



TRANSPORTA
UN SAKARU
INSTITŪTS

Transport and Telecommunication Institute Research Programme (2015-2020)

Final version

This document represents Transport and Telecommunication Institute research programme for period of time 2015-2020. 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.



IEGULDĪJUMS TAVĀ NĀKOTNĒ



EIROPAS SAVIENĪBA

Transport and Telecommunication Research Strategy and Plan for 2015–2020 which has been discussed on

Date	Place	Type of the event
9.06.2015	Riga	Workshop with TTI research to define target research areas
25.06. 2015	Riga	TTI Senate
8.07.2015	Riga	Workshop with TTI researchers on increasing participation in Horizon 2020, COST, ERASMUS+ calls
25.08.2015	Riga	Latvian Association Transport Development and Education
27.08.2015	Riga	Meeting with representatives of Latvian stakeholder
31.08.2015	Riga	TTI Scientific Council

and approved by the TTI Senate at its meeting on 8 of September. The full text of document can be found on the webpage at www.tsi.lv.

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Introduction

Vision of the Latvian government is that Latvia will become a thriving country of active and responsible citizens, and it will unite the society for the creation of new, diverse and unique values in economy, science and culture by 2030. National Development Plan 2020 (Latvijas Nacionālais attīstības plāns, 2015) clearly defines focused directions for growth and the ways of achieving them. One of the strategic objectives is to have advanced research and innovation and advanced higher education.

For the independent evaluation of the research level in Latvia in 2013 a team of experts from Technopolis conducted the research of achievements of TTI and of 150 other national research organisations during the time period 2006-2012 (Technopolis, 2014). During on-site visit of the evaluation team in October 2013 the evaluators interviewed the staff of the Institute and visited all the research installations and laboratories in order to obtain a “firsthand view” of the Institute’s infrastructures. The results of the evaluation were positive and they place the Institute among the top 10% research establishments in the country with particularly positive remarks on its activities and cooperation. As mentioned in the assessment summary of Technopolis (Annex 1), TTI is a unique national player as the private Institute and is strengthening its position in order to become an international key player in the field of education as well as in research in logistics and transport modelling and simulation. At the same time the evaluators noted a number of comments and recommendations to improve the scientific activity of TTI.

The main task during the development of the Research Strategy for 2014-2020 is to implement the recommendations of the evaluation and to fulfil some internal transformations for a more efficient operation of the Institute for ensuring that the Institute can continue to produce a significant volume of high quality work and respond to the rapidly changing environment in Latvia and worldwide in relation to research and its funding.

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.

The Research Program fully corresponds to the national priority of Latvia “Growth of the national economy” by strengthening research and facilitating knowledge transfer between higher education, science and the private sector. The proposed activities will result in the increased number of researchers and students in the field of ICT in transport.

1. Review of the main trends of development for TTI research areas

The main trends in technological development can be well illustrated by Gartner hype Cycle [1]. 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 drills down into the five key phases of a technology's life cycle (Figure 1 [2]):

- **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.

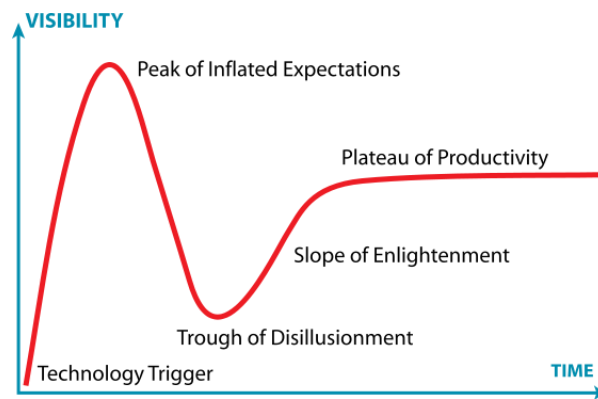


Figure 1. Hype Cycle

The "Hype Cycle" by the technology analysts and consulting firm Gartner illustrates what technologies are currently located on the peak of expectations. Often it 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 [1] 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 (Figure 2 [1]).

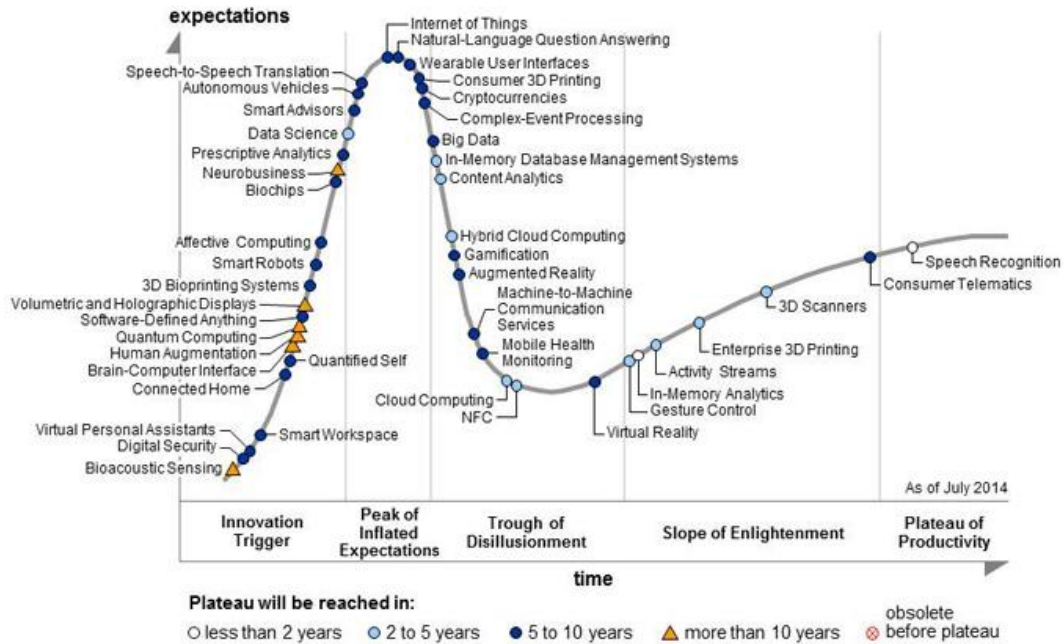


Figure 2. Hype Cycle for Emerging Technologies, 2014

At Figure 3 the same Hype Cycle shows the Transport and Telecommunication Institute (TTI) fields of research interest.

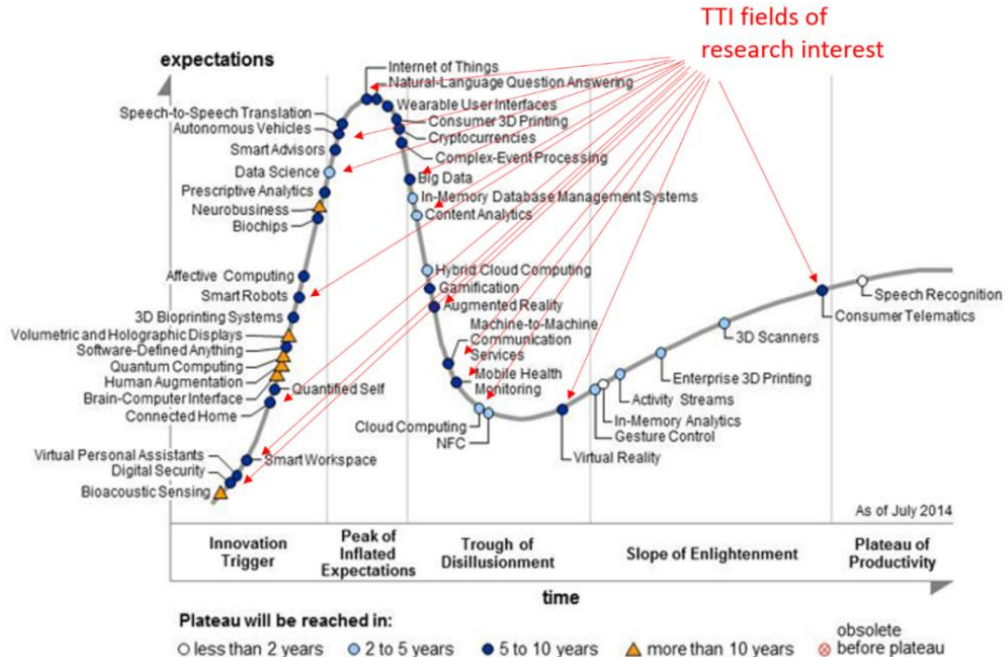


Figure 3. Hype Cycle with TTI fields of research interest

1.1 The main trends of development in the information technologies, telecommunication, electronics

The leading analytical centres released their top 10 strategic technology trends for 2015. These trends are expected to have a significant impact on organizations over the next three years and may require major investment. As with any changes to business processes, these trends will affect organisations and end users, as well as long-term planning, programs and initiatives. The coming year's trends will be focused on merging the real and virtual worlds, data intelligence gathering, and shifting to a digital business model [3-9].

In Table 1 there are the top 10 strategic technology trends for 2015 [3-9].

Table 1. Top 10 strategic technology trends for 2015

N	Strategic technology trends	Brief description of technology
1.	Computing Everywhere	As mobile devices continue to proliferate, Gartner predicts an increased emphasis on serving the needs of the mobile user in diverse contexts and environments, as opposed to focusing on devices alone. Phones and wearable devices are now part of an expanded computing environment that includes such things as consumer electronics and connected screens in the workplace and public space. Increasingly, it's the overall environment that will need to adapt to the requirements of the mobile user. This will continue to raise significant management challenges for IT organizations as they lose control of user endpoint devices.
2.	The Internet of Things	The combination of data streams and services created by digitizing everything creates four basic usage models — manage, monetize, operate and extend. These four basic models can be applied to any of the four "Internets." Enterprises should not limit themselves to thinking that only the Internet of Things (IoT) (assets and machines) has the potential to leverage these four models. For example, the pay-per-use model can be applied to assets (such as industrial equipment), services (such as pay-as-you-drive insurance), people (such as movers), places (such as parking spots) and systems (such as cloud services). Enterprises from all industries can leverage these four models.
3.	3D Printing	Worldwide shipments of 3D printers are expected to grow 98 percent in 2015, followed by a doubling of unit shipments in 2016. 3D printing will reach a tipping point over the next three years as the market for relatively low-cost 3D printing devices continues to grow rapidly and industrial use expands significantly. New industrial, biomedical and consumer applications will continue to demonstrate that 3D printing is a real, viable and cost-effective means to reduce costs through improved designs, streamlined prototyping and short-run manufacturing.
4.	Advanced, Pervasive and Invisible Analytics	Analytics will take center stage as the volume of data generated by embedded systems increases and vast pools of structured and unstructured data inside and outside the enterprise are analyzed. Every app now needs to be an analytic app. Organizations need to manage how best to filter the huge amounts of data coming from the IoT, social media and wearable devices, and then deliver exactly the right information to the right person, at the right time. Analytics will become deeply, but invisibly embedded everywhere. Big Data remains an important enabler for this trend but the focus needs to shift to thinking about big questions and big answers first and Big Data second — the value is in the answers, not the data.
5.	Context-Rich Systems	Ubiquitous embedded intelligence combined with pervasive analytics will drive the development of systems that are alert to their surroundings and able to respond appropriately. Context-aware security is an early application of this new capability, but others will emerge. By understanding the context of a user request, applications can not only adjust their security response but also adjust how information is delivered to the user, greatly simplifying an increasingly complex computing world.
6.	Smart Machines	Deep analytics applied to an understanding of context provide the preconditions for a world of smart machines. This foundation combines with advanced algorithms that allow systems to understand their environment, learn for themselves, and act autonomously. Prototype autonomous vehicles, advanced robots, virtual personal assistants and smart advisors already exist and will evolve rapidly, ushering in a new age of machine helpers. The smart machine era will be the most disruptive in the history of IT.
7.	Cloud/Client Computing	The convergence of cloud and mobile computing will continue to promote the growth of centrally coordinated applications that can be delivered to any device. "Cloud is the new style of elastically scalable, self-service computing, and both internal applications and external applications will be built on this new style," said Mr. Cearley. "While network and bandwidth costs may continue to favour apps that use the intelligence and storage of the client device effectively, coordination and management will be based in the

N	Strategic technology trends	Brief description of technology
		cloud." In the near term, the focus for cloud/client will be on synchronizing content and application state across multiple devices and addressing application portability across devices. Over time, applications will evolve to support simultaneous use of multiple devices. The second-screen phenomenon today focuses on coordinating television viewing with use of a mobile device. In the future, games and enterprise applications alike will use multiple screens and exploit wearables and other devices to deliver an enhanced experience.
8.	Software-Defined Applications and Infrastructure	Agile programming of everything from applications to basic infrastructure is essential to enable organizations to deliver the flexibility required to make the digital business work. Software-defined networking, storage, data centres and security are maturing. Cloud services are software-configurable through API calls, and applications, too, increasingly have rich APIs to access their function and content programmatically. To deal with the rapidly changing demands of digital business and scale systems up — or down — rapidly, computing has to move away from static to dynamic models. Rules, models and code that can dynamically assemble and configure all of the elements needed from the network through the application are needed.
9.	Web-Scale IT	Web-scale IT is a pattern of global-class computing that delivers the capabilities of large cloud service providers within an enterprise IT setting. More organizations will begin thinking, acting and building applications and infrastructure like Web giants such as Amazon, Google and Face book. Web-scale IT does not happen immediately, but will evolve over time as commercial hardware platforms embrace the new models and cloud-optimized and software-defined approaches reach mainstream. The first step toward the Web-scale IT future for many organizations should be DevOps — bringing development and operations together in a coordinated way to drive rapid, continuous incremental development of applications and services.
10.	Risk-Based Security and Self-Protection	All roads to the digital future lead through security. However, in a digital business world, security cannot be a roadblock that stops all progress. Organizations will increasingly recognize that it is not possible to provide a 100 percent secured environment. Once organizations acknowledge that, they can begin to apply more-sophisticated risk assessment and mitigation tools. On the technical side, recognition that perimeter defence is inadequate and applications need to take a more active role in security gives rise to a new multifaceted approach. Security-aware application design, dynamic and static application security testing, and runtime application self-protection combined with active context-aware and adaptive access controls are all needed in today's dangerous digital world. This will lead to new models of building security directly into applications. Perimeters and firewalls are no longer enough; every app needs to be self-aware and self-protecting.

1.2. Digital business applications

It is not difficult to see that many of these trends are interconnected with one another. While the challenges facing IT in 2015 won't be new per se, IT leadership finds itself at a very important crossroads. This coming year presents an opportunity to develop a roadmap and strategy that will reshape how IT supports the business.

Technology is moving at a breakneck pace. Social, mobile, analytics, cloud, and increasingly the Internet of Things have become driving forces behind the rapid evolution of digital businesses. This year's analysts [10-25] highlight five emerging themes that reflect the shifts being seen among the digital power brokers of tomorrow.

1. **The Internet of Me** is changing the way people around the world interact through technology, placing the end user at the center of every digital experience.
2. At the same time, digital devices on the edge are powering an **Outcome Economy** and enabling a new business model that shifts the focus from selling *things* to selling *results*.
3. The **Platform (R) evolution** reflects how digital platforms are becoming the tools of choice for building next-generation products and services—and entire ecosystems in the digital and physical worlds.

4. **The Intelligent Enterprise** is making its machines smarter—embedding software intelligence into every aspect of its business to drive new levels of operational efficiency, evolution, and innovation.
5. Advances in more natural human interfaces, wearable devices, and smart machines are extending intelligent technology to interact as a “team member,” working alongside employees in a **Workforce Reimagined**.

These technologies are quickly becoming the base for how enterprises will build their next generation of business (Table 2).

Table 2. Technologies for next generation of business

N	Trends	Brief description of trends
1.	Beyond the cloud: stop talking about cloud—the value is in using it	No vision would be complete without commenting on the cloud, but cloud computing is no longer an emerging trend. The on-demand technology is pervasive in all decisions made today; the key question is not “Should we use cloud?” but rather “How can we use cloud?” What’s more, cloud isn’t a single concept. Its individual elements—from software-as-a-service (SaaS) to platform-as-a-service (PaaS), from public to private—are as distinct and different from one another as the opportunities are for enterprises to use them. The next phase is putting the cloud to work and crafting an overarching approach that weaves cloud capabilities into the fabric of IT solutions and responses—with business value the uppermost priority.
2.	Design for analytics: formulate the questions, and design for the answers	Business intelligence. Data analytics. Big data. Companies are no longer suffering from a lack of data—they’re suffering from a lack of the right data. Business leaders need the right big data to effectively define the strategic direction of the enterprise. The current generation of software was designed for functionality, but the next generation must also be designed for analytics.
3.	Relationships at scale: moving beyond transactions to digital relationships	Businesses need to re-think their digital strategies to move beyond e-commerce and marketing. While mobile technology, social networks, and context-based services have increased the number of digital connections with consumers, most companies are still creating more detailed views of their consumers, their attributes, and their transactions. Individually, these connections may represent new types of user experiences, even new sets of sales channels—but that’s not the real opportunity. Taken in aggregate, digital represents a key new approach to consumer engagement and loyalty: companies can manage relationships with consumers, at scale.
4.	Seamless collaboration: right channel, right worker, right job	It’s time for the enterprise to reimagining the way its employees work. The rise in social networking has breathed new life into collaboration. Users’ new social behaviour and their growing expectation that every app will be “social” are pushing companies to create new user experiences. However, to increase productivity, enterprises must move beyond standalone social and collaborative channels and begin to embed them directly into their core business processes. The new approach is to build social and collaborative applications throughout the enterprise.
5.	Active defence: adapting cyber security defences to the threat	Despite an increasing focus on securing the digital business, IT departments struggle to keep pace with recent advances in security technology. Enterprises know that endpoint security is not enough, but the move to active defence—risk-based approaches to security management, analytics-driven event detection, and reflex-like incident response—isn’t yet happening on a broad scale. Although these technologies are maturing rapidly and communities are forming to expose the risks, the biggest barrier is the slow adoption of solutions that already exist. IT’s core challenge: get current with best practices in security, get smarter about the new active defence possibilities, and get real about the journey ahead.
6.	Data velocity: matching the speed of decision to the speed of action	Business leaders have been bombarded with statistics about the soaring volume of data that they can mine for valuable insights. They have been deluged with articles describing the incredible variety of “external” data hidden in everything from tweets and blogs to sensor outputs and GPS data from mobile phones. But the next perspective on data that deserves attention is data velocity—the pace with which data can be gathered, sorted, and analyzed in order to produce insights that managers can act on quickly. As expectations of near-instant responses become the norm, business leaders will rely heavily on higher data velocities to gain a competitive edge.
7.	Software-defined networking: virtualization’s last mile	With virtualization investments already paying off in servers, and starting to pay off in storage, businesses must turn their attention to virtualizing the network in order to extend the life of their infrastructure and reap the full value of their virtualization investments. Like other virtualization technologies, software-defined networking (SDN) has the ability to radically change the flexibility with which businesses and IT operate. You may think of networking as a low-level technology, but this aspect has the ability to transform enterprises. With SDN, businesses can finally realize the vision of a dynamic enterprise.

N	Trends	Brief description of trends
8.	Digital-physical blur: extending intelligence to the edge	The real world is coming online, as smart objects, devices, and machines increase our insight into and control over the physical world. More than just an “Internet of Things,” this new layer of connected intelligence augments employees, automates processes, and incorporates machines into our lives. For consumers, this provides new levels of empowerment. In addition to being highly informed, consumers can interact and influence the way they experience everything around them. For their part, organizations now get real-time connections to the real world that allows machines as well as employees to act and react faster—and more intelligently.
9.	Data supply chain: putting information into circulation	Data technologies are evolving rapidly, but most have been adopted in piecemeal fashion. As a result, enterprise data is vastly underutilized. Data ecosystems are complex and littered with data silos, limiting the value that organizations can get out of their own data by making it difficult to access. To truly unlock that value, companies must start treating data more as a supply chain, enabling the data to flow easily and usefully through the entire organization—and eventually throughout the organization’s ecosystem of partners as well.
10.	Harnessing hyperscale: hardware is back (and never really went away)	Eclipsed by more than a decade of innovation in software, the hardware world is now a hotbed of new development as demand soars for bigger, faster, and more efficient data centres. Every company will see the benefits of “hyperscale” innovation trickle into their data centers in the form of cost reduction, but as companies digitize their businesses, more and more will see these systems as essential to enabling their next wave of growth.
11.	Business of applications: software as a core competency in the digital world	The way we build software is changing. Mimicking the shift in the consumer world, enterprises are rapidly moving from applications to apps. Yes, there will always be big, complex enterprise software systems to support large organizations, and IT developers will need to keep customizing those systems, providing updates and patches, and more. But now, as organizations push for greater operational agility, there is a sharp shift toward simpler, more modular apps. What are the implications for IT leaders and business leaders? Soon, they will have to decide who plays what application development role in their new digital organizations—and how they can transform the nature of application development itself.
12.	Architecting resilience: built to survive failure, the mantra of the nonstop business	In the digital era, businesses are now expected to support the nonstop demands that their employees and stakeholders place on business processes, services, and systems. This shift to support ever-changing priorities has ripple effects throughout the organization, especially in the office of the chief information officer. There, the need for “always on” IT infrastructure, security, and business process economics can mean the difference between business as usual and the erosion of brand value. As a result, today’s IT leaders must ensure that their systems are designed for failure rather than designed to spec.

1.3. Trends and technology drivers in transport and logistics development

Logistics and technology go hand in hand [26-38]. While the global supply chain has been around for eons, it is the powered engine, the container box and computers that make our world more connected and more efficient than ever.

1.3.1. Social & Business Trends in Logistics

The main social and business trends in logistics are shown in Table 3 [26-38].

Table 3. Main social trends in logistics

N	The main social and business trends in logistics	Brief description
1.	Super grid Logistics	Super grid logistics will bring up a new generation of logistics companies with primary focus on the orchestration of global supply-chain networks that integrate swarms of production enterprises and logistics providers.
2.	Real-Time Services	Real-time services enable flexible and efficient adaption to changing conditions and ad-hoc optimization of supply chains by integrating real-time information into intelligent and interactive analytics frameworks.
3.	Anticipatory Logistics	Powered by big data-based predictive algorithms, anticipatory logistics enables logistics providers to significantly boost process efficiency and service quality by speeding up delivery time and enhancing capacity and network utilization.

