerging-technology portfolios.

At the Fig. 2 the Hype Cycle has shown with TTI fields of research interest.

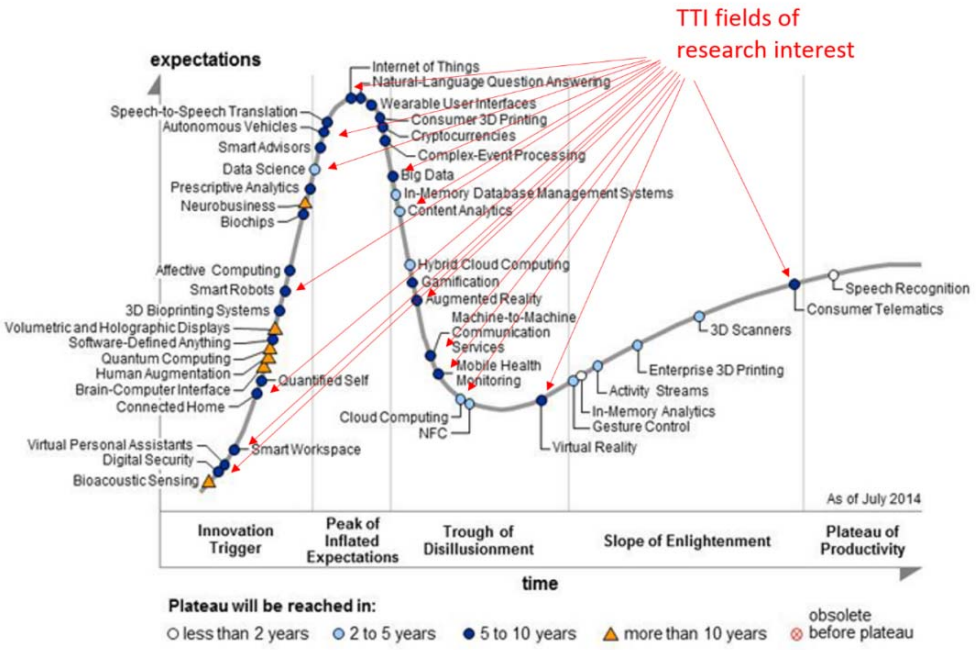

Figure 2. Hype Cycle with TTI fields of research interest

2.2. Research Strategy of Transport and Telecommunication Institute

There is a need to sustain, improve, foster and reward research quality. Various methods are chosen to foster quality culture with respect to a university's research performance and to mobilise its potential among its researchers. Processes for identifying and fostering excellence and prioritising among the multiplicity of projects, were seen to help nurture a culture of excellence by focusing on identified strengths. Fostering excellence constituted the most important element of a research strategy. While there were differing opinions about the right methods and mechanisms to achieve the best results, the idea of defining such internal processes of identification and rewarding of excellence seemed to find overall consensus.

It is needed to foster synergies between different research directions, breaking down traditional borders between faculties and disciplines, as well as more rarely and to a limited extent, between institutions.

Thus, one of the reasons for developing strategies was seen to consist of a more targeted approach of creating opportunities for cross-fertilisation among research departments and units.

Another internal factor which justified the development of an institutional research strategy concerned the efficient use of resources, especially for research infrastructure. Given the rising costs of scientific infrastructure, the university leadership and their staff expressed the need to prioritise acquisitions. Such cost efficiency was associated with the creation of technology platforms where equipment could be shared among a wider range of users.

Important expression of an institutional research strategy would be the plan for hiring professors or priorities for recruitment. At the level of concrete research activities, the identification of the most promising research areas is obviously up to individual researchers so that the future of an institution can depend very significantly on its intellectual capacities and foresight. Thus the recruitment of the most promising professors, who could determine the research future of the institution, will be the most decisive strategic choices of an institution.

The institutional strategy is also intended to help to confront the tougher competition for science and engineering students and doctoral candidates. Making science and engineering more attractive to school leavers and making the institution the chosen site for graduate education may be as two urgent issues to address.

Strategic actions are needed to help internal communication and cooperation and so create stronger and more visible research areas. While it is acknowledged that researchers already tend to cooperate actively with outside partners, university leaders at institutional and faculty level felt that their institution's position, in terms of national and international competition, would be enhanced if internal communication could bring together more

researchers from related fields. Enabling interdisciplinary cooperation internally and forging larger clusters of excellence would help the institution make a bigger impact in the competitive world.