N	The main social and business trends in logistics	Brief description
4.	Urban Logistics	Key issues in urban areas are environmental impact and traffic density. Combined with the growing relevance of e-commerce and home delivery, this makes it essential to have logistics solutions tailored to the specific requirements of urban areas.
5.	Logistics Marketplaces	In the context of globalization and increasingly digital lifestyles, logistics marketplaces create opportunities for new services that can overcome geographical and functional segmentation, and significantly enhance cost efficiency and capacity utilization.
6.	Omni-Channel Logistics	The next generation of retail, including cross-channel, Omni-channel, social, ambient, everywhere and no-line commerce concepts requires logistics networks tailored to the needs of each single channel. This implies high-quality logistics services with minimum investment, by just intelligently using standard logistics networks and assets.
7.	Crowd Logistics	Social networks and crowd-based concepts offer new business opportunities. By placing greater emphasis on crowd sourcing and crowd funding, logistics providers can speed up innovation-to-market cycles and create a new sense of community with customers.
8.	Fair Logistics Low	Logistics will lead the way into a fair and sustainable society by generating social benefits and fostering the circular economy with its products and services. In future, dealing thoughtfully with earth's limited resources will go hand-in-hand with fair and respectful human interaction, and sustainable investment in regional empowerment.
9.	Grey Power Logistics	In five or more years' time, the first wave of digital natives will enter the aged population segment. Grey power logistics – the logistics for an aging society – will offer new services to answer the resulting challenges of this demographic development.
10.	Convenience Logistics	Customers buying goods online appreciate not just price advantage but convenience. It saves costs, time, and physical effort and provides 24/7 availability. Today's market leaders offer food fresher than conventional supermarkets through continuous cold-chain and direct delivery from the producer's site via a standard parcel network.
11.	Multiple Purpose Networks	Multiple Purpose Networks refers to the utilization of standard, existing networks to transport and store temperature-sensitive, special, and dangerous goods, enabled by innovative methods of transportation, smart packaging solutions, and real-time supply chain monitoring.
12.	Shareconomy Logistics	A new sharing culture leads to new logistics needs within the digitalized neighbourhood. Logistics infrastructure and service sharing with competitors open new perspectives for logistics providers, and will create new forms of collaboration across enterprises.
13.	Near- & X-Shoring	Following on from the off shoring wave of the last decade, changing economic and social conditions will bring up new sourcing strategies such as near-shoring, re-shoring/back-shoring, and even x-shoring.
14.	De-Stressing the Supply Chain	Complexity of supply chains and vulnerable customer requirements require the right mix of transportation modes and services. De-stressing means that the transportation of a subset of goods may tolerate a tactical 'slow-down' to optimally balance the supply chain and reduce costs in storage and warehousing.

1.3.2. Technology Trends in Logistics

The main technology trends in logistics are shown in Table 4 [26-38].

Table 4. Main technology trends in logistics

N	The main technology trends in logistics	Brief description
1.	Big Data / Open Data	Big data carries huge untapped potential for optimizing capacity utilization, reducing risk, improving customer experience, and creating new business models. Open external data sources will add a new dimension to big data use cases.
2.	Cloud Logistics	Beyond the hype, the paradigm of cloud-based services is increasingly tangible for logistics. Logistics-as-a-Service (LaaS), logistics mall, Supply Chain-as-a-Service (SCaaS), and on-demand SCM are some of the future topics of logistics.
3.	Autonomous Logistics	Autonomous logistics utilizes innovations such as cellular transport systems, self-steering vehicles, and unmanned aerial vehicles (UAVs) that offer new transport and warehousing solutions, enhancing the efficiency of established assets and providing infrastructure alternatives in remote areas.

N	The main technology trends in logistics	Brief description
4.	3D Printing	3D Printing is a disruptive technology that will change tomorrow's logistics by adding a new diversity of manufacturing strategies. Innovative logistics providers can become thought leaders in orchestrating complex networks that include traditional and 3D manufacturers.
5.	Robotics & Automation	Robotics and automation technologies support zero-defect logistics processes and enable new levels of productivity. The new generation of robots and automated solutions with significantly improved performance and enhanced sensing capabilities offers a serious alternative to manual handling.
6.	Internet of Things	The Internet of Things empowers smart objects to be active participants in self steering, event-driven logistics processes. Logistics is one of the major industries which will benefit from the intelligent conjunction of information and material flows.
7.	Localization & Local Intelligence	By integrating location and spatial information with traditional analytics data, localization and location intelligence (LI) help to increase process efficiency, and provide enterprises with powerful insights into asset utilization.
8.	Wearable Technology	Beyond the hype, wearable devices (together with responsive environments and contextual apps) will in the long run significantly change the ways we work and manage our lives and will impact all industries. Enterprises need to develop a strategy for adopting wearable devices at an early stage.
9.	Augmented Reality	By adding virtual layers of contextual information at the right time and in the right place, augmented reality will provide new perspectives in logistics planning, process execution, and visual analytics.
10.	Low-cost Sensor Technology	Established consumer sensor technologies enable new applications within the logistics industry. With access to low-cost sensors, logistics is likely to increase the use of sensors, creating smart infrastructures for monitoring, inspecting, and controlling industrial and logistical processes.
11.	Crypto-currencies & Crypto-payment	Started by an underground community of cyberpunks in the 1990s, crypto-currencies and crypto-payment quickly evolved to become a significant technology trend with strong potential as a serious alternative to the established financial infrastructures of governments, banks, and credit card companies.
12.	Automated Vehicles	Truly maximizing delivery capability, although this trend's fulfilment is still 10-20 years away. As mentioned before, the "deadhead" problem has wasted miles, and fuel, and drivers hours. Imagine if we can not only find the next closest pickup but that we are able to have the vehicle operating nearly autonomously 24 hours/day. This applies to not just the "big rigs" but to regular delivery vehicles. A delivery can go out for Home Depot, and then the next delivery may be from a sub sandwich shop, or Best Buy—or even delivering packages to FedEx or the post-office from a residence. The opportunities here are truly endless.
13.	Advent of Ubiquitous Web Services Use	The supply chain industry is dangerously reliant on antiquated platforms to transmit data. Compared to other industries, the freight industry truly is stuck in the stone ages when it comes to sharing information between technology platforms. This isn't necessarily a hit on supply chain technology in general, a lot of companies are building brilliant capabilities to analyze data, optimize transportation decisions and do things of the like, but when it comes to sharing that information from one system to another we are woefully dependent on technologies like EDI, email, phones and fax. Future will usher in the event of using web services and a global standard for the language we use to transmit this data. Companies have laid the foundation to help the industry make a huge step forward from where we are today, but it is going to require a commitment from all the companies involved in the supply chain to get us to where we need to be. This will literally change our capabilities overnight. There's such a tremendous amount of waste in the supply chain industry because of unreliable or slow-moving data transmission that we just don't need to deal with anymore. This is going to change the way that companies charge for their services, how they perform advanced demand analysis, reduce the number of electronic "touches" on each shipment and so much more.
14.	Globally Connected Supply Chains	The proliferation of technology will disrupt the global supply chain in the future. It will change the way that importers/exporters are able to manage their connections with transportation vendors of all different shapes and sizes to be able to service customers anywhere in the globe. It will reduce our dependency on having innumerable intermediaries throughout the world to handle our shipping and – as a result – decrease the cost of logistics that companies have to spend to get their products in front of new markets. The challenges in the global supply chain market are many, but the rise of these types of technology platforms will allow us to overcome them and build better and stronger supply chains.

1.4. Market Analysis of the Intelligent Transport Systems and Services (ITSS) Sector

The growing number of vehicles and increasing population has led to the need for effective traffic management. An Intelligent Transportation System (ITS) integrates the transportation network with ICT (Information and Communications Technology) to improve performance, enable multimodal transport and help alleviate road accidents and optimize fuel consumption. Besides being used for road transport, ITS is also used for rail, water and air transport and navigation systems. With the help of sensors, navigation systems, video surveillance devices, and vehicle probes, real-time data is collected. It is then analyzed and communicated to the user via dynamic sign boards, internet, mobile telephony, etc. The usage of ITS to reduce road accidents and increase safety in general is a major driving force for the market. Demand for vehicle to vehicle (V2V) and vehicle to infrastructure (V2I) communication in order to enhance road safety is expected to gain momentum over the next few years. Interoperability issues in between the user and the road or control units may act as a restraint to the industry in the near future. Establishment of standardization and a unified technology is necessary for effective communication.

Within Europe, the key ITSS products and services are currently Network Management with about half of the market, Freight Efficiency with 18% and Automotive Telematics with 14% [61]. By 2020 the Network Management is expected to reduce by 45%, Freight Efficiency by 10% and Communications Services to increase to 20% (Figure 4 [61]). The Figure 5 [61] shows the market shares by product for the whole Europe Market and how these are expected to change in the period 2000-2020.

Key intelligent transportation systems include advanced traveller information systems (ATIS), advanced transportation management systems (ATMS), advanced transportation pricing systems (ATPS), advanced public transportation systems (APTS) and cooperative vehicle systems. ATIS provide real-time traffic, navigation, weather information, etc.; demand for these systems is expected to increase, particularly in developed markets, where manufacturers are installing infotainment and navigation devices in new vehicles. ATMS was the largest segment. They help optimize transportation network operations as well as aid in alleviating pollution and traffic congestion in order to enhance the quality of life. ATMS solutions offered by market participants combine data processing technology as well as sensors and communication to ensure real-time management of transportation networks' operations; information gathered and processed is beneficial to drivers and travellers alike. APTS is expected to be the fastest growing market segment from 2015 to 2020. These systems are used for increasing the efficiency public transit systems' operations as well as boost overall safety. APTS applications include bus arrival notification systems, real-time passenger information systems, automatic vehicle location systems, etc. Cooperative vehicle systems, also known as cooperative vehicle infrastructure systems (CVIS) enable vehicles and transport infrastructure to exchange information in a dynamic fashion. This information includes data related to location, traffic and road conditions, and helps warn travellers and drivers in advance to incidents, blockages and hazards. Technologies used may include 3G, wireless LAN; for example, traffic signals could enable vehicles to synchronize speed with the traffic light cycle. The CVIS project by the European Commission aims at creating a unified technical solution and ensuring interoperability in communication. Another key objective of this project is to address issues of data privacy and security, user acceptance, and system openness, as well as roll-out plans for implementation.

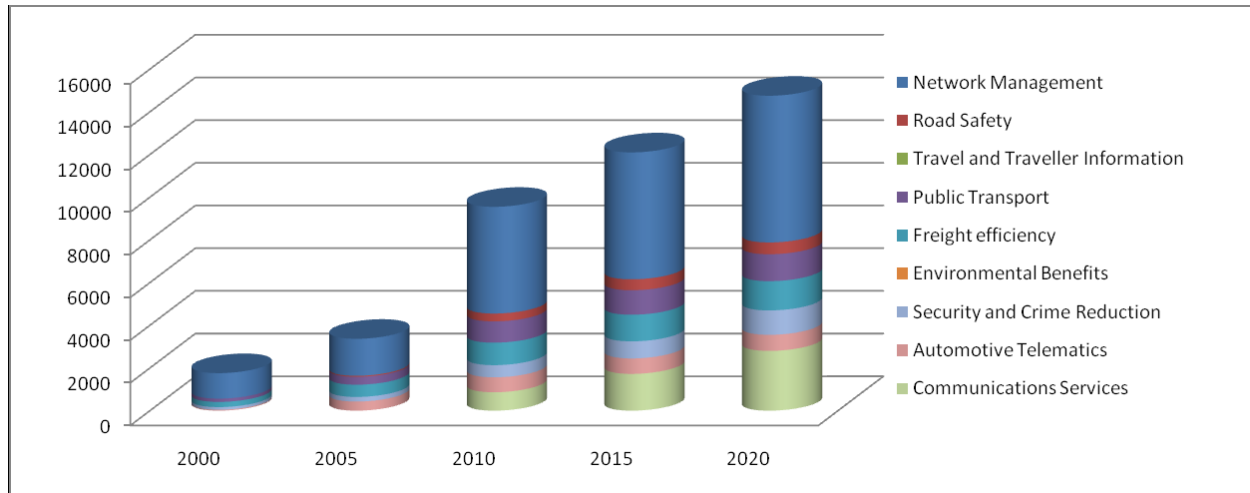


Figure 4. Product-market matrix data: revenues in US \$ million

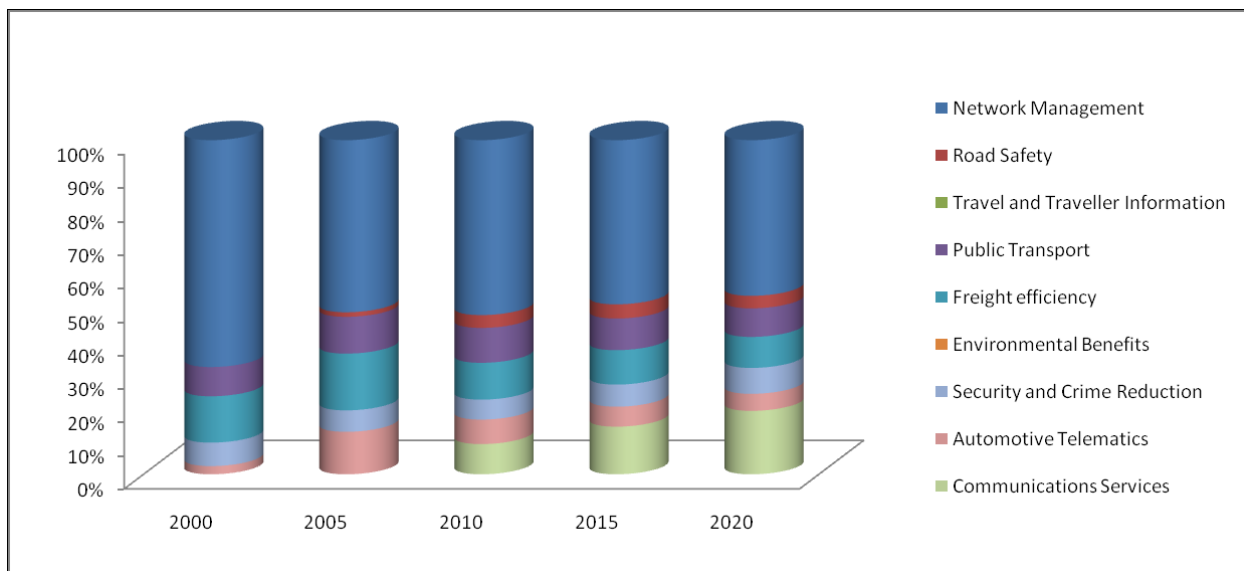


Figure 5. Total Europe shares by product

Building on the momentum and success of prior and current research, and working on the areas that are at the forefront of ITS research going forward, the next primary strategic priorities have been defined [39-71]:

- Realizing Connected Vehicle (CV).** The research will focus much of its CV program activities on adoption and eventual deployment of the system. Future advancements in research and testing of CV technology will not be ignored. In fact, as CV technology is rolled out, added functionality, new applications, and technological enhancements will be investigated under this program in response to user needs and technical issues that arise with scaled deployments supported and informed by the work in the ITS study. As the CV program moves from heavy attention in the research phase to more investment in the development and adoption phases, increased focus on test beds and pilots will be a natural part of the future activities. At the same time, policy and

institutional issues involving deployment will be addressed as deployment scenarios and business models are more thoroughly tested in a real-world environment. Technical guidance and support, professional capacity building, and certification requirements will continue to be important elements of the research as the CV system becomes a reality. Evolution and harmonization of standards for the CV system is already underway and will play an increasingly prominent role as the industry approaches implementation.

- **Advancing Automation.** Automation focuses on research about automated road-vehicle systems and related technologies that transfer some amount of vehicle control from the driver to the vehicle. Different levels of automation may have a significant impact on driving safety, personal mobility, energy consumption, operating efficiency, environmental impact, and land use. While research into automated vehicles and other aspects of automation are in the early stages, it is fast gaining attention around the world in all sectors of the economy. Developing and adopting varying levels of automation technologies offer tremendous possibilities for enhancing safety, mobility, and the environment, but also pose new technical and policy challenges, and the ITS research focus in this area will be on the development of technology and systems to enable smooth and safe introduction of automated features into the nation's vehicles and transportation systems.
- **Emerging Capabilities.** Research will focus on future generations of transportation systems. As the scale of CV implementation grows and as automation of transportation systems increases, vehicle manufacturers, infrastructure providers, innovators, and entrepreneurs will discover new opportunities to use the technologies and the data that will be generated. Technological advances, new functionality, new applications, new operational concepts, and disruptive innovations will result.

The first builds on the substantial progress made in recent years around design, testing, and planning for CVs to be deployed across the nation. The second shapes the ITS around research, development, and adoption of automation-related technologies as they emerge. The priorities reflect a sense of where the bulk of transportation research and innovation is heading, but are not exclusive of other technologies or research areas.

The strategic themes set the direction for the priorities are meant to focus the attention of the ITS community on intended outcomes of new technologies and systems as they are developed, tested, and eventually adopted. The themes align with the research strategic priorities and are embedded in the priorities categories are shown in Table 5.

Table 5. Themes align the research strategic priorities

N	The main research directions in the ITS	Description
1.	Connected Vehicles	<p>The research will focus much of its CV program activities on adoption and eventual deployment of CV systems.</p> <ul style="list-style-type: none"> • V2V communications based on dedicated short-range communications (DSRC) technology. DSRC-enabled devices in vehicles that broadcast safety messages may be regulated and thus comprise a certain set of research, development, and adoption questions that are specific to this authority. • Other CV technologies and communications that are enabled by either DSRC or other networks, such as cellular, Wi-Fi, or satellite. The research will consider how various technologies and communications media will interact and operate within the anticipated CV environment, including safety and other types of applications and messages.

N	The main research directions in the ITS	Description
2.	Automation	The automation research will focus on study about automated road-vehicle systems and related technologies that transfer some amount of vehicle control from the driver to the vehicle. Automation technologies offer tremendous possibilities for enhancing safety, mobility, and the environment, but also pose new technical and policy challenges. The focus of the ITS research in this area will be on the advancement of technology and systems to enable smooth and safe introduction of automated features into the nation's vehicles and transportation systems.
3.	Emerging Capabilities	The emerging capabilities research initiatives will focus on future generations of transportation systems. As the scale of CV implementation grows and automation of transportation systems increases, vehicle manufacturers, infrastructure providers, innovators, and entrepreneurs will discover new opportunities to use the technologies and data generated, while also protecting consumer privacy. Technological advances, new functionality, new applications, new operational concepts, and disruptive innovations will result. The research will track technological, market, and demographic trends throughout the globe and across industries to seek and evaluate emerging capabilities that demonstrate the potential to transform transportation, while also protecting consumer privacy.
4.	Enterprise Data:	With increased connectivity among vehicles, organizations, systems, and people, unprecedented amounts of data are being generated. New methods to collect, transmit/transport, sort, store, share, aggregate, fuse, analyze, and apply these data will be needed for management and operations of transportation systems. Enterprise data management initiatives focus on enabling effective data capture from ITS-enabled technologies, including CVs (automobiles, transit, and commercial vehicles), mobile devices, and infrastructure in ways that protect the privacy of users. These activities also focus on enhancing the creation of data environments that enable integration of data from multiple sources for use in transportation research, management, and performance measurement.
5.	Interoperability	Interoperability is essential to ensure effective connectivity among devices and systems. Interoperability focuses on enabling ITS elements in vehicles, devices, infrastructure, and applications to effectively communicate with other parts of the system as needed, regardless of where they are built and where or when they are used. Interoperability will be more critical than ever before with the implementation of CV systems and the introduction of automated transportation systems as system interdependencies increase, not only in number but also in complexity. Standards and architectures must continue to evolve to ensure that technological advancements are reflected, and the required backward compatibility and interoperability are maintained.
6.	Accelerating Deployment	As new ITS technologies and systems evolve into market ready products, the ITS research must address questions associated with adoption and deployment. Adoption includes the phase after testing, when technologies are ready for initial implementation in the "real world." As technologies transition from adoption to large-scale deployment, the responsibility of support for operators and deployers shifts from research and development to operations. Ensuring a smooth transition from initial adoption (seen as part of the overall research and development lifecycle) to widespread deployment, and working closely with deployers to understand and manage that transition require special attention and detailed programs.

It became clear during the review that no reports were available comprehensively covering the full spectrum of ITSS in the global, European and domestic markets of interest. This is mainly due to the diversity of definitions of ITSS and to the wide variety of narrow interests.

The main technology trends in the ITSS area

The main technology trends in the ITSS area are shown in Table 6 [39-61].

Table 6. Main technology trends in the ITSS area

N	ITS areas	The main technology trends in the ITS
1.	Advanced Traffic Management Systems	<ul style="list-style-type: none"> • Adoption of IP protocols and architectures for data transmission and systems integration • Greater sophistication of modelling techniques and integration with real-time adaptive systems • Increasing use of wireless for connecting field units.

N	ITS areas	The main technology trends in the ITS
2.	Road user charging, congestion charging and electronic toll collection	<ul style="list-style-type: none"> Increasing use of video analysis techniques, e.g. for vehicle detection, classification and number plate reading Increasing sophistication and cost reduction of competing microwave-based/DSRC systems and satellite-based vehicle positioning systems. The DSRC systems introduced by Austria and Switzerland and the satellite-based vehicle positioning system (VPS) introduced and operated in Germany have put down a marker for more sophisticated tolling systems. The launch of Galileo is likely to influence decisions on the market moving from DSRC towards VPS. Integration of other telematics facilities and features, e.g. diagnostics and mobile communications Drive towards technical interoperability across countries worldwide, particularly in Europe. Increasing accuracy levels with satellite technology, essential for a distance based charging. Galileo technology coupled with GPS is expected to provide increased coverage and accuracy. There is some move towards hybrid technology, using both GPS and DSRC where the GPS tracks the vehicle and the DSRC enables direct debits from the user's account.
3.	Road Safety Systems	<ul style="list-style-type: none"> The technology trends associated with vehicle active safety systems are outside the scope of the study as these are best dealt with by automotive engineering specialist organisations. However, it is worth noting that several Advance Driver Assistant System (ADAS) applications are emerging based on the use of digital map data as a key component for enhanced accuracy and results. These include Lane Departure Warning and Adaptive Cruise Control. Several other active safety systems will also be impacted by the use of digital map data, including: Electronic Stability Control, Hybrid Energy Management, Curve Warning and Adaptive Lighting. Overall there is a progressive trend towards autonomously controlled vehicles with the potential for platooning before this. Lateral and longitudinal controls are both required for this with a very distinct link to accurate and reliable location information. Secure data transmitted from the roadside to the vehicle could warn a driver that it is not safe to enter an intersection or that the vehicle is dangerously close to running off the road. Vehicles serving as data collectors could anonymously transmit traffic and road condition information from every major road within the road network, giving highway authorities the information needed to take action to relieve traffic congestion. Protection of privacy is paramount. The intent is that general data collected by the public sector would be anonymous and used only for safety purposes and for efficient management of transportation operations. It is expected that this technology will facilitate a number of uses that drivers may choose such as electronic toll collection or telematics services for which some private information might be required. For those services, the intent is that the owner or driver would have to —opt in and give permission for that information to be shared.
4.	Travel and Traveller Information	<ul style="list-style-type: none"> Floating Vehicle Data, a mechanism to measure the rate of traffic flow and provide an ITSS basis for some businesses to provide real-time and targeted information to drivers via the in-vehicle Radio Data Service – Traffic Message Channel (RDS-TMC); advanced systems that take account of real-time traffic conditions in giving visual and/or audible in-vehicle route guidance to drivers; mobile telecommunications companies offering real-time services to subscribers, providing benefits to the travelling public, recognising the legislative road safety restrictions in place about mobile phone use whilst driving; information provided at the roadside through variable message signs giving network operators an essential tool for real-time, visual messages that are informative, advisory, or mandatory; advanced signage that can inform drivers of parking availability on a real-time basis; websites that enables users to see current road traffic conditions such as road

N	ITS areas	The main technology trends in the ITS
		<ul style="list-style-type: none"> • traffic incidents, road works and congestion on the road network; and • real time rail, air and sea information available via the internet and mobile telephones.
5.	Public Transport Information System	<ul style="list-style-type: none"> • smartcard ticketing technologies that benefit passengers and operators; • automated vehicle location (AVL) technologies that bring fleet management benefits to operators; • AVL that enables local highway authorities and bus operators to work closely together to give buses priority at traffic controls; • roadside and in-vehicle camera technology to enforce bus lanes and to help protect the safety of passengers; • real time information systems to underpin deployment of waiting time information at bus stops or via mobile phones; • optically guided buses that use ITSS to position vehicles properly at bus stops to allow disabled access.
6.	Smartcard Ticketing	<ul style="list-style-type: none"> • Increased use of smartcards/electronic fare passes/E-cards arising from efficient technology developments. • Reduction in use of paper tickets - traditional paper tickets currently dominate the European market. With the development of efficient ticketing management systems, Smartcards are expected to expand and dominate the public transport ticketing market. Mobile E-Ticketing is expected to be more of a focus from 2016 and beyond.

2. Development of TTI Research Strategy and Main Directions of Research Activities

2.1. Analysis of the environment affecting the development of a research strategy

2.1.1. External factors

The strongest external factor contributing to the need to develop a 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.

A tension was also seen between the need to concentrate more resources on a smaller number of particularly well placed areas, and the breadth of the institution's portfolio needed to ensure an attractive teaching environment and provide a sufficient base from which new ideas and fields can emerge. Striking an optimal balance between competitive focus and sufficient breadth was regarded as one of the most challenging questions to be addressed and constantly reviewed in the strategy process.

The leadership stressed the importance of fostering basic disciplinary research and allowing it to compete, together with thematic and applied research, in the international research community. Since disciplinary and basic research represent the foundations of all other thematic and applied research activities, removing disciplines means removing the foundation for all thematic and applied research activities. If there is a lack of balance between basic research in the breadth and focus on thematic and applied research, it may easily become a lose-lose situation for the overall activity of the university. Brilliant "brain seeds", in the form of young academics, will choose fields where there is a career and where research can be funded. It is our opinion that a win-win situation may be achieved only from a good balance between a competitive focus on thematic research and a competitive focus on disciplinary research. But to reach this goal, a re-thinking in research politics with respect to how funds are divided between thematic and applied and disciplinary research activities will be required.

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.

Research strategies were also justified as a method to deal with reduced financial leeway. There are wide-spread pessimism concerning the overall willingness of governments to increase research spending significantly.

Given the belief that the overall money received by the institutions would not increase or at least not sufficiently to be competitive, the conclusion inferred was that, if an institution wants to do something new, it has to withdraw from current activity. There are broad consensus that strategic choices regarding content prioritization could not be avoided.

Entrepreneurship and connections with industry are the most important evidence of an activity having relevance in the current political and economic contexts. Indeed, outreach, seen as service to society and the contribution of university research to national economic growth and social needs, has been, or is being established, as the one of the main functions of universities.

In this situation institutions must include the expansion of knowledge transfer and innovation activities in their research strategies and strategic actions.

Sometimes businesses do not yet see the relevance of university knowledge production to their own concerns. In this case, university must make an effort to inform the companies of the potential interest and benefit to them of university research.

Small and medium sized enterprises (SMEs) especially, do not usually consider that universities could address their research problems. Thus the university must try to be as accommodating as possible and, when unable to respond to the problem itself, it refers the issue to another institution, so that the SME concerned still feels that approaching the university is worthwhile.

2.1.2. Internal factors

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 mobilize its potential among its researchers. Processes for identifying and fostering excellence and prioritizing 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.

To put research performance on a visible pedestal within the institution, by providing special research support, was seen to help build a research culture which could otherwise so easily be pushed into the background by the other demands made on institutions.

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-fertilization 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 prioritize 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.

Since pensions are well below professorial income the disincentive for a professor to retire is considerable, resulting in a serious impediment to the institution's capacity to refresh its research innovation through new intellectual human resources.

Given the problems with an older generation standing in the way of some of the most forward-looking new developments in research, these barriers to the renewal of human resources was seen to be one of the most serious threats to an institution's research development.

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.

There are concerns regarding the fragmentation, or lack, of internal communication between potentially relevant research areas. Such fragmentation is seen to be an inevitable result of the increasing specialization in science upon which scientific progress is predicated.

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.

Institutional leaders and researchers observed that not only funding authorities but also institutional leadership were paying increasing attention to, and making efforts to foster, research consortia.

Enhancing interdisciplinarity is regarded as one of the important tasks of institution, either because the most exciting scientific questions could not be answered without it, or because it enabled universities to help address real life problems which do not easily fall into scientific disciplines.

In order to foster interdisciplinary research on a wider scale, a TTI needs more researchers who have had the exposure of working as "translators" between different disciplinary communities and methods. There is a need to have a sufficient number of "gatekeepers" to act as links between units/organisation and disciplinary communities.

To support external grant acquisition, institution is expanding their research support services, the majority of which had been founded originally to deal with the complicated grant applications for EU funds. With the rapidly increasing multiplicity of tasks and contacts, new competences and significant personnel development are needed to tackle the new portfolio of research support and innovation services.

2.1.3. Challenges and Opportunities in the Current Planning Environment

The institution needs to focus very strongly on internal incentives and procedures to strengthen the quality (and to some extent also the quantity) of research performance. This will be mentioned not only in the strategic plans, but will be also a regular point in the discussions and negotiations between the institutional leadership, its committees and the decentralized units.

Indicator-based performance funding must be introduced at the institution in varying degrees, with the intention of serving as another means to help improve performance levels. This can be mentioned not in the strategic plan, but regarded as part of the overall strategic aim of increasing performance culture.

TTI fully recognizes it must operate within a set of challenges common to all universities arising from the globalization of higher education and significant technological changes. It is also experiencing changes in local demographics. We must forge our own unique path, taking into full account the challenges in our current planning environment. We should capitalize on our strengths and opportunities, define our priorities and formulate our strategies in order to maintain our upward trajectory.

Challenges

Greater demand for public accountability. We must increasingly take proactive steps to communicate and demonstrate our strong commitment to high academic standards and good governance to strengthen public confidence in our value, purpose and the benefits, tangible and intangible; we produce through society's investment in us.

Expanded role of higher education. We are faced with the increasing demand to actively engage in creating and applying knowledge to support industry and drive economic development; to improve people's lives through innovation and entrepreneurship; as well as to integrate these processes into the education of our students to expand their career pathways.

Heightened expectations by students, parents and employers. We must ensure vigorous review and continuous renewal of our academic programmes to maintain high standards and relevance, in light of keen competition and rapid changes that are occurring in the environments in which our graduates will be working and the requirements in today's corporate, NGO and government settings.

Increased globalization of research and education. The problems we are facing under globalization are increasing in complexity, requiring creative solutions. We need to enhance and expand our connections and collaborations with talents around the world to strengthen our interdisciplinary capability and to attract the best faculty, researchers, and students to join TTI to address critical global issues.

Changing patterns in funding. Public funding for higher education is changing significantly and its allocation is becoming more competitive; we must continue to raise our competitiveness, tap new funding sources, and strengthen our financial planning and management to ensure that we can support our strategic initiatives to yield the anticipated return on investments.

Opportunities

TTI impressive accomplishments and distinguished achievements in the past years have provided it with a strong foundation from which to scale new heights. We should support and build on existing strengths, extend our impact on Latvian society and beyond, envision new capabilities, and nurture emerging strengths in accord with our role as a leading university for professional education and problem-based research in the region.

It is our firm belief that TTI has the ingredients to become a magnet for global talents and innovation. We are neither constrained by tradition, nor rigidly defined with a fixed identity. This makes us receptive to new people and ideas and to diversity. We offer an exciting international platform for individuals from different backgrounds to work together and thrive. Such openness and fluidity provide TTI with the

freedom and unique opportunity to chart its own course and shape its future, based on its vision and academic aspirations.

At the same time TTI is at an excellent position — geographically, intellectually, and culturally — to capitalize on its cross-East-West position and strong commitment to innovation and internationalization, to enhance its international network and collaborations with talents in the world to promote cross-fertilization of ideas and create new knowledge to contribute to solving critical global issues.

Despite its relative youth, TTI has been receiving strong local support and increasing international recognition for its pursuit of academic excellence. It has built global academic partnerships and strategic alliances to internationalize education and promote research and knowledge transfer. We have greatly enhanced the diversity of our faculties to support internationalization of learning.

2.2. Research Strategy of Transport and Telecommunication Institute

Framework for development of the research programme of Transport and Telecommunication Institute shown in Figure 6. The main components of this programme are described in the current document.



Figure 6. Framework for development of the research programme of TTI

2.2.1. Our Vision of the University

We will enhance our position as a leading modern university through the delivery of excellent teaching, through the engagement in research of international quality and in the knowledge services of the highest standard, enabling us to make a major contribution to the social, cultural, educational and economic development.

Excellence is at the heart of our strategy. We aim at the highest quality in all we do, achieve through the culture of evaluation and continuous enhancement. The full commitment of our staff and constructive staff support and development are essential to the delivery of our vision for the success of the University.

We will be a socially responsible university, serious about inclusivity and committed to improving social mobility. We will maintain the highest levels of academic and professional integrity and will ensure that

we deliver our obligations in relation to corporate social responsibility. Our strategy will be driven by the values of equality, openness, tolerance and respect. We will demonstrate and expect of others ethical and responsible behaviours.

Our research and knowledge services will be of excellent quality and supportive of our ambitions for outstanding teaching. Our strategy for research will be ambitious, selective and oriented to impact. It will be responsive to the external research context and funding opportunities, so that we maximize the research income in order to create a sustainable research environment. We will create a new structure and strategy for knowledge services which will support expansion of our activities and raise the University's profile as a provider of choice for the research-led innovation.

2.2.2. Implementing the strategy

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

Our ambitions will be delivered largely through three key strategies: Research Strategy (Annex 2), Education Strategy (Annex 3) and Knowledge Services Strategy (Annex 4). Each has its own aims, targets and performance indicators.

The Research Strategy is the core element of this set of strategies (Figure 7). The Knowledge Services Strategy is closely associated with the Research Strategy and is focused on the commercialization of research activities. 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 7. The structure of key TTI strategies

Our vision for Research recognizes that research excellence and innovation are integral to our overall strategy and to our strategies for Education and Knowledge Services. Our goal is to address fundamental and strategically important questions and to deliver economic, social and cultural impact at regional, national and international levels, through engagement in internationally-leading research activities and collaborations. This will be achieved through the following aims:

- We will support the highest quality research and develop collaborations that enhance the contribution of research to the broad portfolio of our activities.
- We will support and develop excellent researchers within a sustainable research culture.
- We will ensure that research informs our teaching and enhances the student experience.
- We will promote and publicize the contributions that our research makes to the advancement of knowledge and to wider economic and societal benefit.
- We will set very high standards to ensure that we maintain and advance our reputation for research. Our strategic investment in and support of research will be necessarily selective.

Our vision for Knowledge Services is to expand our provision of the quality-assured knowledge services commissioned by other organisations to improve their efficiency, effectiveness or profitability. These services are underpinned by our excellence in teaching and research, contributing to and making use of the high-level skills of our staff and our state-of-the art facilities.

2.3. Research Focus

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 the national and international levels) 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 the 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 (pillars) will integrate the research capabilities and the programme strengths of TTI to enhance our capacity to respond to the academic and societal challenges (Figure 8.):

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

➤ **Smart Cyber-Physical Systems**

Cyber-Physical Systems (CPS) refer to the 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.

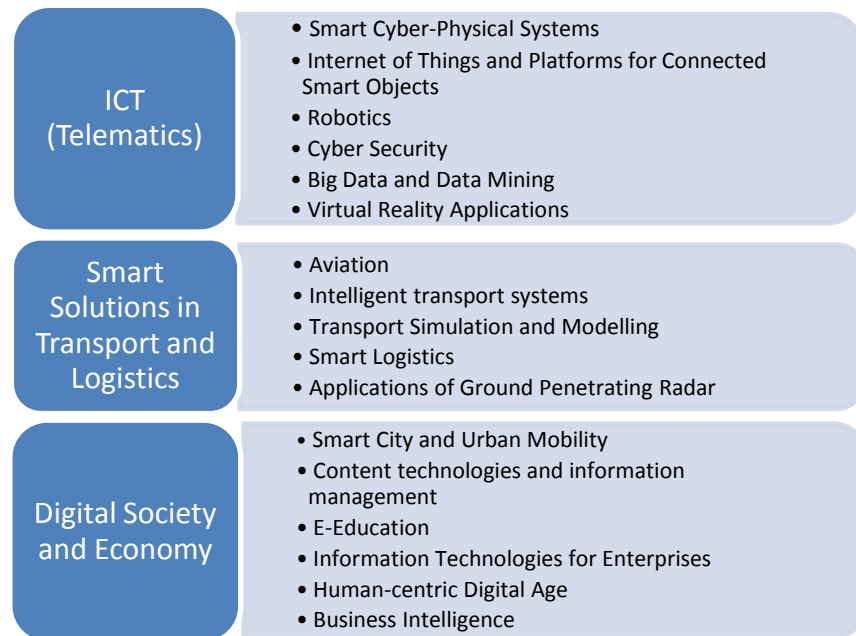


Figure 8. Main directions of TTI research activities

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

➤ **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 the vertically-oriented closed systems, architectures and application areas and move towards the 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 bring 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 provide 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 optimization 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 with 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.

Pillar 2. Smart Solutions in Transport and Logistics

➤ 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 interoperability.
- Implementing Key Performance Indicators (KPIs) 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 analyzing, 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 mezzo 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 optimize the planned delivery route, based on the specifications of Modular Load Units, the vehicle or container and all the 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.
 - Harmonize 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 the 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.

Pillar 3. Digital Society and Economy

➤ Smart City and Urban Mobility

Many innovative solutions for sustainable urban mobility have been or are being 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 the 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 the 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-modal 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 prioritized 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 wifi 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, micro learning, game-based learning and/or virtual environments/virtual worlds to real-life learning situations.

Research activities will focus on the 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 visualize 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 the 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 the idea conception to production.

➤ **Human-centric Digital Age**

The research actions will be oriented at the 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 the business analysis purposes. BI technologies are capable of handling large amounts of the 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.

3. Programme and action plan for TTI research development

This section will present the main strategic initiatives, key performance indicators (KPI) in the KPI framework, action plans for the KPI achievements. A detailed plan of actions for the period up to 2020 (with a half-year step) and the KPI for each stage should be developed before the end of 2015. The key points for these plans are the following:

- Experts' recommendations (see Annex 1)
- Institute development strategy (see Annex 2, Annex 3, Annex 4)
- Priorities the development of Latvia ([Sustainable Development Strategy of Latvia until 2030](#))
- Forecasts for the industry development (Industrial evaluation of RIS3 strategy)

For building realistic plans it is also important to take into account certain limitations (barriers) of the TTI as of a scientific organisation.

For one thing, **1st barrier** is not enough due attention to improving all scientific fields (mentioned in 1st and 2nd chapters) to a higher level, which leads to an uneven development of these areas. But the reason lies in an insufficient number of the research staff not only in the TTI, but in the whole Latvian market.

TTI is a non-profit private state accredited by HEI with primary activities in the field of education and training that was established in 1999 on the base of the Riga Aviation University (RAU). Due to the stable university traditions of conducting scientific research, the authorities' vision of the institute development has permanently involved active scientific activities as an obligatory condition of high quality education in the sphere of ICT, Transport and Logistics scientific direction became the second in priority sphere of the institute activities. The result is the "4" deserved mark from the international experts of the scientific activities of the TTI in 2014, but there has remained a major, above mentioned, problem – insufficiency of resources for the Institute to become more recognized in the European scientific arena.

Thus, we may state the problem of the dedicated (free from the education process) scientific researchers who would be engaged in the scientific research at full range. The Figure 9 presents the KPI values – the number of researchers who are included in the Register of the Academy of Sciences who, at the same time, are academic staff or PhD students. In 2014 26 researchers were registered in the official database, but recalculation to FTE is about 9 FTE (see Figure 9).

2nd barrier - the narrow field of the TTI research (and educational) activities in the modern highly technological and fast developing industry of the "ICT applications" is one of the most competitive ones in Europe and in the world. And in spite of the recognition of the Institute as of a major national player in this field, the starting positions of TTI in the European advancements are much weaker than those of the research entities of the "EU innovations leaders".

Therefore, the main efforts in the nearest five years should be aimed at the effective HR policy and sustainable cooperation strategy with the significant EU and Latvian research players. The TTI future research must be focused on strengthening its positions in the European market.

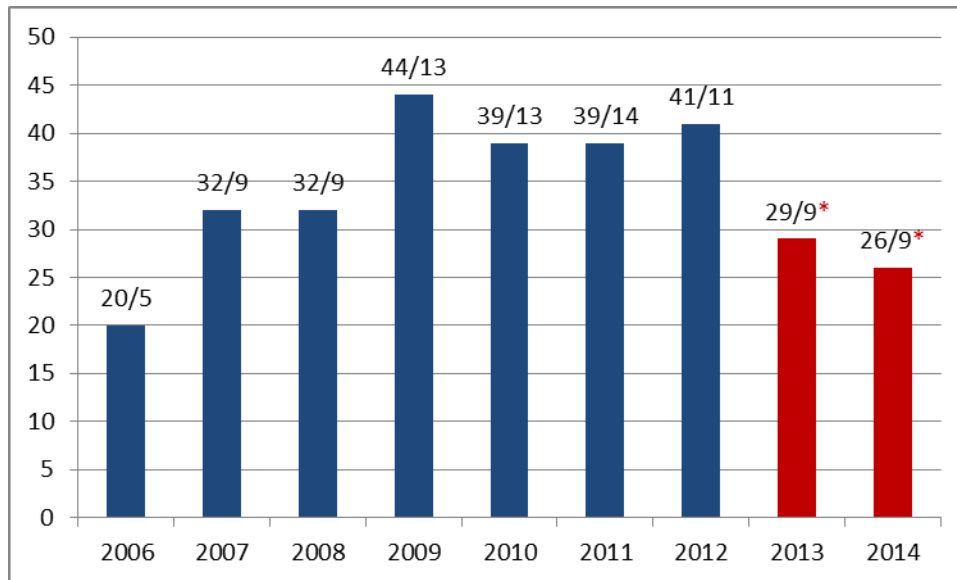


Figure 9. Research staff number/FTE (*elected and registered in official [database](#))

3rd barrier is lack of financial support for research initiatives. This barrier could be overcome by diversification of funding sources among EU funds, National funding programmes and TTI funds for development.

3.1. KPI framework for TTI sustainable development

The target model for research at TTI in 2020 foresees the diversification of R&D areas through the organization of interdisciplinary modes of research, building on core competencies of TTI but enriched the new subject-areas of ICT in transport and logistics.

The target model for research activity in 2020 will also be characterized by the following features:

- "TTI Fellowship" program recruits foreign academics and researchers to work at TTI based on an open international competition (for the positions of Postdoc, Researcher, Senior Researcher).
- "TTI Staff Portfolio" program financially incentivizes the staff and students at TTI to increase their personal publication rate; the amount of the compensation depends on the impact-factor of the journal, the involvement of a foreign co-author and the citation index.
- At least one of TTI's academic journal or international journal with TTI co-publishing is included in the Scopus and/or Web of Science database.
- A developed intellectual property policy is implemented in TTI, including patents, trademarks, other outputs or results of intellectual activity of the TTI.
- TTI holds at least two annual international researches and technology conference sponsored by TTI and international research associations and organizations.
- The graduate programs in TTI relies two pillars:
 - on the "science-education-business" model with active participation of business partners: organizing internships for graduate and post-graduate students; growing the number of programs, developed together with businesses

- on the international base: to establish the international Master's and PhD programs (by 2020 – at least 2 double degree programs with foreign partners, including through distance learning) and to enrich the environment for active international academic mobility, including internships for graduate and post graduate students as well as researchers in the EU research centres, and internships for foreign scientists and students at TTI.

The KPI framework presented on Figure 10 is used to follow the development tendency of TTI as research institution. The Table 7 demonstration current values of indicators (2014) and planned for 2020.