Framework for development of research programme of Transport and Telecommunication Institute shown at the Fig. 3.

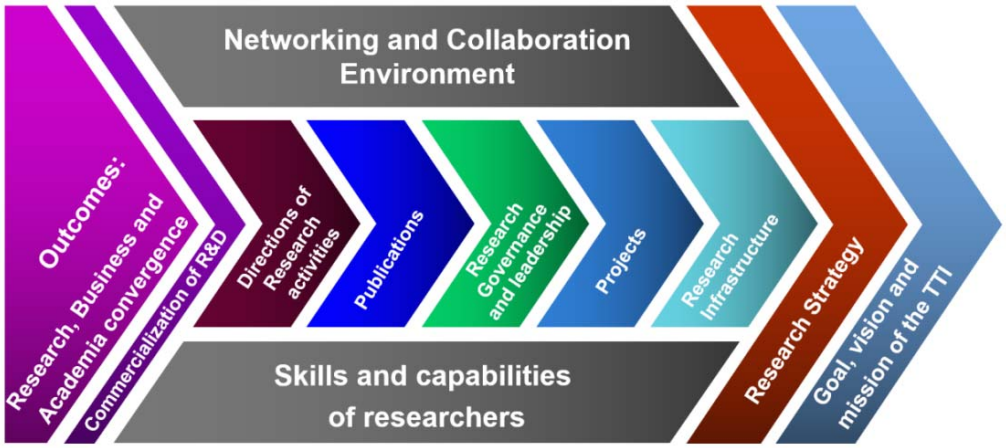

Figure 3. Framework for development of research programme of TTI

The TTI will undoubtedly face some tough challenges in an ever more competitive higher education environment. Although there will be pressures on TTI teaching and research income streams, there are also many opportunities for university to build on its strengths and diversify its activities into new areas. The TTI have the capability to contribute more to university community and to the economy through research and business engagement as well as to grow TTI international profile. All of these activities will help ensure that TTI continue to provide the highest quality education and learning experience for its students.

Ambitions of TTI will be delivered largely through three key strategies: Research Strategy, Knowledge Services Strategy and Education Strategy. Each has its own aims, targets and performance indicators (outputs).

The Research Strategy is the core element of this set of strategies (Fig. 4.). The Knowledge Services Strategy is closely associated with the Research Strategy and is focused on the commercialization of research activities and there is greater emphasis on research with commercial application and societal impact. The Education Strategy is based on the Research Strategy and is focused on the development of the academic component of the university and, at the same time, it serves as a basis for the development of human resources for research activities.

Figure 4. The structure of key TTI strategies

The main directions of TTI Research Strategy Implementation are grouped into 6 strategic initiatives and the roadmaps:

1. Improving the positions in research in the number of TTI fields of research interest.
2. Integration of TTI into the global research and educational system through leading research, information and learning technologies.
3. Creating a novel human resource system and forming a highly professional research staff.
4. Development of strategic communications and achieving high recognition of TTI nationally and globally.
5. Development of the innovation ecosystem to support the growth potential of TTI in knowledge and technology transfer.
6. Transformation and development of the TTI management system based on the principles of a research and business-oriented university.

3. Main Directions of TTI Research Activities

Starting from its current base, the University cannot expect to be able to deliver international-quality research across its entire portfolio. The University does, however, already have demonstrable research excellence (at national and international level) in a number of areas. There is also an opportunity to grow excellence in a small number of other areas where demonstrable excellence does not yet exist, but where there is evidence of clear potential, based on an assessment of existing and emerging capacity and capability, and international, national and local needs and opportunity. The University has already determined those areas of research that it wishes to grow, and for which it wishes to establish an international reputation.

The following three overarching themes will integrate research capabilities and programme strengths of TTI to enhance our capacity to respond to the academic and societal challenges (Fig. 5):

- Information and Communication Technologies (ICT) or Telematics.
- Smart Solutions in Transport and Logistics.
- Digital Society and Economy.

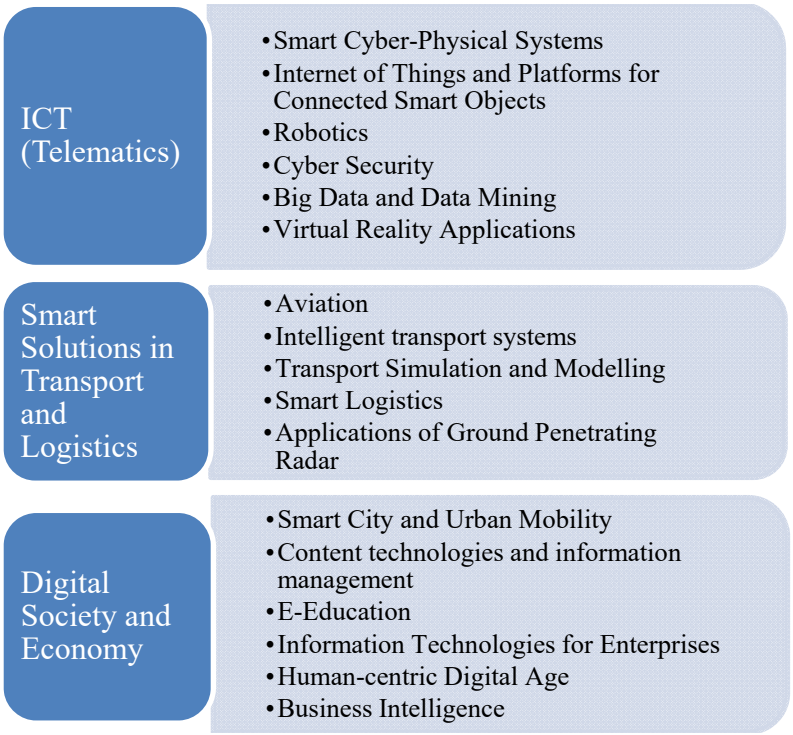

Figure 5. Main directions of TTI research activities

3.1. Pillar 1. Information and Communication Technologies (ICT) or Telematics

The main direction of research activities in the first pillar are:

Smart Cyber-Physical Systems

Cyber-Physical Systems (CPS) refer to next generation embedded ICT systems that are interconnected and collaborating including through the Internet of things, and providing people and businesses with a wide range of innovative applications and services. Research will cover the following themes:

- Modelling and integration frameworks: modelling techniques and comprehensive integrated tool chains for clearly defined use cases.
- Smart, cooperative and open CPS: Methods for engineering Cyber-physical Systems that are able to respond in real-time to dynamic and complex situations while preserving control, system safety, privacy, reliability, energy efficiency and dependability features, and addressing security and privacy "by design" across all levels.

Internet of Things and Platforms for Connected Smart Objects

The evolution of the Internet of Things embedded in Smart Environments and Platforms forming a web of "everything" has been identified as one of the next big concepts to support societal changes and economic growth. The biggest challenge will be to overcome the fragmentation of vertically-oriented closed systems, architectures and application areas and move towards open systems and platforms that support multiple applications.

This topic will be developed across several ICT challenges (smart systems integration, cyber-physical systems, smart networks, big data) and brings together different generic ICT technologies (electronics, wireless networks, low-power computing, adaptive and cognitive systems) across multiple application domains (e.g. energy, intelligent transport systems, environmental monitoring and logistics).

Robotics

Smart automation and robotics are simply vital for maintaining manufacturing and associated services. Robots are increasingly endowed with learning and adaptive capabilities that will have a broad impact on all future ICT systems in a wide range of products and services. Robotics is very broad, both in terms of technologies and disciplines it involves. Research will cover multi-disciplinary and innovation activities like technology transfer via use-cases and industry-academia cross fertilisation mechanisms. Pre-Commercial Procurement will further enable prototype development and stimulate deployment of industrial and service robotics. It will be essential for the deployment of robots to establish systems development processes (from requirement analysis to testing and validation) and to develop techniques and technologies for system design, engineering, architecture, integration, system of systems, modelling and knowledge engineering which are applicable across market domains.

Cybersecurity

The fast evolution of ICT technology together with the uses that are made of it are exponentially introducing new threats, vulnerabilities and risks. There is a growing consensus that the state-of-the-art approach to secure ICT is becoming obsolete. The challenge is to find solutions guaranteeing end-to-end security that withstands progress for the lifespan of the application it supports, regardless of improvements in attacker hardware or computational capabilities. The main research actions will cover the following themes:

- Security-by-design for end-to-end security. Security-by-design paradigms have to be developed and tested, to providing end-to-end security, across all hardware and software layers of an ICT system and application and business services.
- Cryptography. Cryptographic tools for securely binding applications to software, firmware and hardware environments, with or without the possibility to adapt the cryptographic primitives which are used.