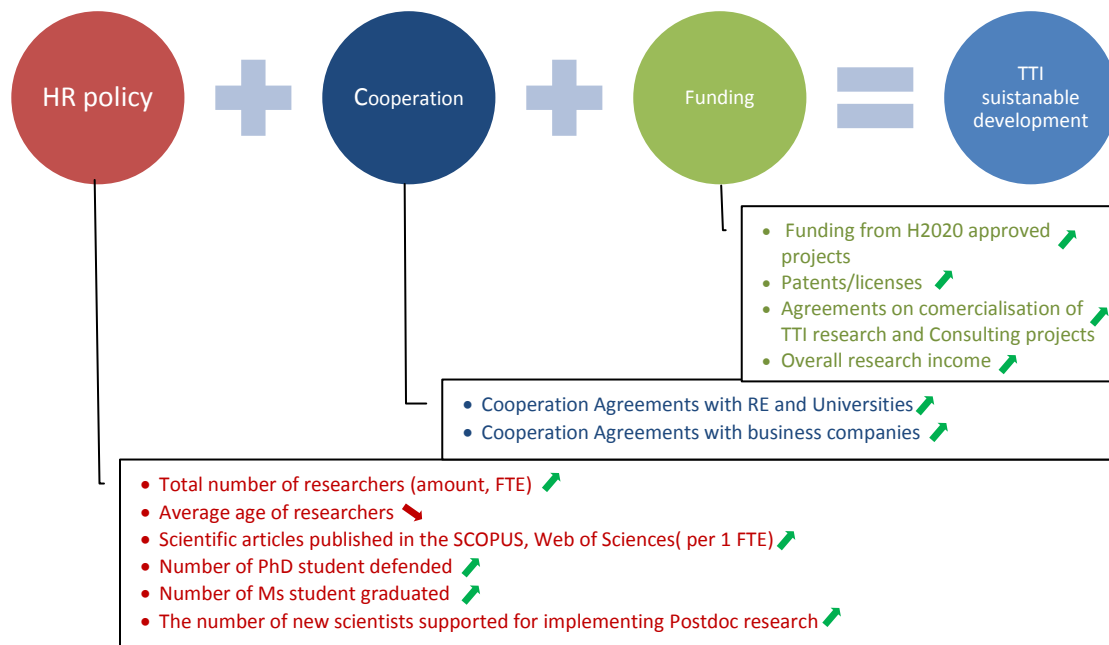


Figure 10. KPI framework

Table 7. Current and planning values of research KPI

Group	KPI	Value	
		2014	2020
HR policy	Total number of researchers:		
	- amount	26	40
	- FTE	9	15
	Average age of researcher	56	45
	Scientific articles published in the SCOPUS, Web of Sciences (per 1 FTE)	0.8	1.5
	Number of PhD student defended	3	6

Group	KPI	Value	
	Number of Ms student graduated	57	70
	The number of new scientists supported for implementing Postdoc research	0	2
Funding	Funding from H2020 approved projects	87 000	120 000
	Patents/licenses	1	7
	Agreements on commercialisation of TTI research and Consulting projects	2	5
	Overall research income		+30%
Cooperation	Cooperation Agreements with EU RE and Universities	12	24
	Cooperation Agreements with business companies	7	14

3.2. Roadmaps of research activities and initiatives

Since the formulation of action plan appears to be of central importance for all aspects of this document the separate roadmaps were drafted for the development plan, highlighting also the impact expected. The roadmaps are drafted for five years and up and foresee the implementation of measures and eventual adjustments and/or corrective measures according to the changing economic or scientific demands.

The main avenues of transformation and development of TTI are formulated into six strategic initiatives:

Strategic Initiative 1 (SI #1). *Improving the positions in research in the number of areas of the sixth technological order*

The initiative is aimed at:

- the diversification of the TTI's research and academic subject areas to expand beyond the narrow confines of its engineering profile;
- raising the standard of the TTI's international research output: quantity of publications, citation index, number of patents and the like, in line with that of leading EU universities.

The context and concrete actions on the implementation of *Initiative 1* divided in two stages according to the roadmap are shown in Annex 12.

Strategic Initiative 2 (SI#2). *Integration of TTI into the global research and educational system through leading research, information and learning technologies*

This Initiative is aimed at improving the graduate programs and the system of recruiting graduate foreign and domestic graduate students. It includes implementing postgraduate programs in cooperation with EU and LV universities and research organizations to include a system of dual degrees and forming a system for scientific internships during the Ms and PhD theses preparation period. This Initiative is aimed at taking the collaboration in research and education at TTI to a new level through:

- partnerships with EU and Latvian Universities, research establishments (RE) and high-tech companies around the world;
- creation of joint Masters and PhD programs;

- implementation of innovative learning technologies, including distance learning, research-based learning, project-based learning, problem-based learning;
- increase in quality and broadening of the audience of the TTI's graduate programs;
- stricter quality control of education.

The implementation will be undertaken in two stages and shown in Annex 13.

Strategic Initiative 3 (SI#3). Creating a novel HR system and forming a highly professional research staff

Reorganization of working with personnel: a move away from the personnel accounting to an HR management system based on the global best practices of motivation, continuing education, etc.

This strategic initiative is aimed at the systemic modernization and an increase in the efficiency of HR work at the TTI. The basic principle of the HR strategy is recognizing faculty, staff and students as the key assets of the TTI that determine its development. There should be a change in the personnel policy program aimed at developing human research potential and includes the development of:

- assessing the quality of personnel;
- retention of the excellent researchers;
- system to attract talented young researchers;
- system to attract highly qualified personnel from other countries.

The implementation of the initiative will be undertaken in two stages and shown in Annex 14.

Strategic Initiative 4 (SI#4). Development of strategic communications and achieving high recognition of TTI nationally and globally

The initiative is aimed at raising the international competitive advantage of TTI by increasing brand awareness of the TTI internationally, recreating its image and developing a corporate culture, and significantly increasing the efficiency of its internal and external communications. The initiative is based on a comprehensive communications strategy, implemented across all areas of TTI development including, first of all, research development.

The implementation of the initiative will be undertaken in two stages and shown in Annex 15.

Strategic Initiative 5 (SI#5). Development of the innovation ecosystem to support the growth potential of TTI in knowledge and technology transfer

This SI is aimed at transforming the processes of organizing technology transfer, R&D commercialization placing the innovation ecosystem at TTI at a higher level in line with the TTI's development objectives.

The activities are to be carried out in two stages, each of which focused on a separate development driver of the innovation ecosystem (see Annex 16).

Strategic Initiative 6 (SI#6). Transformation and development of the TTI management system based on the principles of a research and business-oriented university

New challenges and ambitious goals of the University demand a complete overhaul of the TTI's management system. The implementation of this initiative involves moving the entire management

system and the TTI in general towards the triangle principles of *a research-community-innovation* oriented university. This initiative is carried out in two stages and shown in Annex 17.

All activities of these strategic initiatives affect the following results in:

- Research Governance Development
- Human Resources Development
- Networking
- Infrastructure improvement
- Financial issues

3.3. Human resource development. Postgraduate education and postdoctorate research

The Human Resources Strategy for Researchers is a tool provided by the European Commission. With its help, TTI has adopted the principles of the [European Charter for Researchers](#) and the [Code of Conduct for the Recruitment of Researchers](#) as a part of the development processes of the researchers' employment contracts, careers and the work environment.

According to the Human Resources Strategy for Researchers process consists of phases:

1. Gap analysis. The current practices and procedures of TTI are compared with the principles identified in the European Charter for Researchers.
2. Drafting an action plan. The action plan incorporates a concrete plan outlining how to implement the observed developmental measures.
3. The European Commission' experts review of the action plan.
4. The TTI subjects the implementation of its action plan to a self-assessment after two years. This process is repeated every two years.
5. An external evaluation is carried out every four years.

The practical implementation of HR strategy work at TTI was coordinated and planned by a working group authorized by the TTI Rector. The work was directed by the TTIs quality steering group, which has representatives from both teaching and research personnel and is chaired by the Rector. The quality steering group examines quality management at the TTI as a whole and supports the Rector in the HR strategy implementation. HR strategy work is a part of the quality work and development of operations at TTI. The working group operated in cooperation with the personnel organisations and other stakeholder groups and research personnel participated in the work through the following channels: Research council and Quality Steering group.

The gap analysis started in September 2014. The working group compared the regulations, principles and operations models used at TTI with the goals set in the European Charter for Researchers. On the basis of its assessment, the working group concluded that the procedures that are based on legislation, the Strategy of the TTI and its implementation programmes (internationalization, HR and communications strategies). For example, the terms of employment, recruitment, salaries, gender balance and participation in decision-making bodies are areas where the required regulations and instructions are already in place. The procedures that generally will correspond to the recommendations have been developed till 31 of December 2015.

The topics that were defined on the basis of the gap analysis as areas that became the base for actions plan. Issues related to the changing research distribution by age, stability of employment contracts, the

meaning of supervisory work and communications were highlighted as the result of the working group activity and need actions that promote mobility, career advancement and equality.

The main actions can be combined in groups:

- *Mobility* (exchange visits, STSM, summer schools, etc)
- *Access to career advice* (self-assessments, career roadmap, training)
- *Stability and permanence of employment* (funding between projects, sharing good practices, HR planning, clearer career plans, highlighting the supervisory role, making use of development discussions)
- *Professional responsibility and attitude, ethical principles* (training on the legislation concerning document management, protection of research data, ethic aspects)
- *Dissemination of research results*
 - popularizing science, for example by organizing regular and open thematic events that present current research
 - support for scientific writing, publishing active support for popularizing research results; training, researcher interviews on YouTube, open events for stakeholder groups, communications plans of research projects, meetings with the funders after the research projects have been completed.

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 (by amount and by FTE), but also a significant change edge structure of the research staff. Figure 11 shows the current edge structure of the research staff and target until 2020.

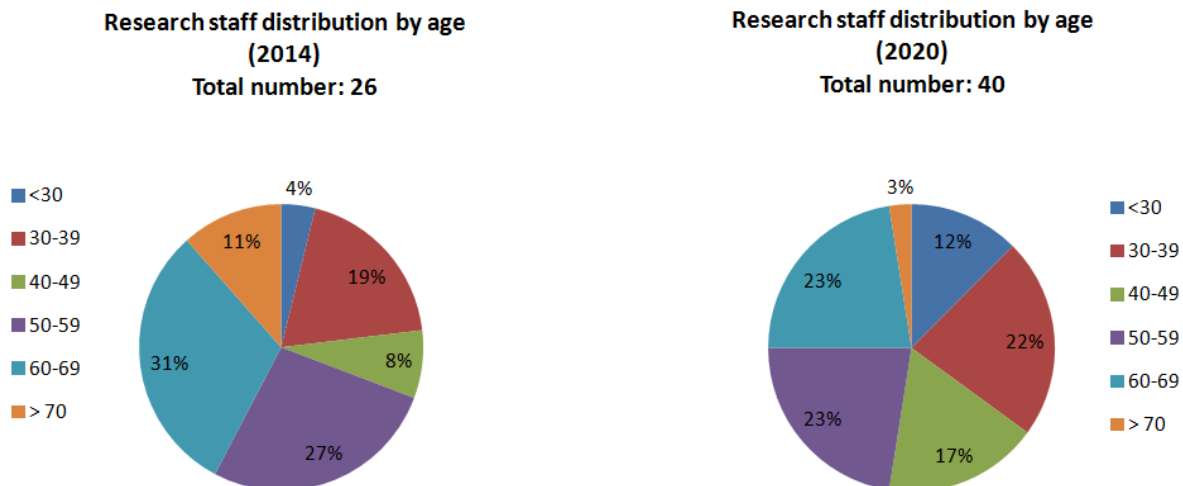


Figure 11. Research staff distribution by age

TTI has PhD program in Telematics and Logistics. A doctoral thesis is generally understood as the conduct of scientific research under the supervision of qualified academic staff (associate or full professors). Research work is therefore carried out in a particular department of the institute, the resources of which are used. The same applies for master students working on the master thesis, where a similar situation of supervision is given (assistant, associated or full professors). The goal of 3 from TTI

Ms Programmes and PhD program – to prepare the high quality personnel for EU in the STEM fields. The list of the PhD defended in 2006-2015 is in Annex 6.

At the same time the spotlight on the main problems in this direction:

- insufficient number of students taking the graduate and postgraduate program (Table 8);
- insufficient number of students' timely defences;
- insufficient number of doctoral students from Business Environment;
- insufficient quantity of foreign PhD students.

Table 8. Number of Master and PhD students in 2006-2014

	2006	2007	2008	2009	2010	2011	2012	2013	2014
Completed their Master degree	97	125	103	102	103	80	61	72	57
Started PhD studies	3	9	3	8	7	3	2	1	2

Tasks:

- To establish of a database and contacts to former TTI students successful as researchers abroad or in leading position in national and international companies. The purpose is to involve the alumni in the development of the scientific research at TTI, both as partners for international cooperation, mentors and supporters in general. Furthermore, positive contacts could particularly be useful for applications within the Horizon2020.
- Further establishment of partnerships with universities in Europe and oth., with research institutions. Partnerships are formal cooperation agreements concerning both higher education and research cooperation.
- To establish a double mentoring system for PhD students: Depending on the field of study mentors can be found both in international universities/research institutions and/or in enterprises. Mentors in this case are understood as persons providing financial and scientific support for individual PhD students allowing them to carry out doctoral research work at the highest level.
- Introduction of a joint PhD program in Transport Management. To establish joint PhD programs with European and other international universities: such programs offer the advantage of a solid basic education at TTI combined with the realization of the doctoral thesis in internationally recognized and well equipped institutions. Students in this case should have supervisors at both universities in order to obtain a better identification with the research work and the cooperation itself.

3. 4. Collaboration strategy

Establishing a networking framework between TTI and the Latvian, the EU and other Research Institutes will be pursued from the very beginning of the TTI creating. TTI pays special attention to the collaboration of scientific personnel with colleagues from others research entities (RE) and universities and as the results of this collaboration are:

- common papers with researchers from Ben Gurion University (Israel), Gediminas Technical University (Lithuania), Magdeburg University (Germany) and others.
- Annual International Conferences, scientific workshop in the frame of EU projects have been organized on regular basis.

- with the Fraunhofer IFF (Magdeburg, Germany) referred to the transferring of technology of creating virtual reality worlds to TTI, etc.

TTI established close collaborations with EU Universities through ERASMUS program and it gives an opportunity to establish new scientific contacts (for instance, with University of Žilina (Slovakia)), refers to more active participation in international Conferences and a growth of the number of joint publications and common scientific projects.

Common scientific projects within the frames of various EU programs give an opportunity to find new scientific projects and lead to the knowledge and best practices transfer not only to TTI, but general to Latvia. Good examples here are the B2BLOCO project and TTRANS project within the frame of the FP7 Program. The outcomes of these projects are of great importance because of linking different types of institution in the area of transport in a network. This network will unite scientific organization and SME for more intensive integration of new technologies in practice that is of the essence for both parties (see Figure 11).

And for next (2015-2020) period TTI has the ambitious plan: to increase the quantity of cooperation agreements **twice** and establish the strong scientific alliances in main directions of TTI research activities.

First of all, the research activities aim at opening the grounds for exchanging knowledge, and combining capabilities of the participating members, exploit existing research results and invest in developing more knowledge, assuring at the same time the research sustainability.

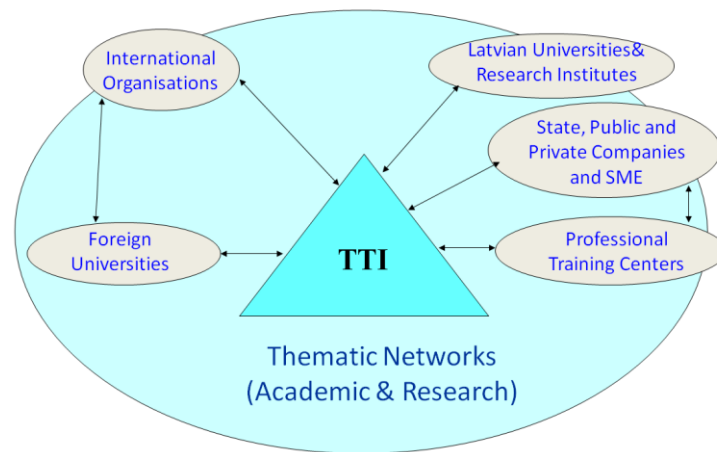


Figure 12. Cooperation cloud of TTI

At the same time, it need used to initiate an open scientific platform to be evolved further to common excellence activities and it will ensure sustainability of the networking for long-term period. Such activities include staff exchanges, expert visits, short term on - site or virtual training, workshops and seminars.

TTI has the plan for 2015 to sign the agreements and develop of cooperation plans at least with 3 research establishments (RE):

- **Centre for Research and Technology-Hellas (CERTH), Greece.** It is a legal entity governed by private law with non-profit status, supervised by the General Secretariat for Research and Technology (GSRT) of the Greek Ministry of Education and Religious Affairs. CERTH has important scientific and technological achievements in many areas including: Energy, Environment, Industry, Mechatronics, Information & Communication, Transportation & Sustainable Mobility, Health, Agro-biotechnology, Smart farming, Safety & Security, as well as several cross-disciplinary scientific areas.
- **Fraunhofer Institute for Factory Operation and Automation IFF (Magdeburg, Germany).** IFF is an autonomous research unit in the Fraunhofer-Gesellschaft's network. Its mission is to directly support business and benefit society with its applied research. It relies on an international research network of partners from business, industry, research and academia in the fields of logistics, automation, process and plant engineering and digital engineering.
- **The University of Tartu (Computer Science Institute) (Estonia)** is in the world's top 400 universities (THE ranking) and belongs to the top 1% of the world's most-cited universities and research institutions in several fields, including engineering (according to ISI Web of Science).

Close collaboration with these internationally-leading counterparts in Europe will help to achieve the goals through the following activities:

- organization of young researcher's seminars and training schools;
- organization of workshops and Conference;
- enhance the educational programme for graduate (Ms Computer Science, Ms Management Information Systems, Ms Transport and Logistics) and post-graduate students;
- enabling short term scientific missions with the aim of international collaboration in preparing exploitation of research (mainly publications);
- preparing common project proposals.

TTI decided to join [ECTRI \(European Conference of Transport Research Institutes\) organization](#) to become more visible in the European research area. By participations in ECTRI thematic groups: TG Mobility; TG Freight and Logistics; TG Traffic Management, TTI participates in activities related to the thematic groups: define research topics of interest for influencing EC policies and programs; participation in EU projects; networking and scientific exchanges. Participation in ECTRI thematic groups give ability to bring out TTI interests to participate in EU research projects and to be involved in proposals initiated by ECTRI members.

TTI also (as whole organization or research personnel) participated in activities of next European organizations mentioned below:

- Joint Transport Research Centre of the OECD (Organisation for Economic Cooperation and Development) and ECMT (European Organisation of Ministers of Transport)
- Informatics Europe
- European Engineering Deans Council
- Association of Paneuropean Coach Terminals
- Association for Information System
- European Council for Small Business and Entrepreneurship etc.

Following national academic and research entities are treated as core partners: Institute of Electronics and Computer Science (EDI); Riga Technical University (RTU), Latvia University of Agriculture (LLU), Vidzeme University College (ViA).

Taking into account the comments of the experts on the need to revitalize the TTI Research activities in the field of Energy TTI began cooperation, suggests to sign the contract with the Latvian Institute of Physical Energetics (FEI) and collaborate with this RE on R&D of the smart grids and green technologies.

4. Participation in projects

The core element of the TTI research plan is the participation in different level research projects: international, national and local. For the last 6 years TTI has participated in more than 29 different level projects (international, national and local), including 4 projects completed in the framework of the FP program of the EU. Most of the projects are related with the TTI main research area - ICT application in transport and logistics. The Annex 8 shows the funding amount of TTI from the research activity by their sources.

The analysis of the data shows the positive trends in funding research activities of the TTI and underlines that the institution does not receive any financial support from the state. The analysis by sources of financing for the 2009-2014 gives the following distribution presented in Figure 13.

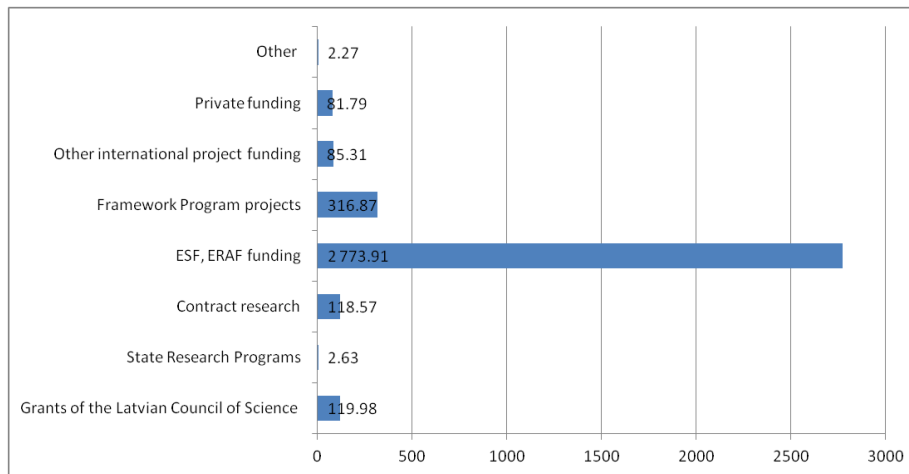


Figure 13. Source of funding expressed in thousands EUR (2009-2014)

79% of the financing were received during execution of 2 ERAF projects and 2 ESF projects. ESF projects were targeted on the support of the master study programme ([Support for implementation of TTI master degree programme „Master of Natural Sciences in Computer Science”](#)) and the support of the doctoral study programme ([Support for implementation of the Transport and Telecommunication Institute doctoral degree programme „Telematics and logistics”](#)). In the observed period of time, also the following projects received ERAF funding: [Optical fiber sensor applications for automatic measurement of the weight on the move: research and development](#); [Information and communication technologies as a single academic resource in the Transport and Telecommunication institute](#). Also, starting from 2014 TTI got opportunity to be financed in the framework of the State Research Programs, earlier participation in the program projects were financed by TTI (source of funding - Private funding) [NextIT](#). Also, positive dynamics could be seen in completing the contract research. For the analyzed period of time TTI participated in two FP7 projects and provided more than 5 proposals (in cooperation with EU partners).

Here, there must be noted, that during the evaluation of the TTI, experts by their marks, underlined its good national research level that is why the main goal till 2020 is to significantly raise participation of TTI in the international level projects. The core problem in the significant change of the situation is the lack of staff. Currently TTI is running out of the research capacity. This makes clear that in order to actively

participate in projects it is necessary to increase significantly the number of researchers and academic staffs involved in the research. Here, two main opportunities are foreseen: 1) active involvement of master and PhD students in the projects; 2) to increase quality and skills of the existing academic staff, who currently are not active in the projects; 3) active involvement of external researchers.

That is why in the framework of this research program the holistic approach is proposed as the core strategy of participation in the projects. This approach takes into account: lack of research staff; 2) the conclusion of the EU experts, which says that TTI has good national research level, but still cannot be treated as a significant international player. That is why the approach takes into account the international level research possibility, without detracting participation of TTI in the national level research programs and projects. The general view on the holistic approach could be presented by Figure 14.