Big Data

The activities under this topic contribute to the Big Data challenge by addressing the fundamental research problems related to the scalability and responsiveness of analytics capabilities (such as data mining and visualization). Special focus is on industry-validated, user-defined challenges like predictions, and rigorous processes for monitoring and measurement. Research will cover the following themes:

- Development of novel data structures, algorithms, methodology, software architectures and optimisation methodologies for carrying out data analytics, data quality assessment and improvement, prediction and visualization tasks at extremely large scale and with diverse structured and unstructured data (transport is priority area).
- Explicit experimental protocols and analyses of statistical power for the description of usability validation experiments for the systems proposed.

Virtual Reality Applications

Virtual Reality, which can be referred to as immersive multimedia or computer-simulated life, replicates an environment that simulates physical presence in places in the real world or imagined worlds and lets the user interact in that world. Virtual reality artificially creates sensory experiences, which can include sight, hearing, touch, smell, and taste. Research will cover the following themes:

- Development of 3D virtual reality models for urban regeneration and planning and transport projects.
- Development of training applications of 3D virtual reality to allow professionals to conduct training in a virtual environment where they can improve upon their skills without the consequence of failing the operation.

3.2. Pillar 2. Smart Solutions in Transport and Logistics

The main direction of research activities in the second pillar are:

Aviation

Aviation is vital for our society and economy. It provides mobility to citizens and freight, amongst the regions of Europe and beyond. Research will cover the following themes:

- Condition-based health management, replacing scheduled inspections and thus decreasing maintenance costs and increasing safety and aircraft availability through accelerating the integration of innovative and existing sensor technologies, advancing data analysis methods and promoting standards for health sensing across dissimilar systems and structures, developing and validating multiple sensor technologies on systems and structures, and addressing relevant regulatory barriers.
- Autonomous, intelligent and evolving systems (e.g. Remotely Piloted and Unmanned Aerial Vehicle Systems for monitoring of critical infrastructure).
- More robust, cost-efficient solutions for the whole life-cycle, based on novel methodologies and technologies towards improving the safety of the air transport system.

Intelligent Transport Systems

Intelligent Transport Systems (ITS) provide the key to achieving the vision of seamless transport both in passenger and in goods transport markets on the base of ICT use. Research will cover the following themes:

- Multi-modal, cross-border traffic management, information and planning systems to serve passengers and/or other users.
- Analysis of the range of services to be made accessible under each interface, by taking into account differences in preferences and behaviour between various user groups.
- Identification of the success and failure factors (technological, economic and socio-cultural) of the new concept(s), such as mobility as a service, with particular attention to the users' acceptance factors.
- Identification of the necessary framework (regulatory, technological, financial, etc.) to support the implementation of new services, including the needed private-public collaboration requirements.
- Identification and development of viable business models suitable for future market take-up.
- Identification and validation of measures apt to induce socially-responsible travel behaviours and advanced planning (e.g. via integrated intermodal paperless ticketing).
- Enable services based on appropriate access and sharing of data leveraging in-vehicle resources and 2-way V2V, V2I, I2I and vulnerable road users' connectivity in complex urban environments.
- Demonstrating and validating cross-modal integration and potential for cross-border inter-operability.
- Implementing Key Performance Indicators for the performance assessment and measurement of ITS deployment and benefits/impact assessment.

Transport Simulation and Modelling

The wide range of transport modelling application is connected with the movement of passenger transport, urban traffic analysing, strategic freight-network planning, etc. The transport modelling complexity is defined by the huge amount of users and stochastic processes in the transport systems. Research will cover the following themes:

- Development of micro, macro and meso level traffic models.

- Development of transport infrastructure models.
- Development and implementation of methodologies and procedures to support the use of traffic simulation, especially on the topics of calibration and validation.
- Methodological approach for harmonizing national travel surveys (related to protocol, questionnaire design, variables definition, etc.).
- New generation of transit assignment models with Intelligent Transport Systems applications.

Smart Logistics

Freight transport logistics is an industry sector responsible for managing the flows of goods and information between a point of production and a point of sale or use in order to meet the requirements of clients and consumers. Logistics focuses on the planning, organisation, management, control and execution of freight transport operations. In a logistics sector with highly increased collaboration, intermodal and dynamic re-routing of freight, there is a need to exploit ICT advances such as Internet-of-Things, big data, new satellite navigation infrastructure and Intelligent Transport Systems with changes in business needs. Research will cover the following themes:

- Planning and data
  - Identify opportunities for increased availability of freight data (such as shipments, volumes, statuses, destinations, etc.) taking into account security, privacy, data ownership and policies for data sharing.
  - Develop algorithms to increase both load factors and optimise the planned delivery route, based on the specifications of Modular Load Units, the vehicle or container and all required destinations.
- Dynamic routing and business models
  - Develop event management systems that create visibility and transparency and allow real-time exception management for faster traffic reconfiguration and increased resilience.
  - Develop business models for dynamic transport services (e.g. cargo was automatically switched between barge and train because a truck encountered traffic congestions and was late at the hub).
- Interoperability and everything connected
  - Develop simple connection tools that allow low-cost integration of SMEs in the supply chain, offering two-way communication and allowing both efficient planning of their part of the supply chain and giving feedback to other stakeholders.
  - Integrate simple and cost effective sensors or smart devices (IoT, ITS) into supply chain data management tools.
  - Harmonise interoperability between supply chain partners, allowing easy information sharing and creating trust in the complexity of multi-modal transport. Solutions should link all public and private stakeholders.

Applications of Ground Penetrating Radar

Ground Penetrating Radar (GPR) is a safe, advanced, non-destructive and non-invasive imaging technique that can be effectively used for inspection of composite structures and diagnostics affecting the whole life-cycle of civil engineering and transport infrastructure (SETI) works. GPR provides high resolution images of subsurface and structures through wide-band electromagnetic waves. It is quick and inexpensive in comparison to other investigation methods and is capable of probing down to a few tens of meters, depending on the system characteristics and on ground conditions. Research will cover the following themes:

- Protocols and guidelines for different applications will be developed, for effective application of GPR in CETI.
- A novel GPR will be designed and realized: a multi-static system, with dedicated software and calibration procedures, able to construct real-time lane 3D high resolution images of investigated areas.
- Advanced electromagnetic-scattering and data-processing techniques will be developed. The understanding of relationships between geophysical parameters and CEIT needs will be improved.

Freeware software will be released, for inspection and monitoring of structures and infrastructures, buried-object localization, shape reconstruction and estimation of useful parameters.

3.3. Pillar 3. Digital Society and Economy

The main direction of research activities in the second pillar are:

Smart City and Urban Mobility

Many innovative solutions for sustainable urban mobility were developed or developed in a variety of social, economic and geographical contexts. The research will address the following domains:

- Traffic and travel avoidance: planning and location policy; innovative demand management approaches while providing citizens, businesses and organisations with minimum levels of access; less car dependent lifestyles.
- Optimization of existing infrastructure and vehicles: this may include smart pricing of parking, public transport and road use; increasing load factors and making the last mile more efficient in urban freight transport; integration between urban freight and passengers transport networks within appropriate city and transport planning governance; innovative use of passenger transport means; planning for increasing the resilience of the urban transport system to extreme weather events.
- Optimization of multi-modals hubs and terminals for passengers and freight; integration of systems, (sustainable) modes and 'mobility as a service', more efficient transfers; transformation of districts; multi-purpose use of space for vehicles.
- Supporting modal shift towards more efficient modes: increased walking and cycling; mobility management and travel awareness; increased attractiveness of public transport; new coordination and service concepts.
- Analysis of the characteristics of prioritised areas in terms of spatial, demographic and socio-economic characteristics and identification of the factors that influence mobility and accessibility.
- Identification and/or development of new, efficient, inclusive, affordable and accessible mobility solutions and public transport models taking also advantage of IT applications (such as social media, app-oriented services, etc.).
- Analyse differences between various travel motivations (leisure, business) and the related travel time value and examine the extent to which the proliferation of ICT applications such as Wi-Fi connections (e.g. in trains, ships) tend to reduce the perceived cost of travel time for private and corporate travel.

E-Learning

The development and integration of robust and fit-for-purpose digital technologies for learning are crucial to boost the market for and innovation in educational technologies. This requires an industry-led approach in close cooperation with academia to defining the frameworks and interoperability requirements for the building blocks of a digital ecosystem for learning (including informal learning) that develops and integrates tools and systems that apply e.g. adaptive learning, augmented cognition technologies, affective learning, microlearning, game-based learning and/or virtual environments/virtual worlds to real-life learning situations.

Research activities will focus on innovative technologies for learning, on the underpinning interoperability standards and on the integration of different components into smart learning environments. They should combine different technologies (e.g. mobile, augmented reality, natural interaction technologies, simulation, games) and support composing, re-using and distributing interactive educational content and services, with assessment and feedback functionalities.