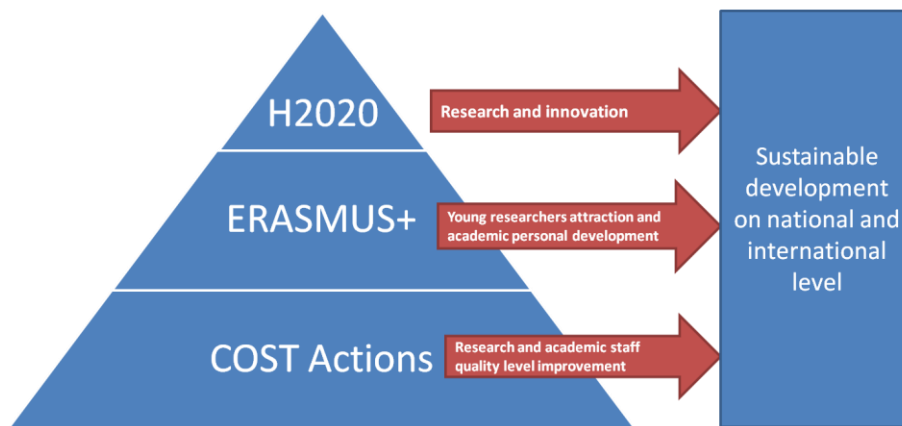


Figure 14. Holistic approach on improvement participation in the international level projects

The approach is directed to the sustainable development of TTI at the national and international levels. But this could be reached only by having necessary resources. Here, under “resources” we primarily understand academic and research staff. According to the approach it is planned to intensively use the projects in the framework of the COST program in order to increase the quality level of the academic and research staff using at the same time the COST Actions as a platform for PhD and master students. The next level is focused on participation in ERASMUS + program projects. This gives opportunity to make research and management staffs familiar with the projects (management and active research) and at the same time improve the education process and involve young researchers in the project. Finally, the last level is orientated on participation in the Horizon2020 program. The projects in the framework of the program are orientated on research and innovation processes. From such projects TTI could benefit much from the scientific point of view: highly cited articles, participation in international level conferences, patents, etc. But participation in the Horizon2020 needs advanced research staff and intensive collaboration with international players. Both issues shall be reached by active participation in the previous level programs.

4.1 COST Actions

Cost Actions is an efficient networking tool which is able to establish strong collaboration between researchers, engineers and scholars. The main activities supported by the COST Actions are as follows: workshops, conferences, training schools, short-term scientific missions (STSMs), and dissemination

activities. COST Actions does not fund research itself, but is able to establish intensive knowledge sharing among the participants in the selected field and therefore raise the quality level of the staff involved and at the same time provide opportunity for PhD and master students to be involved in the international community of experts in the selected field of research.

4.1.1. Current state

TTI has been participating in COST Action science 1999. From this time TTI has successfully participated in 10 COST Actions. The participation in COST Action gave possibility to obtain new knowledge and practical experience to successfully defend PhD theses.

As good example, here, the promotion works of the following PhD students could be mentioned:

- Integral estimation of urban public transport system service quality from the end-users point of view (by Irina Pticina, defended in 2015);
- Non-traditional regression models in transport planning and modelling (by Nadezda Spiridovskaya, defended in 2015)
- Reconstruction of the roadway coverage parameters by radar subsurface probing (by Aleksandrs Krainukovs, defended in 2014);
- Methodology of decision-making support on the base of urban transportation system microscopic models repositories (Elena Yurshevich, defended in 2013);
- Development of new approach for simulation and analysis of traffic flows on mesoscopic level (by Mihails Savrasovs, defended in 2013);
- Modelling of the urban transport impact on the city atmospheric environment using apparatus of mathematical physics (by Stanislav Aryeh Fradkin, defended in 2013);
- Monitoring System of the Quality of Passenger Terminal Services and the Realization of the Passenger Logistics Centre within a Multi-modal Transport System (by Vaira Gromule, defended in 2010);

This concerns us that COST Actions by their activities workshops, conferences STSM provide perfect environment to push young researches to do their scientific research and finally defend their promotional works. Also, it must be mentioned that all the above PhD students are still active in research in TTI.

At the current time TTI is involved in a number of actions related with the field of the current research program. The list of running actions is presented in the table below. As most of the TTI research is orientated on application of ICT in the field of transport mainly, TTI participation is focused on the Transport and Urban Development domain of COST.

Table 9. Running COST Actions

Action title	Period	Supervised
COST Action TU1408 Air Transport and Regional Development (ATARD)	2015-2019	Prof. Igor Kabashkin
COST Action TU1306: Fostering knowledge about the relationship between Information and Communication Technologies and Public Spaces supported by strategies to improve their use and attractiveness (CYBERPARKS)	2014-2018	Prof. I. Yatskiv
COST Action TU1208: Civil Engineering Applications of Ground Penetrating Radar	2013-2017	Prof. V.Kutev

4.1.2. Planning

Taking into account the particularities of the COST program, it is not possible to create a specific list of the actions in which TTI staff will be able to participate in the future. Therefore, here are highlighted

only the domains which are interesting for TTI participation. Under the list of interesting domains, the following ones could be enumerated (see table below). In order to involve the staff in COST Activities the research department of TTI, on a regular basis, will scan the initiated projects and share this information with all TTI staffs using the organisation internal communication tools (like e-mail, workshops, day of science in TTI etc). It is planned before 2020 to have the following involvement in COST Action:

- Information and Communication Technologies Domain - **4 actions**;
- Materials, Physics and Nanosciences - **1 action**;
- Transport and Urban Development - **4 actions**;
- Trans-Domain Proposals - **1 action**.

Table 10. Target COST domains

Domain title	Domain description
Information and Communication Technologies (ICT)	The ICT research area is best summarised as treating the processing, transmission, storage, retrieval, management, usage, and exchange of information and knowledge, with emphasis on fundamental aspects and pre-competitive technology development.
Materials, Physics and Nanosciences (MPNS)	The Domain thus also incorporates nanomaterials and nanosciences and the nanotechnological applications thereof. It also supports exploratory basic and applied research in physics, theoretical and experimental, as a key to understanding the laws governing the behaviour of matter and energy.
Transport and Urban Development (TUD)	TUD fosters research coordination in the fields of transport and the built environment, which play a strategic role in the modern society and economy.
Trans-Domain Proposals	Trans-Domain (TD) COST Actions offer researchers fertile ground for future networks across many science and technology disciplines, by allowing unusually broad, interdisciplinary proposals to cover several scientific fields.

4.2. ERASMUS +

The ERASMUS + program provides a number of opportunities to raise the quality of the education process and therefore prepare a new generation of academic and research staff. The projects in the framework of ERASMUS + are orientated on the innovation solutions in education, knowledge exchange, joint master program etc. Participation in ERASMUS+ projects gives a wide range of possibilities for the education and research staff and for PhD students.

4.2.1. Current state

Taking into account that ERASMUS + is a new program, TTI does not have much experience in participating in this program, but still a number of the proposals have been completed and are still pending for the evaluation, where TTI participates as a partner or as a lead partner. Now, 2 proposals have been accepted and are running:

Table 11. Running ERASMUS+ projects

Project title	Period	Supervised
Learning with ICT use (LEARN IT)	2015-2018	Prof. Y. Stukalina
Implementation of Software Engineering Competence Remote Evaluation for Master Program Graduates (ISECRET)	2015-2017	Prof. B. Mishnev

Taking into account the particularities of the above projects it has been possible to involve new researchers into the projects execution, those who did not participated in the projects before.

At the same time TTI implements mobility of learners and staff actions. Currently TTI has [20 agreements](#) with EU institutions. The list is updated continuously and includes the following EU institutions (selected list): University of Murcia (Spain), Madrid Technical University (Spain), University of Žilina (Slovakia), University of Economics and Innovation in Lublin (Poland), Vilnius Gediminas Technical University(Lithuania), Luleå University of Technology(Sweden), Otto-von-Guericke University Magdeburg (Germany), Anadolu University(Turkey). Most of the above mentioned partners are active in research and TTI has prepared a number of proposals in the framework of ERASMUS+ program.

In 2015 TTI together with partners prepared 5 proposals for ERASMUS+ program calls:

- A new generation of entrepreneurship learning system - TTI participates as partner;
- IoT based engineering didactics - TTI participates as partner;
- Joint study programme in economy with IT - TTI participates as partner;
- Innovative education for economy and IT synergy- TTI participates as partner;

4.2.2. Planning

Among the number of funding opportunities in the framework of ERASMUS+ program TTI will focus on Key Action 2: Cooperation for innovation and exchange of good practices. Among all, the following actions will be in the center of the TTI attention in the future, as listed in Table 12.

As the second level priority Key Action 2: Mobility of individuals is treated. Among the actions supported by this key activity, the following two could help to reach the scientific program strategic goal: Mobility of learners and staff; Erasmus Mundus Joint Master Degrees

Table 12. Target actions in ERASMUS+

Action	Aims
Strategic partnerships in the field of education, training and youth	Strategic Partnerships aim to support the development, transfer and/or implementation of innovative practices as well as the implementation of joint initiatives promoting cooperation, peer learning and exchanges of experience at the European level.
Knowledge alliances	Knowledge Alliances aim at strengthening Europe's innovation capacity and at fostering innovation in higher education, business and the broader socio-economic environment
Sector skills alliances	Sector Skills Alliances shall aim at tackling skills gaps, enhancing the responsiveness of initial and continuing VET systems to sector-specific labour market needs and demand for new skills with regard to one or more occupational profiles.
Capacity building in the field of higher education	This action which aims to support the modernisation, accessibility and internationalisation of higher education in the Partner Countries

4.3. HORIZON2020

Horizon2020 program provides a range of opportunities for financing high-level research projects in different application fields. Most of Horizon2020 subprograms are orientated on establishment strong research cooperation between EU countries. Such cooperation will lead to innovative solutions and therefore able to raise the scientific level of participants and gives social and economic impact for all partner counties.

4.3.1. Current state

In the past, the TTI staff participated in number of FP6 and FP7 proposals as partners. The following projects could be mentioned as successfully completed in the framework of FP7 program: [Enhancing the transfer of Intelligent Transportation System innovations to the market \(TTRANS\)](#); [Baltic-to-Balkan Network for Logistics Competence \(B2B LOCO\)](#). Analysis of the proposals evaluation results shows, that one of the important factors in the proposal acceptance is the quality level of the consortia partners and involvement in the proposal of the representatives of industry and SME partners. That is why TTI decided to join [ECTRI \(European Conference of Transport Research Institutes\) organization](#) to become more visible in the European research area. By participation in the ECTRI thematic groups: TG Mobility; TG Freight and Logistics; TG Traffic Management, TTI participates in the activities related to the thematic groups: define research topics of interest for influencing EC policies and programs; participation in EU projects; networking and scientific exchanges. Participation in the ECTRI thematic groups gives ability to bring out the TTI interests to participate in the Horizon2020 projects and to be involved in the proposals initiated by the ECTRI members.

In 2015 two proposals are pending for evaluation in framework of Horizon2020 program:

- **H2020-ICT-2015: Collective Awareness Platform for safety in the CITY (CAPaCITY) - TTI participates as partner;**
- **H2020-TWINN-2015: Enhancing excellence and innovation capacity in sustainable transport interchanges (ALLIANCE) - participates as a leading partner.**

Here we should mention that in the framework of the Horizon2020 program the TWINN proposals give ability to significantly raise the level of scientific excellence. This type of calls also could be used for the research and the academic staff quality level rise and at the same time for the establishment of the cooperation network.

4.3.2. Planning

The planning of the activities in the framework of Horizon2020 will be linked with the ECTRI organization proposals. Currently, TTI has planned to support 5 proposals in the framework of Horizon2020 and is planning to have 2 projects in 2026, 2017. The following topics have been selected based on the information provided by ECTRI and on the information provided by potential partners:

In the framework of **MOBILITY FOR GROWTH (opening: 30/09/2015 for 2016 topics- 30/09/2016 for 2017 topics)** the following topics have been highlighted by TTI as interesting for participation (see Annex 9)

In the framework of the **AUTOMATED ROAD TRANSPORT (opening: 30/09/2015 for 2016 topics- 30/09/2016 for 2017 topics)** the following topics have been selected as primary interests of TTI:

Table 13. Target calls in Horizon2020 (Automated Road Transport)

Topic	Dates	Potential partners
ICT infrastructure to enable the transition towards road transport automation	2 stages: 1st 26-01-2017- 2nd 28-09-2017	DEUSTO, DLR, ITS
Automation pilots for passenger cars	2 stages: 1st 20-01-2016- 2nd 29-09-2016	AIT, BME, DEUSTO, FHG /LBF,

In the framework of the **EUROPEAN GREEN VEHICLES INITIATIVE 30/09/2015 for 2016 topics- 30/09/2016 for 2017 topics)** the following topics have been selected as primary interests of TTI:

Table 14. Target calls in Horizon2020 (European Green Vehicle Initiative)

Topic	Dates	Potential partners
Electrified urban commercial vehicles integration with fast charging infrastructure	Single Stage- 02-02-2017	DEUSTO, FHG /LBF, ITS

Beside the activities in the framework of ECTRI TTI is planning to cooperate in the framework of the Horizon2020 with the partners from the previous projects and new ones. Having positive experience in cooperation and on the basis of the plans of future collaboration, the following list of potential international partners could be provided:

- Universidad Autònoma de Barcelona (UAB), Spain;
- Fraunhofer-Gesellschaft and Fraunhofer IFF, Germany;
- The University of Trieste (UNITS), Italy;
- The Institute of Logistics and Warehousing (ILiM), Poland;
- Poznan School of Logistics (WSL), Poland;
- Tallinn University of Technology (TUT), Estonia;
- Vilnius Gediminas Technical University (VGTU), Lithuania;
- Hellenic Institute of Transport (HIT)/Center of Research and Technology Hellas (CERTH), Greece;
- University of Tartu, (Estonia).

Also based on the results of the implemented TTRANS project (in the framework of FP7) the following network for research cooperation has been established in Latvia: Kemek Engineering Ltd; KOMIN SIA; Complete Payment Systems (CPS) Ltd. Mapon Ltd; Mappost Ltd; SWD Factory Ltd; X InfoTech Ltd; Rigas Karte Ltd; AVA Ltd etc.

Among all the above topics, grants of the **European Research Council** are in the frame of the TTI interests. Taking into account the particularities (grant is given to a person, not an institution) of grants provided by the European Research Council the possibility to get the grant will be shared among the staff and the PhD students of TTI using internal standard communication tools. The following grant types will be promoted:

- ERC Starting Grant for the young, early-career top researchers (2-7 years after PhD) -up to 2 million euro for a period of 5 years;

- ERC Consolidator Grant for the already independent excellent researchers 7-12 years after PhD) -up to 2.75 million euro for a period of 5 years;
- ERC Proof of Concept Grants for ERC grant holders who want to check the market and/or innovation potential of the research results of the ERC-projects -up to 150,000 euro for a period of 12 months.

It is planned to have at least 2 proposals in 2016, 2017 years for the European Research Council grants. One proposal is planned in call ERC Proof of Concept as a logical continuation of the project SVARI, which was financed by ERDF, one is planned in ERC Starting Grant for young researchers.

Also TTI will continue to use TWINN proposals of the Horizon2020 program in order to raise the level of research and academic staff in the selected fields. It is planned to have at least 2 proposal in 2016, 2017 and get at least 1 project.

4.4. Other programs

The following programs will also be in the circle of the TTI attention:

- **International level**
 - *Interreg Europe 2014-2020*: having good cooperation in the Baltic Sea Region with Estonia, Lithuania and Finland allows taking part in the projects in the framework of Interreg Europe 2014-2020. But 15% co-financing must be taken into account. The two following topics are particularly interesting for TTI: 1) Research and Innovation; 2) Environment and resource efficiency;
 - *Crossborder cooperation programs* (Latvia-Lithuania, Estonia-Latvia-Russia, Estonia-Latvia): but particularities of the cooperation programs significantly decrease participation of the research institution;
 - *Eea-Grants, Norway-Grants*: A few point make this programme not so attractive for the TTI staff: small experience in writing proposals in the framework of this programme (only one not successful proposal with good evaluation); 2) high level of completion; 3) high salary rates in Norway, which makes misbalance in the work to be done by Latvian and Norway partners.
 - *Baltic-German University Liaison Office projects*: Low level of financing (up to 5000 EUR).
- **National level**
 - *Contract research*. TTI will continue to provide research service to the business entities, industry, municipalities and government.
 - *ESF, ERAF funds*.
 - *State Research Programme*: gaining possibility to get financing in the framework of the State Research Programme, the TTI staff is interested to take part in this activity. In 2014 TTI started to implement the project [NextIT](#) together with Riga Technical University.
 - *Grants of Latvian Council of Science*: Here significant cooperation partners are Riga technical University, Latvian University, and Latvian Agriculture University.

4.5. Summary

Based on the evaluation provided by the international expert, TTI should put attention on the international collaboration to become a more significant research player at the EU level. One of the approaches is to increase TTI participation in international level projects. The proposed holistic approach takes into account the existing problems of TTI – mainly lack of qualified staff. That is why the three-level approach is proposed. The first two levels are targeted at the increase of the number and quality of the researchers, by involving them into EU level projects, which mainly are orientated on collaboration, networking, knowledge sharing, staff exchanges, training of staff etc. The last level is represented by Horizon2020 calls, which are orientated on advanced innovative research.

To sum up the plans of participation in EU level scientific programs, the following chart could show the development dynamics of participation in COST, ERASMUS+ and HORIZON2020 programs.

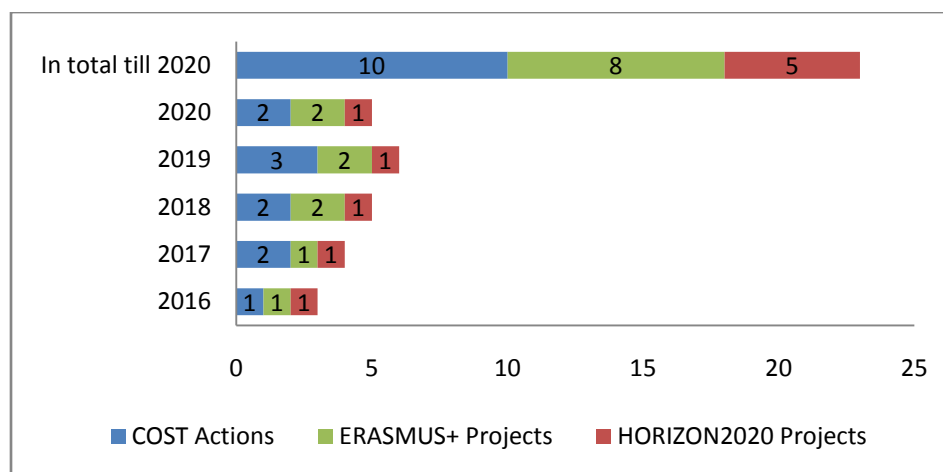
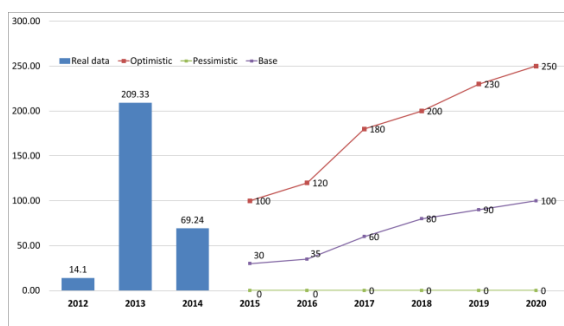
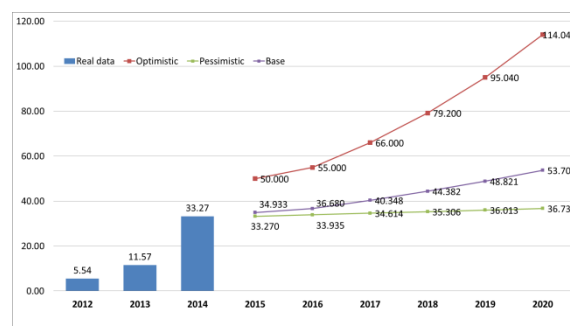


Figure 15. Number of initiated projects in the framework of COST, ERASMUS+ and Horizon2020

The following financial outcomes are planned before 2020 year per each category of funding source.



Projects in frame of Horizon2020 (in thousands EUR)



Other international projects (in thousands EUR)

Figure 16. Forecast of income from Horizon2020 and other international projects

5. Action plan for increasing publication activity

5.1. Problems of publicizing activities and presumable decisions on raising the efficiency of these activities

A summary of publications and other scientific outcomes of TTI's research work are presented in the Figures 17 and 18.

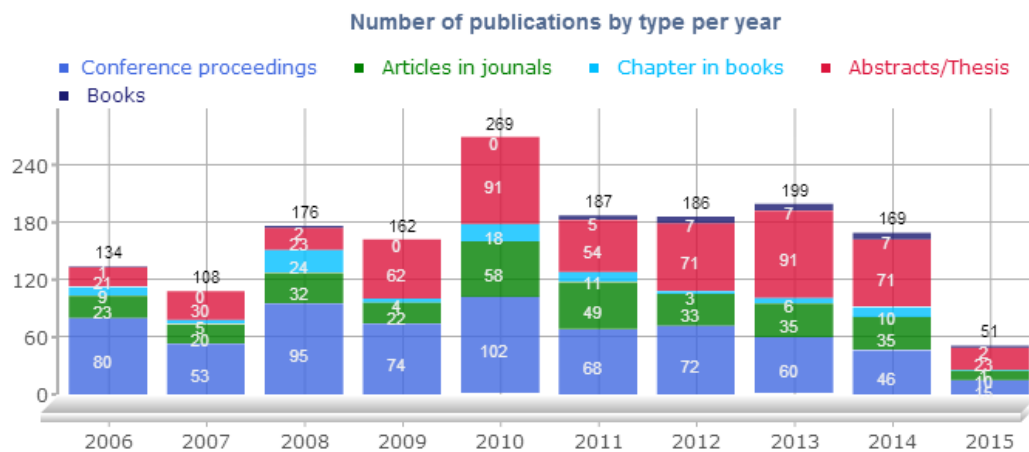


Figure 17. Dynamics of publications 2006-2014

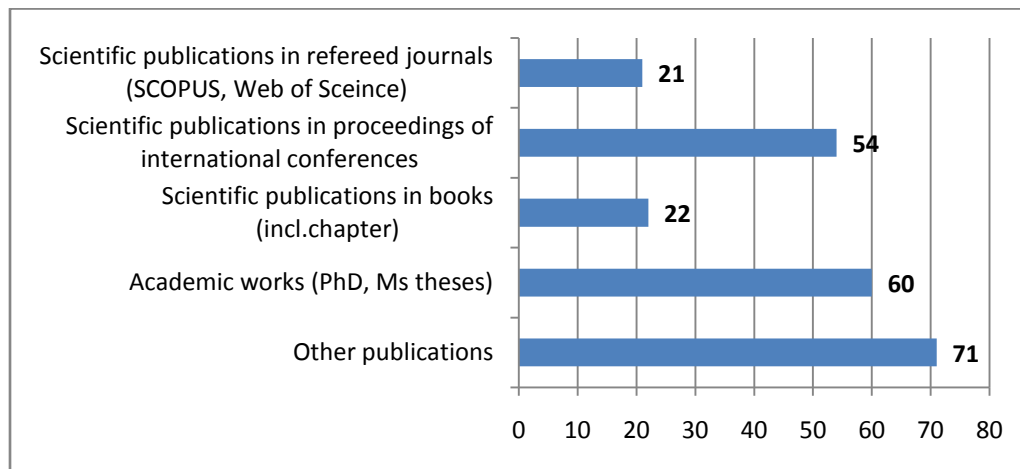


Figure 18. Scientific Work, 2014

We can underline following problems:

1. In TTI, there is no complete system of accounting and analyzing the results of the scientific activities.
2. The organisation does not encourage its staffs to creating high-cited publications in high rating journals. The majority of journal publications has low-impact factor.
3. The author is not engaged in his/her publication career. The author does not know what and where to publish.