Content technologies and information management

Research and Innovation activities in this challenge will provide professionals with new tools to model, analyse, and visualise vast amounts of data from which to extract more value, to make an intelligent use of data coming from different sources and to create, access, exploit, and re-use all forms of digital content.

Information Technologies for Enterprises

ICT tools and technological innovation are fundamental for the creative industries and their competitiveness. They widen creative possibilities and improve efficiency in all sectors.

Competitiveness of enterprises can be stimulated by development of ICT applications oriented on real SMEs demand, by effectively building up and expanding vibrant individual technological ecosystems for the creative industries' needs and by fostering exchanges between the creative industries SMEs and TTI as provider of ICT innovative solutions. Research activities will support the creative industries SMEs

in leveraging emerging ICT technologies (e.g. 3D, augmented reality, advanced user interfaces, visual computing) for the development of innovative products, tools, applications and services with high commercial potential. Research in new technologies and tools will support enterprises in the creative process from idea conception to production.

Human-centric Digital Age

The research actions will be oriented at in-depth exploration of the development of fundamental notions such as identity, privacy, relationships, culture, reputation, motivations, responsibility, attention, safety and fairness, in the hyper-connected age where the limits between offline and online are blurred in numerous ways. They will provide new knowledge of the ways by which individuals and communities work, think, learn, behave, and interact in the new hyper-connected environments and of how these new developments affect people's perceptions of self, services, entrepreneurship, and governance.

Business intelligence

Business intelligence (BI) is the set of techniques and tools for the transformation of raw data into meaningful and useful information for business analysis purposes. BI technologies are capable of handling large amounts of unstructured data to help identify, develop and otherwise create new strategic business opportunities. The research will address the following domains:

- Analyses of business intelligence applications and analytics.
- Best practices in business intelligence.
- Data warehousing and data mining strategies for business intelligence.
- Examination of the use of analytics in support of business processes and decision-making.
- Metrics and their effectiveness in business intelligence analyses.
- Organizational culture and its impact on business intelligence.
- Relationship between knowledge management and business intelligence.
- Using business intelligence for security analysis and fraud detection.

Mentioned above research fields tend to be more interdisciplinary and TTI should increase the movement from monodisciplinary research practices towards interdisciplinary approaches and improve the support towards stimulating and conducting the multidisciplinary researches. For instance, it can be provided through post doc researchers, vising researchers, invited professors etc. These changings indicate increased interest in collaboration activities, often linked special funding and stakeholder engagement.

For becoming more significant research player on EU level, TTI should put attention on international collaboration. One of the approaches is to increase TTI participation in international level projects and establish the research consortiums with leading European research establishments.

4. First Year Results

2016 year is over and it is possible to make some preliminary estimation of the first year progress of the implementation of the TTI Research Strategy. Annual evaluation of the progress is important to follow Key Performance Indicators (KPIs) declared in the strategy (Transport and Telecommunication Institute Research Programme 2016-2020, 2015).

4.1. Projects

Active participation in the different level projects was a key point of the research activities in 2016. TTI continued to implement already existing projects, but in the same time started to implement a number of new projects.

In total in 2016 TTI has initiated participation in 3 new COSTS actions, has developed a number of proposal in frame of ERASMUS+ projects (4 proposals in total) and HORIZON 2020 (5 proposals). In frame of HORIZON 2020 one project was supported by funding.

The supported project was in the frame of H2020-TWINN-2015 activities and is titled as “Enhancing excellence and innovation capacity in sustainable transport interchanges” (ALLIANCE). The ALLIANCE project commenced on 1st January 2016 and it is one of the first results of the TTI Research Program in action. The ALLIANCE project’s purpose is to strengthen the scientific and technological capacity of TTI in research activities related to multimodal transport networks (ALLIANCE, 2016). Latvia is ranked below 70% of the EU27 average of the composite indicator on research excellence, the scope of the project is the enabling of stimulating and strengthening the scientific and technological capacity of Latvia and the raising of the profile of the research staff and their institution, by providing

knowledge in the field of smart interconnecting sustainable transport networks. The objective of ALLIANCE project is to have advanced research in the field of transport in Latvia by allowing TTI to coordinate the project and cooperate with two leading research organizations in the domain of transportation: University of Thessaly (Greece) and Fraunhofer Institute for Factory Operation and Automation (Germany).