4. The indicator of being cited is not sufficient.

5. High indicators the researches' citing are provided mainly by participation in the projects which doubtfully add to recognizing the TTI when it is not the leader of a project.

The suggested plan of resolving these problems consists of several projects which directly or indirectly encourage the publication activities of the TTI staffs.

- "Direct" support of the publication activities a system of motivating to publishing in journals, which considers the number of the author's previous articles, the impact-factor of the journal, the age of the author and the possibility of the article being cited some time after its publication. Those articles are meant which get into Scopus and Web of Science.
- "Indirect" support of publication activities is aimed at creating comfortable and efficient media for the scientific work in TTI.

The major aim of all plans is creation of that kind of the surrounding medium in which staffs and students of TTI would like and be able to write scientific articles in high impacted peer-reviewed journals and easy provision of this medium. Achievement of the aim has a complex character and includes the following tasks:

- Analytical work on analyzing the publication activities for the 2012-2014.
- Conducting a questionnaire with the aim of spotting difficulties in writing scientific articles and determining motivation for their writing.
- Organisation of the system of collecting and accounting the publications of the TTI staffs and students for further basis of rating of chairs and staffs, influencing remuneration on the articles, and further planning.
- Development of a motivation system of remuneration for the published articles and organisation of such system which would encourage the growth of publications in high impacted peer-reviewed journals.
- Creating a system of support in writing articles in English and giving methodical recommendations on writing articles.
- It is necessary to increase the number of joint papers with the scientists having a higher level of citing. There is implemented the strategy of inviting foreign scientists with high publication results as scientific co-supervisors of doctoral and master students.
- Enhancing the work on promoting the TTI scientific journals to WoS and Scopus.

Plans of implementation, anticipated results and required resources will be indicated for each of the projects.

5.2. Establishing a portal for collecting and accounting the publications of students and staffs (Technological base)

The aim of the project is creating a comfortable means for accounting and presenting the publicized articles, PhD and Ms theses.

The project tasks:

- Portal development (before 12.2016):

- with the possibility of maximum loading of references to articles, PhD theses, master papers into a single base
- with the possibility of grouping and rating scientific achievements per each person, chair, departments.
- To develop a system of accounting publications which would allow to analyse quantitative and qualitative indicators of publicizing activities according to departments and spheres of knowledge as well as to the types of publications. The system separately considers articles in periodic editions, monographs, articles in monograph sets, reports, theses, text books and methodical materials, reference literature.
- Development, on the base of the loaded data, of the system of rating chairs and staffs. The rating results should be used in allocating resources; the rating would be available on line and may be referred to for contest applications, etc.

Ways of achieving aims and decisions of the set tasks: The IT department is delegated development of the online-portal with the possibility of using students. Support of the portal will be in charge of the TTI scientific department.

Plan of the project implementation with indication of dates:

1. Technical assignment for the portal formation (December 2015);
2. Portal development (January - September 2016);
3. Portal putting into action (September - December 2016).

Anticipated results: Introduction of a single system of storing scientific papers and of the scientific activities rating system will allow:

- From the point of view of management – to conduct monitoring and set rational aims and direct the scientific activities of the departments (possibility of checking statistics, accounting the departments activities in allocating resources, searching for bottlenecks and points of growth, searching for really strong chairs and scientific groups);
- From the point of view of staffs – to locate their portfolio in a single place so that it could be used in making reports, participation in competition, job finding, etc;
- From the point of view of the chair – to collect all its achievements in a single point to present to the authorities (and to show differences and advances on a competitive base).

The given project is an absolute foundation for developing other projects aimed at the encouragement of the staffs' scientific activities since it is a long termed one.

5.3. Direct support of the publishing activities

Project aim: motivating staffs to writing articles in peer-reviewed journals with high-impact factor.

Project tasks:

- Development of the system of remuneration for the published articles on the basis of the analysis of the publication activities of staffs, sociological questionnaires of staffs, research of the systems of sponsoring the publicizing activities;
- Development the motivation system to the staffs publicizing their articles in journals with a high impact-factor;

- Publication by the end of 2020 more than 60 articles in journals indexed in Scopus and Web of Science.

Table 15. Current and planned number of publications indexed in SCOPUS and Web of Science

Year	Number of publications
2020	60
2019	45
2018	35
2017	30
2016	25
2015	21
2014	18 (SCOPUS) +3 (Web of Science) =21
2013	28 (SCOPUS) + 4 (Web of Science) = 32
2012	23(SCOPUS) +2 (Web of Science) =25

Ways of achieving aims and decisions set in the tasks project: To delegate to the scientific research department and HR Department the development of the system of bonuses for publications in peer-reviewed journals on the basis of sociological polls and research of analogical systems in other institutes. To develop the system of stimulations this would contain two parts:

- the basic part for publication in the journal indexed in Web of Science or Scopus;
- and the stimulation depending on the journal impact-factor.

While creating the system of stimulations it is important to consider the age of the author and the number of the articles published before (the less articles – the bigger stimulation), the co-authors, the number of citing after some certain time elapsed from the date of publication.

The indicator of being cited is provided by three main factors: actuality and quality of the scientific results in the scientific article; reputation (impact-factor) of Journal and the authority in the scientific medium of authors Quality and actuality of scientific research is achieved first of all by the effective participation of the staffs in projects (international mostly) and consulting agreements for real business.

Plan of the project realization:

1. Questionnaire of staffs (September 2015);
2. Development of the motivation system of bonuses (September-November 2015);
3. Confirmation of the documents at the TTI Senate, juridical and financial agreements (October-December 2015);
4. Implementation of the PR system, introduction of the online portal for the publications entering (January 2016 - June 2016).

The main principles of assessing publications to establish stimulating remunerations are as follows:

- additional remuneration is set for one year according to the results of the analysis of the researcher's publication activities in the three previous years;
- publications must be verified and remuneration should be set to the researcher only for the publications which show correctly the name of the institute;

- remuneration should be set independently from the academic and research position.

The budget will include special raise for the "first" publication (for a young author who has got many publications yet). This raise is sufficient enough to get through to the publication once, after that it would be easier to do again due to the accumulated experience. And it would be enough to finance 3-5 serious publications to get the skill of writing articles in foreign journals after which there should start the system of rating and competition for financing among separate chairs and staffs.

In the short term perspective, the given initiative will help to increase the number of publications in the peer-reviewed journals and in the long term perspective; it will attract researchers to writing articles in high-impacting journals.

5.4. Indirect support of publishing activities

5.4.1. Questionnaires about scientific activities among researchers

The aim of the project is to understand the existing motivation of the TTI staffs regarding scientific activities (writing articles in peer-reviewed journals), as well as to determine the points of growth (what is needed for productive scientific work).

Project tasks:

- Conducting questionnaires about scientific activities and motivation factors;
- Examining these questionnaires and making proposals for the motivating system of remunerations for the articles published in the reviewed journals.

Ways of achieving aims and decisions set in the tasks project: The chair of Social Sciences department should be charged with the task of conducting sociological questionnaires about motivation of staffs and students by scientific activities, about the number of publicized articles, about their subjective author assessments, about what is needed for scientific work, and get analytics of the received data.

Plan of the project realization with the dates indicated:

- Making list of questions for sociological questionnaires (September 2015);
- Conducting sociological questionnaires (October 2015);
- Processing of the questionnaires results and passing them to the group developing the portal of the security system for storing the scientific publications and the system of bonuses for the publications (November 2015).

The result will be objective understanding of the TTI staffs' motivation to conducting scientific activities and working out proposals which will determine the obstacles preventing the institute from the development of its scientific activities. This is a required feedback system without which it is impossible to develop an efficient system of development and stimulation of the scientific activities since it is necessary to check up the hypotheses on which the given system is built (in general, it is built on establishing a comfortable environment for writing articles and encouraging their publications).

Such questionnaires should be carried out annually to trace the changes in thinking and motivation of the TTI staffs.

5.4.2. Assistance in publicizing articles in peer reviewed journals with high-impact factor

The aim of the project is the assistance to staffs and students in mastering technical, methodical and linguistic skills of writing articles in peer-reviewed journals with high impact factor.

Tasks of the project:

- Delivering to the authors skills and technologies of writing and promoting publications in peer-reviewed journals with high impact factor (through the courses of academic writing);
- Delivering courses about writing articles in English;
- Development of methodical materials and online courses on the topics of writing and publicizing articles;
- Development of the base of the typical article templates;
- Development and renovation of the list of journals recommended for publications.

Ways of achieving aims and decisions set in the tasks project: TTI Scientific Department (and the Chair of Linguistics Department) should be charged to develop a plan and organize a working group for collecting methodical materials to realize the above mentioned aims.

Plan of the project realization with dates indicated:

1. Developing new and collecting the existing methodical materials (January – May 2016);
2. Development of online courses according to the preset tasks of the department (May – August 2016);
3. Conducting online and off line courses as well as consultations; development of the base of the article templates (October - December 2016).

Anticipated results:

- Increase of the quality and quantity of publications in English;
- Conducting 12 hour off line and online courses with the total number of participants more than 50 staffs and 150 master and doctoral students during 2016-2018. The given courses will allow centralized help to students and staffs in how to start writing a scientific article and lay it out correctly.

5.4.3. Growth of visual scientific activities of the scientists in TTI and outside Latvia

Researchers of TTI should register and make up persona; files in Web of Science, Scopus and Research Gate systems.

TTI should confirm the scientific policy and adopt a set of documents regulating certain things, there included: a researcher must create a publication and sign it as a TTI staff if this publication is the result of either a project activities or master or doctoral studies.

TTI should make up the lists of high-rating journals in the directions which the authors should be going to publish in. As example recommended Journals in the sphere of Transport are supplemented in Annex 10.

5.4.4. Creating a video about a contemporary young TTI scientist

The aim of the project is to popularize the image of a modern researcher.

The task of the project: Creating a high-class virus advertising video which would present the image of a successful researcher and scientist.

Ways of achieving aims and decisions set in the tasks project: To delegate making the above video to third companies engaged in the given theme on the commercial basis. To delegate promotion of the video to the students' club and the marketing department by the available media ways.

Plan of the project implementation with the meeting dates:

1. Setting of a technical assignment on the part of the scientific department (January - February 2016)
2. Making an completing of the video (March - September 2016).

Anticipated results:

An interesting video spread through the Internet can be watched millions times. The anticipated effect will pay back its creation since it will attract the target audience which TTI is much interested in – master and doctoral applicants, other educational institutions students. Also, such video will clearly explain that it very noble and achievable to be a successful scientist and researcher (by means of publication activities as well).

5.4.5. Supporting the Journal of Transport and Telecommunication

The *Journal of Transport and Telecommunication* (T&T) is an Open Access Journal that was established by the TTI in 2000.

ISSN: 1407-6160

Publisher: Transport and Telecommunication Institute

The editor-in chief: Dr.hab.sc.ing, prof. Igor Kabashkin

The Journal is indexed in 26 data bases, including SCOPUS, EBSCO, DOAJ, ProQuest etc.

It is an online scientific platform aiming at disseminating research results in the field of Transport and ICT. The main scope and mission of the Journal is to provide a forum for the publication of high quality scientific papers and a dissemination community for new ideas and developments in quite original subject area at the junction of two technologies - Transport and Telecommunications. The need for scientific journals in this niche is dramatically increase due to the sharp increase in scientific research in areas such as intelligent transportation systems, autonomous vehicles, cooperative transport systems, the use of virtual reality and augmented reality in the operation and maintenance of transport and other areas actively developing in this niche.

TTI signed a contract with De Gruyter company on support and promotion of the Journal and develops of new publish policy.

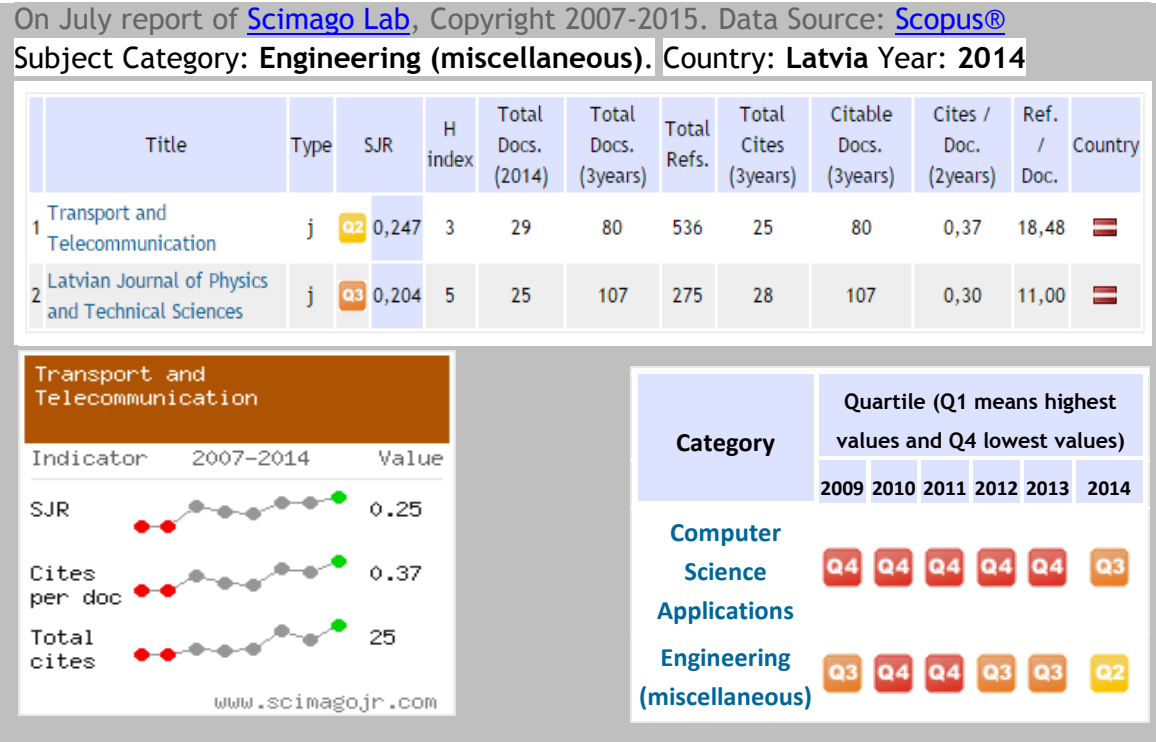


Figure 19. Journal data

Plan for improving the Journal:

1. Continuing to invite new and renewing some existing members of the Editorial Board (EB) and increase it till 25-30 members both from universities and from business and industry;
2. Invited Guest Editors for issues with special topics within the frame of Journal subjects;
3. Dramatically increase number of international reviewers;
4. TTI became a member of the European Conference of Transport Research Institutes (ECTRI - <http://www.ectri.org/>). This organization brings together leading transport research institutes of Europe. The provisional agreement was reached on the active informing institutions of ESTR about Journal publications, as well as the use of the Journal as a platform for publication in magazine of the research results by leading scientists of these institutions. It expands the research community of authors of the journal, enhances the scientific level of published materials and helps to invite leading European scientists in the EB. At the same time it significantly expands the number of active research readers of the Journal, which will increase the readability of the journal and increase the number of its key metrics. In addition to the above points, an established International Research Advisory Board can help support a journal and its editors by sharing best practices with them and promote journal among research community. The first experience of cooperation within ECTRI shows that substantive niche occupied by the magazine is extremely popular, and 15-year-old experience of the magazine causes high credibility from the scientific community;
5. Negotiations with the national and international professional associations held about placing at their information portals Information about the journal and its publications;
6. Interventions can increase the number of published articles and the annual number of issues which ultimately will also help its promotion and increase the value of the journal metrics.

6. Knowledge Sharing Activities

Knowledge sharing and transfer is a core element of the TTI activities and Knowledge Services Strategy is one of the TTI main strategies (Annex 4). In spite of the fact that TTI was well evaluated by the international expert team as a research organization, the experts have pointed out a number of recommendations, which must be taken into account in the TTI development. It has been pointed out by the experts that TTI does not have enough of international collaboration and especially in the frame of the technology transfer. The aim of the knowledge and technology sharing and transfer is to significantly raise the level of knowledge of the TTI research and academic staff in order to be in accordance with modern knowledge in the selected area and to increase the visibility TTI at the international level. As mentioned in the presentation of Dr.A.Kiopa, Deputy State Secretary-Director of HE, Science and Innovation Department on WIRE 2015, 4 June 2015 Riga (Latvia) "...Role of Universities in Latvian R&D&I System to be Knowledge Hub, and Research Institutes - to develop relevant knowledge". That's why the spotlight in the research program is Knowledge development and sharing. The purpose of the knowledge services strategy will be the clear definition of the activities and tools which will be implemented in order to support effective knowledge sharing with TTI partners. This strategy will set a collaborative research roadmap development with reference to impact factors of the TTI development.

6.1. Context of the Knowledge Services Strategy

In the Knowledge Services Strategy, business engagement is defined as all aspects of working with business. Business is understood as including the public sector, the private-for-profit sector, and the not-for-profit sector. Engagement encompasses:

- consultancy;
- knowledge transfer;
- applied research and development;
- workforce development;
- student and graduate placements;
- involvement in the development and delivery of University programmes and services.

TTI is planning to be known as the University of Applied Sciences. In achieving this aim, the TTI will use its relationships with business to deliver the lasting benefits to the economy through high-quality knowledge transfer and workforce development, while at the same time:

- helping to deliver an excellent student experience;
- promoting the development of business-aware and business-responsive academics;
- maintaining industrially-relevant provision;
- growing its international reputation for business creation and support;
- maximizing employability, enterprise and employment opportunities for its graduates.

The strategy reflects the strong alignment between research, business engagement, scholarship and teaching at the University, and consequently articulates closely with the research strategy and academic strategy. Key drivers for this approach include the responsibility of the University as a civic university to support the economy and welfare of society in the region, to ensure that its research has relevance and impact, to promote employability and entrepreneurship, and to enhance the workforce development for employers. All of this, and more, is linked directly to business engagement.

The main objectives of the business engagement strategy are to:

- become recognized as a sector leader in the delivery of client-focused knowledge-based business services;
- support regional and local regeneration, through the creation and growth of new businesses, applied research, high-level consultancy, knowledge transfer, and delivery of customized education and training programmes;
- ensure that all learning and teaching is informed by, and supportive of, innovation, employability and entrepreneurship, including the offer of direct real-world business experience for full-time students;
- ensure that the applied research strategy of the TTI is supportive of the business engagement strategy and academic strategy;
- facilitate career development opportunities in business for staff to:
 - provide staff with professional updating opportunities to inform their teaching, research and personal development;
 - assist with staff recruitment and retention;
- generate income for the TTI.

TTI will deliver its business engagement objectives, presented as the following two groups of activities:

Growing the business engagement culture by:

- creating a client-focused approach,
- creating the strategic framework for business engagement,
- implementing appropriate operating and management structures,
- embedding business engagement, and managing its performance,
- developing staff capacity and capability,
- providing guidelines for the staff involved in the business engagement activity,
- establishing high-quality facilities and infrastructure,
- delivering a high-profile marketing and communications strategy.

Growing partnerships, products and services by:

- developing partnership networks,
- developing products and services for the business market,
- promoting and supporting company formation,
- developing workforce development and employer- based students.

The content of the above mentioned activities of the knowledge services and business engagement strategy is shown in Table 16.