The overall methodology of the project is built around the analysis of the needs of Latvia and the surrounding region of the Baltic sea (Lithuania, Estonia, Poland) on knowledge gain about intermodal transportation networks and the development of the tools to attain this knowledge, providing at the same time excellence and innovation capacity (ALLIANCE Deliverable D2.1, 2016). The expected impacts on the overall research and innovation potential of TTI and Latvian research community will be of high importance and TTI will benefit from ALLIANCE by:

- Improving its knowledge in methodologies for preparing, writing and publishing scientific papers.
- Strengthening its research capacity.
- Establishing international research teams in specific areas of interest.
- Generating new innovative ideas for future research work through the project's activities.
- Setting up the fundamentals for the young generation of researchers.
- Being integrated in a number of existing international transportation research networks.
- Being incorporated in the European research system of transport and logistics.

The implementation of the project will result in moving the TTI in general towards the triangle principles of a research-community-innovation oriented University.

TTI continue to implement iSECRET project (Implementation of Software Engineering Competence Remote Evaluation for Master Program Graduates) in frame of ERASMUS+ programme. Expected results of the projects are the following: creation of operational prototype of Internet Portal for Software Engineering & Software Technologies (SE&ST) master program's graduates competence evaluation and certification; design of the Basic ECTS oriented Framework applicable for Joint Master Programs in SE&ST implementation and assessment; demo example of SE&ST Master Program's Education Outcome (competence) definition in terms of e-CF freely accessible for European educational community as Open Educational Resource (OER). The iSECRET project implementation is important for TTI, as it is raises the quality of the education process and therefore prepare a new generation of academic and research staff. Also should be noted, that iSECRET is a first project with TTI's leadership, it gives an opportunity to raise the skills in project management of the TTI's staff. In the same time iSECRET provides the networking opportunity as it is unites number of academic institutions from EU: WSG – University of Economy in Bydgoszcz (Poland), KTU – Kaunas Technological University (Lithuania), UM – University of Murcia (Spain), TEIEP – Technological Educational Institute of Epirus (Greece), UP – Plovdiv university (Bulgaria). This network could be used to implement more projects in the future.

Also, in 2016 TTI continue to implement the EDU-RAIL project (Harmonised and Modernised Multidisciplinary Railway Education) funded under Interreg programme. The project EDU-RAIL aims at reducing fragmentation of railway engineering, transport and logistics vocational education and training programmes in the region. By harmonising and modernising railway education through jointly developed regional specialisation modules the project contributes to the development and further integration of the Central Baltic labour market. In practice the project jointly develops aligned specialisation modules that take into account the needs of the regional labour market, including shared challenges of further integration with European railway system and joint regional aspects. The harmonised and modernised teaching process allow the railway institutions to better prepare the educate specialists for the regional employers need and demand in order to enable smooth cross-border rail transportation within the common transport area. As a result of the project five multipurpose specialisation modules are designed for full-time students and for in-service training programmes. The project contributes to reducing fragmentation of railway education in the region by harmonising railway engineering, transport and logistics programmes. Cross-border cooperation enables the educational institutions to achieve the necessary methodological strength to solve together regional challenges and to raise the quality of railway vocational education and training programmes. The implementation of the project is in the frame of the research strategy of TTI, as this project allows to get additional competences in the railway sector and prepare new academic and research staff in the area of ICT application in railway transport. The TTI could benefit much from the project's partnership, moreover the partners of the project are declared in the research strategy as a key research and academic partners for TTI for a planning period.

In 2016 TTI has successfully implemented a number of consulting projects for the industry and municipalities and continue to work in this direction. TTI as research institution has participated in proposals for European Regional Development Fund (ERDF) with 3 proposals and got finances to implement one of the projects.

4.2. Knowledge sharing

TTI ambition is to increase significantly the volume of activity and income resulting from business and industrial collaborations and contracts and increased numbers of strategic partnerships with industry and commerce.

An adequate quality of the science base is a necessary precondition for improving cooperation between businesses and academia, and for leveraging private investment (EC, 2015). For this goal realization the special TTI Autumn 2016 "Research-to-Business (R2B) was organised and included the following events:

"Science Night" and Seminar "Building Information Modelling" on September

Seminar for business and research community "How You Can Bring INDUSTRY 4.0 Technologies to Logistic Networks" by Prof. Michael Schenk, Director of Fraunhofer Institute for Factory Operation and Automation IFF (Fraunhofer-Institut für Fabrikbetrieb- und automatisierung, Magdeburg, Germany) on 13 October

ECTRI Assembly on 24-25 November 2016 with TTI hosting. In the frame of ECTRI Assembly a seminar where the representatives of Latvian transport industry reviewed the recent developments in transport area in Latvia was organised

Seminar "Sustainable Urban Mobility Plan: Information Gathering & Analysis Tools" organised by Jasper and TTI for municipalities on December etc.