Table 16. List of the knowledge services and business engagement strategy

N	Activities	Content
1.	Creating a client-focused approach	<p>The University is keen to pursue a distinctive approach to business engagement, characterised by an integrated, partnering, solutions-based approach, reflected through:</p> <ul style="list-style-type: none"> the ongoing development of client-focused relationships with employers, involving a wide-ranging offer to meet their education, skills, knowledge and consultancy needs, the presence of a strong, co-ordinating hub in the form of the University's Knowledge Sharing Centre, the development by faculties of relationship management approaches to employer contacts, co-ordinated operationally using mechanisms such as the customer relationship management system and business development manager team, and strategically through the academic board's business engagement policy committee, the development by each faculty of appropriate structures, roles and responsibilities to manage and deliver their business engagement activity, the consistent use of client feedback to inform the delivery and development of all types of business engagement provision, the development with business partners of an integrated approach to business through the use of the OneDoor – this will strengthen collective capacity to make progress on workforce development and knowledge transfer, and will facilitate collaboration with other learning providers where appropriate, to maximise capacity, knowledge and delivery skills, the investigation of the potential for a new commercial drivers for the delivery of client-focused workforce development provision at institute level, the development and maintenance by faculties of effective relationship management approaches to employer contacts using an institution- wide, integrated approach, the development by each faculty, roles and responsibilities to manage and deliver this activity within its own particular operating context, the development of packages of services and courses to meet potential client needs, which will include: <ul style="list-style-type: none"> applied research consultancy knowledge transfer partnerships knowledge exchange internships student placements staff secondments tailored training packages accredited and non-accredited taught programmes. liaison between all TTI faculties and departments to ensure that all staff engaged in any business-facing activities are focused on providing an excellent customer experience at all times.
2.	Creating the strategic framework for business engagement	<p>Throughout the period of this plan, the TTI framework for business engagement will include the following:</p> <ul style="list-style-type: none"> the consolidation of the University's highly effective infrastructure for initiating, developing, implementing and evaluating business engagement activity of all types, the exploitation of appropriate external funding opportunities to provide the seed-corn for sustainable business engagement in the long term, the utilisation of a business case model, and regular business performance reviews, to encourage and embed financially sustainable activities, close co-operation with and between the TTI research teams to promote synergies between business engagement and research, and to provide a coherent external face to the marketplace, the requirement for approval of robust business cases and risk analyses for all projected new activities, the implementation of mechanisms to incentivise faculties and individuals to engage

N	Activities	Content
		<p>with business,</p> <ul style="list-style-type: none"> the alignment of the TTI targets, key performance indicators, and other relevant institutional performance indicators, with the annual planning processes of the faculties facilitating monitoring of progress to achieve year-on-year performance improvement and the embedding of a performance management culture, exploration of the opportunities to partner with external providers of business services, development of long-term strategic partnerships with major businesses and employers.
3.	Implementing appropriate operating and management structures	<ul style="list-style-type: none"> Effective engagement with the business, industrial and public sectors requires further embedding of the significant cultural changes that are taking place within the TTI. These will be promoted and encouraged through the continual development of robust support structures for enterprise, knowledge transfer and workforce development. The Knowledge Sharing Centre will work with faculties to deliver a consistent and coherent outward-facing mechanism for business engagement activity which offers: <ul style="list-style-type: none"> customer-focused service, including professional project management, a responsiveness that complies with external business requirements, staff who can build the links between University and business. University-wide adoption of the corporate customer relationship management system is mandatory, ensuring that business interactions are captured, shared, and used to support and enhance business relationships.
4.	Embedding business engagement, and managing its performance	<p>A number of key principles have been established to ensure that business engagement activity within the University is managed and monitored appropriately, namely:</p> <ul style="list-style-type: none"> business engagement activity will be integrated into a faculties core activity, the precise roles and responsibilities of faculties in relation to supporting business engagement will be made explicit through service level agreements, given that it is seeking year-on-year improvement, the TTI targets will inform the development of annual targets for each faculty, as part of the annual planning process; care will be taken to ensure that the targets of faculties align with the corporate business engagement agenda, but are also owned by the relevant faculties, who in turn are responsible for ensuring that departmental targets are strategically aligned with the targets of individual staff members within the department, there will be regular reviews of all large-scale projects – the Research Department will exercise an overall monitoring function in relation to the performance of all publicly funded projects, to avoid claw-back of funding due to poor performance, capital facilities and campus services will be reviewed and monitored to ensure that they are fit-for-purpose, including the identification of specific space needs, an extensive review programme will be carried out to ensure that employability and enterprise skills are appropriately embedded within all TTI programmes.
5.	Developing staff capacity and capability	<ul style="list-style-type: none"> The TTI will seek to develop and enhance the business engagement skills and attributes of its staff through a range of measures. Core principle identifies as fundamental the maintenance and celebration of the TTI position as a people-led organisation that recruits, values and invests in high-quality staff. Staff development provision for business engagement will be reviewed and expanded to maintain its relevance to the needs and demands of staff and students, equipping them with the skills to participate in workforce development, knowledge-transfer and enterprise in a supportive, inclusive and customer-focused manner. Business development managers, deployed from the Research Department and reporting to deans, will have a specific remit to facilitate business-facing activity and relationship management in faculties. A programme of incentives to stimulate and facilitate staff engagement will be adopted. These will include financial and explicit career structures for staff engaged in this activity. The consultancy policy will be promoted to all staff. This policy will be reviewed in the light of the increasing importance of commercial business engagement activity, and any modifications disseminated to all staff.

N	Activities	Content
		<ul style="list-style-type: none"> • In allocating staff responsibilities, faculties will seek to provide time for business development and related programme development activity in line with the TTI workload model. • The TTI will be supportive and will encourage its staff to be entrepreneurial and enterprising, and will facilitate fractional contracts if the level of external consultancy is substantial. The salary level for the percentage time associated with a company will be determined by the external agency.
6.	Providing guidelines for staff involved in business engagement activity	<ul style="list-style-type: none"> • A structured approach will be developed to stimulate and facilitate faculties and staff engagement in this agenda. Specific support will be provided for staff engaged in client-facing activity and programme development. • Guidelines and frameworks for costing and pricing of all business engagement activity, including accredited and non-accredited learning, will be reviewed to provide the basis for business negotiation, and to maximise contributions from employers. Support will be provided for implementation by employer-facing staff and teams. Policies and guidance associated with business engagement will be available on the business pages of the TTI website. • The TTI will seek to achieve and maintain Putting the Customer First accreditation for all aspects of its business engagement activity. • The TTI will endeavour to identify, protect and accelerate the commercialisation of intellectual property (IP), by managing IP in line with its intellectual property policy, which will continue to be disseminated to staff along with the IP user guide. The TTI will normally own the IP, with the result that the TTI has responsibility for protecting the IP. Joint ownership of IP will be avoided. • The TTI will use its best endeavours, where appropriate, to seek commercial return for developments, ideas and IP deemed to have commercialisation potential. This will usually be achieved through spin-outs or licensing. • Staff will be supported to take forward developments with commercial potential, where this is deemed appropriate. The contribution of TTI staff to commercialisation will be recognised in any agreements established. • The TTI will seek to use external partners where appropriate, to assist with the commercialisation of IP, in particular where this may aid market finding and/or pursuit and winning of capital.
7.	Establishing high-quality facilities and infrastructure	<ul style="list-style-type: none"> • Support facilities will be developed in selected areas with potential to attract external income. Staff supported from the special fund will provide the service level necessary to attract external contracts to specialised facilities. • The TTI has invested heavily in its research centre and now has extensive high-quality facilities covering a range of business sectors. The TTI will market these facilities to the business community to maximise their benefit to the community and generate a return to the TTI.
8.	Delivering a high-profit marketing and communications strategy	<p>To maximise the profile and strategic importance of its business engagement activity, the TTI will adopt a multi-faceted marketing and communications strategy which reflects the TTI strong client-focused approach and facilitates promotion of the services and successes of the TTI. The development, implementation and monitoring of the strategy will be undertaken by the Department of Marketing, working closely with the Research Department.</p> <p>The marketing and communications strategy will provide a framework for the following activities:</p> <ul style="list-style-type: none"> • undertaking effective market research and intelligence gathering, including an appropriate University-wide mechanism for reporting and acting on market information, • developing an appropriate, fit-for-purpose, publications strategy of relevance to the target market, • engaging closely with key partners, stakeholders and intermediary bodies (such as the local enterprise partnership, local authorities and others) to ensure that the TTI is identifying, and appropriately responding to, business needs, • making full use of social networking media, as appropriate, to extend the TTI reach to the

N	Activities	Content
		<p>business community,</p> <ul style="list-style-type: none"> • demonstrating externally the culture change occurring within the TTI, through the promotion and external dissemination of the University agenda and expertise through academic papers, conferences and other networks, • developing expertise within the TTI appropriate to the marketing of business engagement, to expand the TTI offer and market share, • promoting business engagement internally by: <ul style="list-style-type: none"> ○ continuing to provide information about the support available for staff, ○ establishing a business engagement community to share best practice (including embedding activity at school and section level), ○ developing the range of materials available to support business-facing activities, including the customer-relationship management system, a business toolkit, and a website-based business innovation observatory.
9.	Developing partnership networks	<ul style="list-style-type: none"> • One of the main TTI tasks is play a key regional, national and international role through an extensive network of local, regional, national and international partnerships with public and private enterprises. • As a University which recognises and values the benefits of partnership working, it will build on its established engagements with a wide range of organisations, regionally, nationally and internationally. These include the local enterprise partnership, national professional associations, regional and municipal authorities, chamber of commerce, and a wide range of education organisations from professional schools to private training providers. • Stakeholder and intermediary bodies have an important role in facilitating access to the local and regional SME community, in addition to their role in ensuring that the TTI is accurately articulating and responding to current business needs. • New collaborative arrangements will extend partnerships to include a wider range of strategic private sector relationships with key players in the advanced manufacturing, digital, environmental and business services sectors. • Partnerships will also be explored with external agencies which can undertake or facilitate technology-transfer activity, including those willing to provide, or find, investment in return for equity. • Memoranda of understanding will be developed to underpin strategic partnerships. These memoranda will define roles and responsibilities in the context of supporting the implementation of joint activities. • Through research, exchanges and projects, the TTI will seek to learn valuable lessons from elsewhere about effective models of business engagement, particularly from institutions in Europe which are noted for their business success. • In addition to external bodies, partnerships between departments within the University will also be actively encouraged and facilitated. Processes will be put in place to maximise the benefits to all parties of collaborative activity. • The TTI will continue to invest in the acquisition, retention and development of high-quality staff, equipped with the academic, leadership and student support skills necessary to deliver the University's aims in a supportive, inclusive and customer-focused manner.
10.	Developing products and services for the business market	<ul style="list-style-type: none"> • Packages of services and courses appropriate to potential client needs will be developed – linking applied research, consultancy, knowledge transfer, courses (accredited and non-accredited), and other tailored activity as appropriate. • In-house and external expertise will be enlisted to define capabilities and products. Faculties will develop relationships with businesses to define the offer and to promote the business value of knowledge-transfer, HE-level skills and competences. • In the context of an increasingly competitive environment, market research and regular business intelligence will be used at strategic level to inform the development of new and existing products. The TTI will dedicate resources to ensure that this activity is integral to business engagement.

N	Activities	Content
		<ul style="list-style-type: none"> • In addition to market research, a proactive approach will be taken to new product development through an increased focus on market-making. This will be achieved through co-ordinated futures planning, facilitated as necessary by external agencies, and through developing the TTI role in leading new market creation, as well as responding to market needs. • Faculties will identify clear programmes and related products and markets in response to employer demand and needs. They will enlist appropriate in-house and external expertise to define capabilities and products. • Faculties development plans will reflect the portfolio developments entailed by business engagement requirements. • Effective use will be made of the client relationship management system and the TTI will seek to coordinate an active network of enterprise and workforce development practitioners across the TTI and between partners.
11.	Promoting and supporting company formation	<ul style="list-style-type: none"> • The University will grow its national reputation, building on its significant achievements in generating start-up companies, by continuing to dedicate resources to the support of new graduate businesses. • The role of the fellowship scheme in creating a cluster of digital and creative businesses will be expanded through: <ul style="list-style-type: none"> ○ attracting new external resources, ○ enhancing the relationship between fellowship scheme and the sister project of Business, ○ closer integration of the fellowship scheme and with the TTI graduate business start-up programme. • The generation of start-ups will be heavily promoted through initiatives such as entrepreneurship, to encourage students to consider an entrepreneurial career. • The TTI will not normally hold the majority share in any spin-out or start-up company. The equity will be agreed with the start-up company on an individual basis prior to establishment of the spin-out or start-up business. The TTI wishes to maximise the number of companies which are independent and which obtain external investment. The TTI will seek to minimise the number of wholly TTI-owned companies. • There will be a greater emphasis upon brokering partnerships with external business angels and holders of seed-corn and proof of concept funding. The TTI will offer support and guidance to a spin-out or start-up company, but recognises that some external investors will wish to deal directly with the company and staff within it, in preference to the TTI.
12.	Developing workforce development and employer-based students	<ul style="list-style-type: none"> • As part of the annual planning cycle, all faculties will be required to develop, plan for and implement specific actions and targets for workforce development. This will involve clearly identifying the specific employment sectors and organisations to be targeted, and identifying the likely student numbers involved. • The extensive activity that already exists with employers will be separately identified and integrated within the workforce development strategy to accurately reflect the full range of activity. • The TTI will also exploit funding opportunities arising from these bodies and will take a leading role in shaping the initiatives. • The TTI will use its business engagement as a mechanism for helping to ensure a comprehensive and coordinated approach to delivery of the employability strategy. Relationships with employers will be used to promote opportunities to develop strong employability skills and attributes through placements and internships, employer links to courses and programme developments, market research, marketing and events. • The University will strategically manage entrepreneurship to deliver key aspects of the employability strategy, particularly the demonstration of employability attributes.

6.2. Primary knowledge sharing tools

In order to service the needs of the industry with rapidly changing trends, scientific and academic institutions have to implement innovative learning systems and be able to match up to the expectations of the industry for knowledge support. The knowledge grows more with communication, sharing of ideas and transfer of knowledge through face-to-face communication, discussions, faculty and researchers training programs, conferences, and industry-institute interactions. The Table 17 shows the primary tools of knowledge sharing.

Table 17. Primary knowledge sharing tools

Tools	Impact
Annual International Conference “Reliability and Statistics in Transportation and Communication” organized by TTI	The conference provides excellent possibility for knowledge sharing. The international status of the conference gives possibility to invite advanced researchers from EU (for example in the framework of COST Actions)
Publications in Transport and Telecommunication the Journal owned by TTI	The journal is indexed by more than 20 bibliography databases, including SCOPUS. The bibliography indexes for the past years have shown the growth of the journal quality and therefore could be a good tool to share research results among the auditorium of the journal.
STSM in the framework of COST Actions (PhD, master students and other researchers)	Participation in COST Action provides good possibility for knowledge sharing at the international level with key players in the research area of EU.
Knowledge Sharing centre	The existing knowledge-sharing centre of TTI provides capabilities for TTI students and industry partners to collaborate and share actual knowledge among the Knowledge Sharing participants.
Participation in external International Conferences	Intensive participation of research and academic staff in international conferences could raise the knowledge level. The list of possible conferences is given in annex 6.

6.3. Cooperation with industry

R&D and knowledge and technology transfer, as well as business projects, necessarily involve cooperation and networking. TTI is a research and business oriented at the same time organization and its researchers are participating in activities of the Latvian public organizations (see Figure 20):

- Latvian Telecommunication Association (LTA);
- Latvian Information and Communications Technology Association (LIKTA) ;
- Latvian Electrical Engineering and Electronics Industry Association (LEtERA);
- Ministry of Transport of the Republic of Latvia (electronic communication sector council of the experts);
- Latvian branch of IEEE;
- Latvian Simulation Society;
- Latvian Operations Research Society ;
- Latvian Logistic Cluster;
- Latvian Transport Development and Education Association;

- Aviation Research Centre Ltd.;
- LEO Competence Centre;
- Latvian Supply Chain Association;
- Latvian Green Technology Cluster: e- mobility etc.

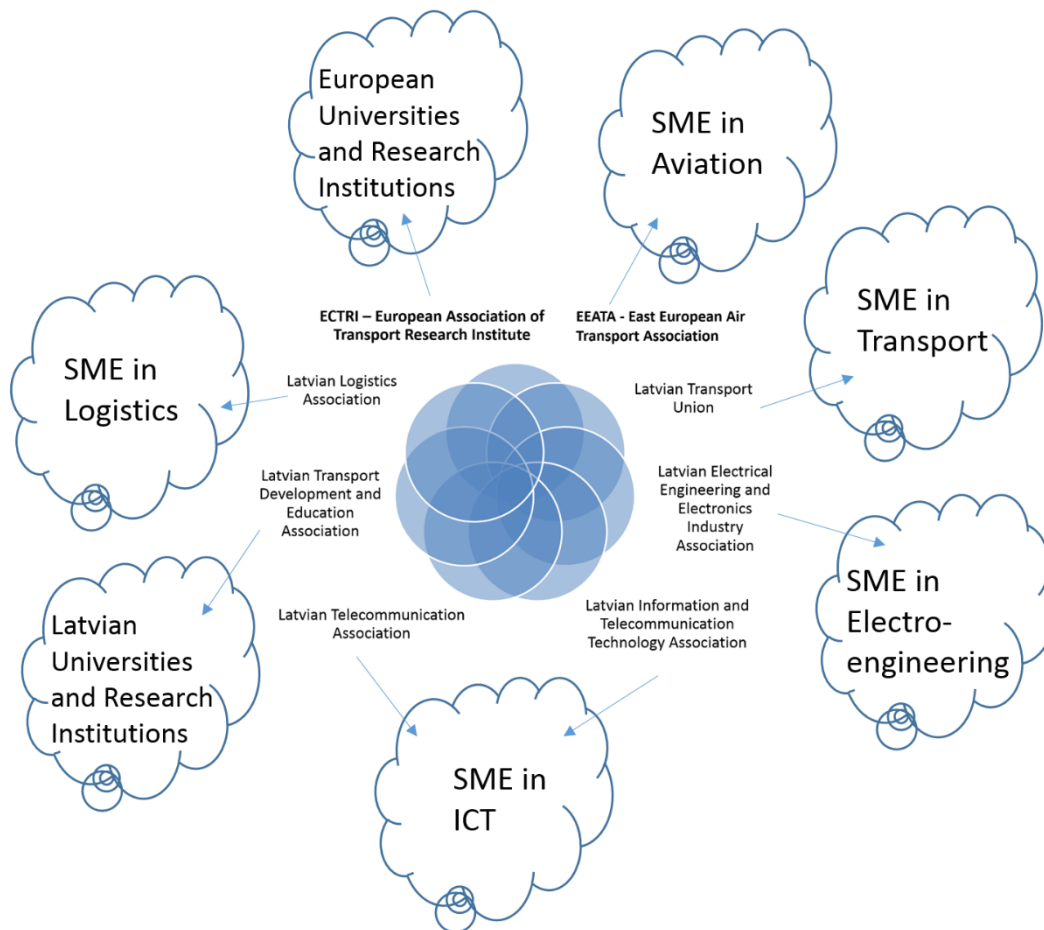


Figure 20. Cooperation cloud of TTI

The main aims in collaboration with the above mentioned associations in the period (2016-2020) are:

- to define society, business and industry needs and requirements to R&D&I;
- support preparation of the project proposals for identification and promotion of new innovative opportunities for SMEs taking into account society, business and industry needs;
- search of additional funding opportunities, incl. business investment opportunities, etc.

TTI is one of the active promoters of the Aviation cluster establishment which is plan to 2016.

TTI has already built close contacts with entities coming from the stakeholders, from Latvia and the wider region, and from other EU states and will actively continue towards this direction. Indicatively, the

following entities have already joined the TTI business network: Kemek Engineering Ltd; KOMIN SIA; Complete Payment Systems (CPS) Ltd., Mapon Ltd; SWD Factory Ltd; Rigas Karte Ltd; etc.

TTI has the plan for 2015 to sign the agreements and develop the cooperation plans at least with 4 entities: EcoTelematics Ltd., SMappost Ltd., Rīgas starptautiskā autoosta JSC and X Infotech Ltd.

6.4. Patents

As one of the weak points in the current scientific activity of TTI, the experts of Technopolis emphasize a low number of patents, which directly influences the capability of TTI to successfully commercialize its research results. Currently, according to the European Patent Office information, 2 patents are registered.

Table 18. List of patents

Title	Inventor	Applicant	Nr. /Year
Device for registration of magnetic field in electric facilities	Jurijs Roliks	TTI	LV15042 (A) 2015-07-20
Road vehicle weigh-in-motion method, system and apparatus	Grakovskis Alexander; Kabashkin Igor; Krasnitsky Yury; Laksa Igor; Petersons Elmars; Pilipovecs Alexey; Truhachov Victor	TTI	EP2878935 (A1) 2015-06-03

TTI plans to increase the number of patents by active participation in national and international level projects. Currently 2 patents are pending for approval. At the same time, in the framework of the project [NextIT](#) it is planned to introduce one patent proposal together with Riga Technical University.

Also TTI plans to become more active in the participation in the Aviation Research Center activities together with Riga Technical University, Telematics and logistics institute and D and D Centrs Ltd., which gives opportunity to develop new diagnostics methods in collaboration with the industry participants.

It is planned to have 7 active patents in 2020. The planning of the year by year graph is introduced on Figure 21.

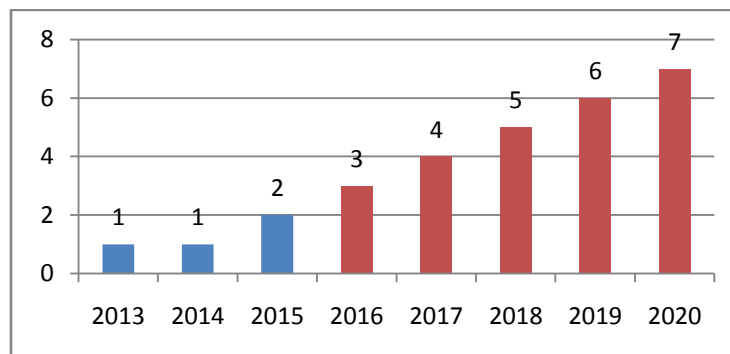


Figure 21. Active patents (current and planned)

6.5. Consulting capabilities

TTI has a positive experience in providing consulting service to the business and industry entities. For the last 6 years TTI has implemented more than 10 consulting projects for business and municipal organizations. In the future it is planned to increase the number of consulting projects. This will be done by signing cooperation agreement with the core field players in the area of ICT applications and involving more young researchers.

6.5.1. Laboratory of Applied Software Systems

The Laboratory of Applied Software Systems of the Transport and Telecommunication Institute carries on research and offers consulting in the following fields: traffic, logistics and business processes. The research and analysis are fulfilled using nowadays simulation software. The software of the laboratory allows doing the high-quality, representative and many-sided analysis of the research systems.

Table 19. List of services provided by the Laboratory of Applied Software Systems

Area	Service
Traffic	<ul style="list-style-type: none"> • Optimal traffic movement organization • Traffic forecast • System bottleneck research • Choice and search for optimal traffic lights cycle • Architectural plan checking up according to requirements • Public transport schedule optimization
Logistics	<ul style="list-style-type: none"> • Critical state of the system research • Optimization and strategies grounding • Warehouse modelling • Transportation process research and optimization • Investigation of the efficiency of using resources in the service and production areas • Production planning • Supplies and storage organization • Distributed, manufactured and warehoused systems investigation
Business processes	<ul style="list-style-type: none"> • Financial flows simulation and market research • Choice of optimal management strategy • Business process reengineering; • Risk management • Forecasting

6.5.2. Centre of Telecommunications, electronics and robotics

The Centre of telecommunications, electronics and robotics has been founded in 2013. It includes nine laboratories equipped with the latest software and hardware widely used in the academic and research activities. Each laboratory is a collection of contemporary technical, software and methodological maintenance, which allows conducting classes with students, implementing research activities and providing consulting services at the highest level. The following laboratories have been formed and equipped as part of the Center: Laboratory of Physics and Electrical Machines; Laboratory of Modelling of Electronic Systems; Laboratory of Embedded Systems and Digital Signal Processing; Laboratory of Industrial Automation; Laboratory of Subsurface Radiolocation; Laboratory of Robotics and Students'

Research Work; Laboratory of Designing And Prototyping; Laboratory of Telecommunications and Electro-Optical Systems Laboratory of Electronics. The center provides following consulting services:

- Non-destructive quality control of road surface;
- Assessing the quality of the laying road surfaces;
- Detection of hidden engineering communications;
- Detection of archaeological and natural artefacts (tree roots, stones etc);
- Electronic devices design and prototyping;
- Electronic component parameters measurement and testing;
- Automotive systems and drone's communication and control systems analysis and design;
- Digital signal processing devices design and prototyping;
- Sensors parameters measurement and testing;
- Transport telematics systems devices analysis and design;
- Optical communications components parameters measurement and testing;
- Computer networks elements parameters measurement and testing;
- RFID programming and RFID base system design.