TTI continues to regularly hold International Conferences, which are officially recognized by the international research community. The most significant among them is the TTI's Annual International Conference "Reliability and Statistics in Transportation and Communication" that was reorganized to Multidisciplinary Conference in 2016. The number of participants in 2016 was increased by 25%. The Conference Proceeding from 2016 will be published in Elsevier Procedia Engineering.

According to the official statistics of TTI regarding the publication, the number of research papers in 2016 continues to insignificantly decreases, but in the same time the quality of the papers become higher. This conclusion could be draw as the percentage of the papers indexed in SCOPUS or WoS become 15% higher. Additionally in 2016 TTI has registered 3 new patents.

TTI continues to develop its own scientific journal "Transport and Telecommunication" (ISSN 1407-6160, ISSN 1407-6179 on-line), indexed by Scopus. According Scimago service "Transport and Telecommunication" journal increased the quality of content. The H-index was increased from 3 to 5, SJR was increased from 0.25 to 0.27, cites per .doc - from 0.37 to 0.63, total cites - from 25 to 42, % international collaboration raised from 10% to 26%.

4.3. HR development

The basic principle of the human resource (HR) strategy is recognizing faculty, staff and students as the key assets of the TTI that determine its development.

The human resource development is not only the issues of the number of the research personnel in the research entity, but also a point of the edge structure of the research staff. That is why the KPI framework takes into account not only increasing the number of researchers, but also a significant change edge structure of the research staff.

In order to make development of the HR resources a number of activities were implemented. First of all TTI participated and supported 4 proposals for postdoctoral grants in frame of European Regional Development Fund.

In 2016 TTI, the Faculty of Computer Science and Telecommunication together with X INFOTECH Ltd announced a first student research paper competition. The topics were in the frame of TTI Research Strategy and included the next subjects:

- Analysis of the Face Recognition and Verification Techniques
- Digital Watermarks to Protect Electronic Identification Documents from Forgery
- Analysis of the Fingerprint Recognition and Authentication Algorithms
- etc.

The goal of three TTI's master programmes and PhD program is to prepare the high quality personnel for EU in the Science, technology, engineering and mathematics (STEM) fields and the

competition allowed attracting students to scientific activities and enhancing students' future career opportunities.

To improve the quality of research and academic staff and cover the gap of insufficient quantity of postgraduate students from Business Environment and foreign PhD students the new Policy of Establishing International Joint Supervision of Doctoral Thesis are developed in 2016. It will lead to more binding cooperation and increase its level of internationalisation. This policy of joint supervision of doctoral thesis will allow TTI to collaborate with universities and individual researchers abroad on the co-supervision of a PhD's thesis. The students who engage in such agreements will receive an enriched international experience. The exposure these students will have to different cultural and scientific environments will increase their employability after graduation. TTI will benefit from having high profile international linkages with prestigious universities and international recognized researchers abroad, and will enhance its overall international profile and reputation.

5. Conclusions

Research excellence and innovation are integral to the vision of the Transport and Telecommunication Institute. Its goal is to address fundamental and strategically important questions, and to deliver economic, social and cultural impact at regional, national and international levels.

Delivery of the TTI Research Strategy is measured against a series of key university-level indicators and targets that are set out in an Operational Plan. Faculties and other research units are developing their own research strategies that are aligned with the objectives identified in the TTI Research Strategy. The Transport and Telecommunication Research Strategy 2015–2020 was approved by the TTI Senate. The full Strategy can be found on the webpage (Transport and Telecommunication Institute, 2015).

The main avenues of transformation and development of TTI are formulated into 6 strategic initiatives and the roadmaps, how to attract the human resources, improve the research infrastructure and facilitate cooperation between higher education, science and the private sector, as well as transfer of research and innovation to business, are drafted for up and to five years and foresee the implementation of measures and eventual adjustments and/or corrective measures according to the changing economic or scientific demands.

Authors consider the implementation of planned research activities also strongly depends on networking and cooperation with industrial research and other research and education institutes to improve their efficiency, effectiveness or profitability.

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