6.5.3. Multimedia laboratory

The laboratory is equipped with video-recording and editing equipment complex, which allows creating educational, informative and commercial videos.

6.5.4. Virtual Reality Laboratory

Virtual reality laboratory is the TTI joint project with the Aviation Research Centre Ltd. and Fraunhofer Institute for Factory Operation and Automation IFF, Magdeburg (Germany) (start – 2013). Virtual reality laboratory is dedicated to giving aviation maintenance staff practical skills for control, diagnostics and maintenance of equipment and units, which are placed on the latest generation helicopters and airplanes. Aviation companies have permanent need for technical personnel qualification adaptation and increase. This concerns monitoring, diagnostics and maintenance of the new types of helicopters and airplanes. The problem is aggravated by two factors:

- Practical skills of using the equipment and software have to be acquired before the airplanes and helicopters are supplied;
- Training procedures with real equipment are difficult due to high cost of modern airplanes and helicopters.

These problems can be solved by using virtual reality 3D models.

The main planned activities of the laboratory will be:

- Development of the integrated applications on the virtual models development platform;
- Development of the integrated concept of using virtual models as simulators for the improvement of practical maintenance skills;
- Simulation of the maintenance personnel behaviour in a real aviation environment;
- Development and practical implementation of the scenarios for demonstrating and evaluating practical maintenance skills obtained by aircraft technicians;

- Virtual simulators development for training specialists in order to maintain, operate and repair airplanes and helicopters.

6.5.5. Forecast of income from consulting activities

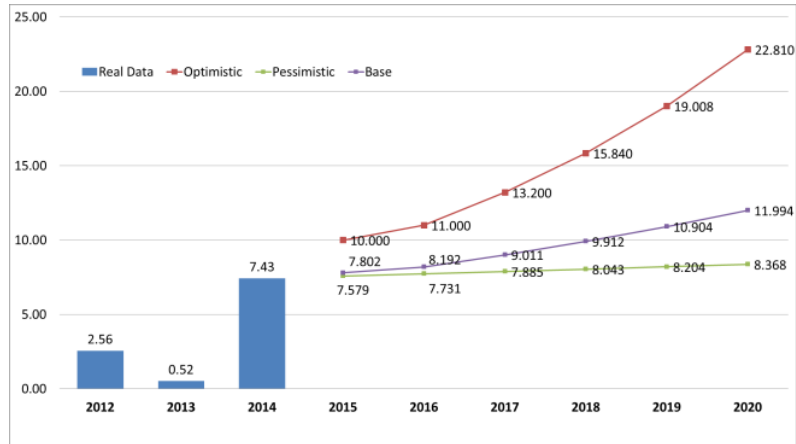


Figure 22. Planned income from consulting activities

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Annex 1. Technopolis group report on TTI assessment

Annex 2. Transport and Telecommunication Institute. Research Strategy 2015– 2020

Our vision for the Research Strategy is:

Research excellence and innovation are integral to the vision of the Transport and Telecommunication Institute. Our goal is to address fundamental and strategically important questions, and to deliver economic, social and cultural impact at regional, national and international levels. We engage in internationally leading research activities and collaborations.

Our Strategy is informed by the following set of values, by which the University will judge the merits of planning and investment decisions for research:

1. Research excellence contributes significantly to our reputation, both at a national and international level.
2. We engage in high quality research, both basic and applied, to answer fundamental and strategically important questions and to benefit the wider community.
3. Research informs our teaching and we seek to engage students in our research programmes.
4. We value the expertise of our staff and students, and are committed to supporting them to reach their full research potential.
5. We are committed to maximising the income associated with our research and through this providing the sustainable environment needed to enhance our research.

The TTI will:

- support the highest quality research and develop collaborations that enhance the contribution of research to the broad portfolio of our activities;
- support and develop excellent researchers within a sustainable research culture;
- promote and publicise the contributions that our research makes to the advancement of knowledge and to wider economic and societal benefit.

We will set very high standards to ensure that we maintain and advance our reputation for research. To do this the University will set ambitious, but achievable research performance expectations, and our strategic investment in and support of research activities will necessarily be selective.

Strategic objectives

The University Research Strategy is presented as a series of objectives under six main themes:

Theme 1: Research excellence and profile

1. To support and enhance existing areas of excellent research.
2. To identify and develop emerging areas of research excellence, including those that cross traditional subject or discipline boundaries.

3. To achieve an optimal performance in the national system of accreditation of scientific organizations, thereby maintaining a visible, quality assured research standing in the academic community and beyond.
4. To support the effective dissemination of original and significant research outputs through high quality outlets.
5. To understand, influence and respond to external research priorities at both national and international levels.

Theme 2: Collaboration

1. To promote and support collaboration in order to extend the quality and breadth of our research.
2. To provide support for collaborations that address strategically important priorities, including interdisciplinary research.
3. To develop sustainable collaborations nationally and internationally, working with leading HEIs, research institutions and other organisations, including industry and other commercial partners.

Theme 3: Sustainable research environment

1. To increase the proportion of academic staff engaged in high-quality research through recruitment and ongoing staff development.
2. To direct targeted investment towards key infrastructure and an agile research support system which fosters and sustains high quality basic and applied research and responds promptly to emerging opportunities.
3. To enhance the resilience of our research base by diversifying our engagement with external funding streams.
4. To recruit, develop and retain high-quality postgraduate research degree students and to provide them with a stimulating and supportive research environment and development opportunities.

Theme 4: Supporting researchers and research leaders

1. To attract, retain and reward high quality academic and research staff who are able to make a significant contribution to our research profile.
2. To encourage all staff and research degree students to reach their full research potential and to support their career development.
3. To facilitate best practice in research leadership and management, including equal opportunities and diversity.
4. To make good use of our collaborations to develop opportunities for career and skill development.

Theme 5: Research informs educational strategy

1. To ensure that the curriculum is informed and enriched by research.

2. To engage research-active academic staff at all levels in teaching.
3. To foster the development of research skills in students and to engage them in research, where appropriate, through taught programmes.

Theme 6: Social, economic and cultural impact

1. To engage with partner organisations and communities to inform our research and deliver social, cultural and economic benefits.
2. To exploit the potential of the University's research both to generate resource for the Institution and in order to offer solutions to real- world problems.
3. To promote the impact and value of our research, to generate public understanding and awareness of the University and its contribution to society.

Next steps

Delivery of the TTI Research Strategy will be measured against a series of key university-level indicators and targets that will be set out in an Operational Plan. Faculties, Schools, Departments and Centres will be required to develop their own research strategies that are aligned with the objectives identified in this University Research Strategy. Faculties will be asked to report progress against their own strategies and targets and these will be reviewed on a regular basis by the University's Senate. The Senate will also keep the TTI Research Strategy under review throughout the period 2015–2020, receiving reports on progress against identified targets and reporting as appropriate to Academic Council.

Annex 3. Transport and Telecommunication Institute. Education Strategy 2015–2020

Our vision for the Education Strategy is:

To provide an excellent, inspiring and challenging educational experience underpinned by research, scholarship and professional and ethical practice, through which our students will be able to achieve personal, academic and career success.

This will be achieved through a culture of enhancement with five strategic aims:

1. We will provide an educational experience underpinned by research, scholarship and professional and ethical practice that inspires, engages and challenges students and promote success in an inclusive and supportive environment.
2. Through and beyond the curriculum, we will enable students to develop skills and gain experience which will prepare them for success in the graduate global labour market.
3. Our learning and support environments, resources and infrastructures will be high quality, effective, efficient, flexible and conducive to student learning.
4. We will foster a shared responsibility for learning and enhancement with our students to further enrich their overall experience.
5. We will develop, recognise and reward excellent and inspirational staff.

Through these aims we expect the TTI Graduate to:

1. Demonstrate command of a significant body of subject knowledge and skills.
2. Be able to make a successful transition into employment and/or further study.
3. Be confident to engage in lifelong learning in pursuit of personal, academic and career development.
4. Display effective academic, research, information and digital literacy skills.
5. Be able to work autonomously and collaboratively.
6. Have an enterprising outlook and be capable of logical, critical and creative thinking to solve a range of problems.
7. Have a global perspective and be able to act in an ethical and socially responsible manner.

Meeting these aims

Aim 1: We will provide an educational experience underpinned by research, scholarship and professional and ethical practice that inspires, engages and challenges students and promote success in an inclusive and supportive environment.

We will offer challenging courses informed by research, scholarship and professional and ethical practice, and delivered by staff who are experts in their fields. The curricula will support transition to higher education, be innovative, inspiring, engaging and globally relevant. Teaching and assessment methods and technologies will be pedagogically informed and promote deep and independent learning and success. We will foster an inclusive, multicultural learning experience where difference is valued and incorporated into all facets of our students' education. Excellent academic, personal and specialist support and services will be integral to the overall student experience.

1. Courses will be distinctive, leading edge and underpinned by research, scholarship, professional and ethical practice.
2. Course design will be innovative, inspiring, challenging and inclusive and promote the development of the attributes of the TTI Graduate.
3. Course design and delivery will promote a global and sustainable development perspective and multicultural understanding.
4. Course design and delivery will be flexible and responsive to the needs of our students and a diverse market.
5. Best pedagogic practice will inform teaching and assessment methods and technologies and promote student centred, individual and collaborative learning.
6. Students will be supported, according to their individual need, to make an effective transition into higher education and become confident, successful learners.
7. Students will have individual access to a range of professional academic, personal and specialist support and services throughout the student life cycle.

Aim 2: Through and beyond the curriculum, we will enable students to develop skills and gain experience which will prepare them for success in the graduate global labour market.

This will include work-related learning in all courses; work experience, placement and volunteering opportunities; personal development planning which will lead to a graduate portfolio; opportunities for direct engagement with regional and national employers; services for student enterprise; careers information, advice and guidance; support with job applications; services of an in-house recruitment agency up to and after graduation.

Our curricula will include work-related learning or work experience opportunities with real life learning being a feature of many of our courses.

Employability and career management skills, supported by our investment in Personal Development Planning, will be embedded in our courses, to prepare and equip students for graduate employment or further study.

We will support academic staff to be knowledgeable and confident with regard to employability and enterprise.

1. We will develop effective employer engagement by establishing positive working relationships with employers. We will work with our alumni to support our students and encourage employers to contribute to the student experience and to recruit Portsmouth graduates.
2. We will continue to invest in single-window system so that services to students, graduates and employers are consolidated. We will continue to work closely with the Students' Union to ensure that we are listening to the student voice and responding to the demands of a changing student population.
3. We will invest in support for student enterprise and we will provide opportunities for enterprising and entrepreneurial students and graduates to start businesses or to use their enterprising skills to gain employment and become enterprising employees.

Aim 3: Our learning and support environments, resources and infrastructures will be high quality, effective, efficient, flexible and conducive to student learning.

1. We will provide students with a high quality environment where planning enables us to anticipate and respond to changes in pedagogies, technologies and student learning needs and the changing educational landscape. We will invest in infrastructures, technologies and resources and we will further develop efficient technology enhanced learning and online services for students.
2. We will establish systems to enable us to anticipate student learning needs so that physical structures, IT infrastructure, online and library resources respond to changes in student demand and behaviour.
3. We will deliver high quality, efficient and effective learning spaces, learning resources and environments.
4. We will invest in the IT infrastructure, online resources and the integrated e-learning environment so that courses are delivered using the most appropriate technology and resources.
5. Our virtual learning environment, e-learning tools and mobile learning technology will be enhanced to provide a modern, efficient, flexible and engaging learning environment for students.
6. We will exploit technology, including online services to enhance the wider student experience.
7. Our quality assurance and enhancement policies, procedures and practices will be proportionate, minimise bureaucracy and focus on promoting a quality student learning experience.

Aim 4: We will foster with our students a shared responsibility for learning and the enhancement of learning to enrich their overall experience.

We will work with our students to engender a shared responsibility for learning. We will further enhance the collection and analysis of student feedback and further develop mechanisms for the student voice to inform and enhance all aspects of course design, delivery and review. We will promote opportunities for students' personal as well as academic development.

1. We will engender a sense of community and a shared commitment to learning, development and responsibility with our students so that they consider themselves co-partners and active participants in their learning.
2. We will enhance mechanisms to gather and respond to the student voice by further developing systems to gather, evaluate and respond to student feedback.
3. We will collaborate with TTI Students' Self-government to ensure that the student voice is fully incorporated into university committees and working groups.
4. We will work with the TTI Students' Self-government and the local community to promote extra curricula opportunities for students to develop personally and gain a global and socially responsible outlook.
5. We will encourage students to participate in our quality assurance and enhancement procedures so that their views more fully inform course development and delivery.

Aim 5: We will develop, recognise and reward excellent and inspirational staff.



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Excellent and innovative staff will be core to the success of the Education Strategy. We will invest in staff and aim for our students to be taught, supervised and supported by staff who are experts in their field. Career development structures and programmes will support staff to develop and enhance the skills, knowledge and attributes required to support this Education Strategy. We will recognise, reward and celebrate excellence in teaching, academic leadership and learner support through a new framework of awards and rewards.

1. We will appoint and develop staff with strengths and potential in teaching/supporting learning and research/scholarship excellence relevant to the post.
2. The TTI internal legislation will be revised to ensure that it supports the Education Strategy and aligns with the Latvian Education legislation.
3. We will work with the University of TTI Students' Self-government to recognise and reward teaching and learning support excellence.
4. Career paths to Professorship based on teaching excellence, academic leadership and pedagogic advancement will be promoted.
5. Staff will be expected to incorporate best pedagogic practice, research-led/informed teaching and scholarship within their teaching.
6. Staff will be developed and supported to engage in pedagogic research.

Annex 4. Transport and Telecommunication Institute. Knowledge Services Strategy 2015–2020

Our vision for the Knowledge Services Strategy is:

The Transport and Telecommunication Institute will expand its provision of quality-assured knowledge services commissioned by other organisations to improve their efficiency, effectiveness or profitability. These services are underpinned by our excellence in teaching and research, contributing to and making use of the high-level skills of our staff and our state-of-the-art facilities.

Scope

Knowledge services include:

- applied research projects;
- continuing professional development;
- consultancy;
- commercial use of specialist facilities;
- the exploitation of intellectual property;
- commissioned teaching paid for by public and private sector organisations.

Strategic position

The provision of knowledge services will complement our work in education and research, subject to many of the same quality assurance, funding and governance arrangements.

The interaction of staff with other organisations through the provision of knowledge services will help to inform our Curriculum and Employability Strategy by building partnerships in sectors of prime relevance to students' courses and future careers.

The provision of knowledge services through accredited teaching is covered by the ambitions and principles espoused in our Education Strategy.

The provision of the knowledge services that stem from research strengths will stimulate research activities that impact on the economy and society. These will contribute directly to the delivery of our Research Strategy through publications, income and postgraduate research support.

Strategic aims

The strategic aims of the Knowledge Services Strategy are to:

1. Develop in all parts of the university a culture of engagement with other organisations that leads to mutually beneficial relationships.
2. Increase our contribution to regeneration and the expansion of employment opportunities.
3. Support, celebrate and reward success in the provision of knowledge services.
4. Enable students and staff to be entrepreneurial in the exploitation of intellectual assets.
5. Develop quality assurance, financial and governance arrangements for all knowledge services.

6. Ensure that the university's facilities and supporting services are appropriate to achieving our ambitions.

Meeting these aims

Aim 1: Develop in all parts of the university a culture of engagement with other organisations that leads to mutually beneficial relationships.

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

We will do this by:

- encouraging and supporting the formation of multidisciplinary teams which draw upon expertise across the University, and engage external partners;
- supporting and running industry or sector-focused events;
- increasing the number of our commercialisation awareness programmes in the areas of technology transfer, and the exploitation of intellectual property;
- supporting staff in developing the curriculum and programmes of study in ways that will lead to engagement with other organisations;
- encouraging work with social enterprise and charities that provide volunteering and work-related opportunities for students.

Aim 2: Increase our contribution to regeneration and the expansion of employment opportunities.

Our ambition is to provide high-level skills, applied research and leadership to encourage inward investment to the region, and to promote the sustainability and growth of existing enterprises.

We will do this by:

- developing a comprehensive portfolio of Continuing professional development programmes for the business, commercial and industrial communities in response to regional demands and aligning our provision with developing workforce needs;
- expanding the number of knowledge transfer partnerships and other collaborative research programmes;
- helping to lead and shape collaborative bids for regeneration funding from government and elsewhere;
- expanding the range of specialist facilities available for commercial use;
- participating in local regeneration groups including the Local Enterprise Partnership and Shaping the Future of Portsmouth.

Aim 3: Support, celebrate and reward success in the provision of knowledge services.

Our ambition is to ensure that the provision of knowledge services is a core part of our business, and this will be reflected in career development opportunities for staff.

We will do this by:



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- providing specialist support for staff in the early stages of project development;
- supporting and promoting cross-faculty collaboration in programme development and delivery which enables less experienced staff to draw upon the experience of others;
- incorporating the provision of knowledge services in promotion and reward criteria;
- ensuring that groups and departments share in the benefits of providing knowledge services through increased funding and the targeted use of purse accounts;
- working with heads of department to ensure that staff workloads can accommodate and be responsive to opportunities to provide knowledge services.

Aim 4: Enable students and staff to be entrepreneurial in the exploitation of intellectual assets.

Our ambition is to facilitate enterprise as a key component of our approach to enhancing students' future career opportunities, through direct support and the example of successful staff entrepreneurs.

We will do this by:

- providing practical advice and guidance for staff and students wishing to take forward entrepreneurial ideas;
- providing opportunities for staff to engage with innovation and enterprise, including access to workshops and seminars;
- working to secure financial and other resources to enable ideas and innovations to be brought to commercial success.

Aim 5: Develop quality assurance, financial and governance arrangements for knowledge services.

Our ambition is to ensure that our commercial partners are highly satisfied with the services that we supply, that these activities make a positive contribution to the University's financial position, and that the principles of good governance espoused elsewhere in our Strategy apply equally to the provision of knowledge services.

We will do this by:

- incorporating the provision of all accredited programmes within our framework for teaching quality assurance and enhancement;
- developing feedback systems and other quality assurance mechanisms for non-accredited programmes of professional development;
- supporting the increase in income through diversification of sponsorship;
- adopting competitive, realistic and cost-effective pricing methodologies, with provision below full cost only where there are demonstrable non-financial benefits;
- requiring partners to respect the academic freedom and integrity of our staff, including the need for ethical approval and the right to the publication of results.

Aim 6: Ensure that the university's facilities and supporting services are appropriate to achieving our ambitions.

Our ambition is to have sector-leading support and facilities to enable the delivery of professional standard knowledge services.

We will do this by:

- ensuring highly visible, rapid and well co-ordinated responses to external enquiries;
- providing business support services focusing on gaining and managing grants and contracts and the exploitation of intellectual property;
- providing business incubator facilities within the University principally for students, and supporting access to external facilities;
- providing high quality spaces and services for the delivery of programmes of professional development and commercial use of facilities;
- providing support for the management of events and courses.

Annex 5. Roadmap for 2015 (Core planned activities)

	Activities	Data	Results
1	Creation of International Scientific Advisory Board	IX 2015	Approval of the Regulations Personal structure
2	Description of the current state: facilities, infrastructure, equipment, budget, output	IV 2015	SWOT analysis
3	Realistic estimation of the resources necessary to proceed towards European level in and research	IX 2015	
4	Determination of evaluation criteria (KPI) in context with the implementation of actions plan	VIII 2015	KPI framework for TTI research activities
5	Description of the measures required for the achievement including the required budget.	IX 2015	Approval of the development plan
6	Changes in the regulatory documents of scientific activity	XI 2015	Changed documents regulating scientific activity
7	Revision and adjustment of TTI Statutes according to the demands of the development plan	X 2015	
8	Agreement on procedures for progress monitoring, evaluation and corrective measures	XI 2015	
9	Amendments to the existing contract of the rector, vice-rector and deans, set concrete performance of the approved program of scientific development, and development of procedures for assessing effectiveness of the rector and vice-rectors	XII 2015	Contracts of rector, vice rector and the deans

Annex 6. List of defended PhD in 2006-2015

N	Name (given name and family name)	Topic of dissertation	Year of completing the degree
1*	Vasilijs Demidovs	Development of models of the Dataware of Decision Support Systems at the Railway	20.06.2006
2	Helen Afanasyeva	The Estimation of Transport Logistic Processes Models on the Base of Intensive Computer Methods of Statistics.	04.07.2006
3	Andrejs Romanovs	Application of multi-criteria analysis methods to the tourist information system development	19.12.2006
4	Andrejs Solomenikovs	Simulation Modelling and Research of Marine Container Terminal Logistics Chains. Case study of Baltic Container Terminal.	17.04.2007
5	Alexander V. Berezhnoy	Investigation of the Traffic Flow Models Managing Parameters Influence on the Efficiency of the Urban Traffic Control	7.10.2008
6	Vaira Gromule	The System of Monitoring the Quality of the Coach Terminal Services for the Realisation of a Conception of a Passenger Logistics Centre in a Multimodal Transport System	15.12.2010
7*	Natalia Petukhova	Temporal Data Models in the Information Systems on the Railway Transport.	30.03.2011
8	Takhir Mamirov	The Development of Problems Resolution Methods of Precise Vibrodiagnostics of Transport Aggregates.	8.09.2011
9	Stanislav Aryeh V. Fradkin	Modelling of the urban transport impact on the city atmospheric environment using apparatus of mathematical physics	14.02.2013
10*	Mihails Savrasovs	Development of new approach for simulation and analysis of traffic flows on mesoscopic level	03.10.2013
11*	Elena Yurshevich	Methodology of decision-making support on the base of urban transportation system microscopic models repositories	12.12.2013
12*	Alexander Krainyukov	Reconstruction of the roadway coverage parameters by radar subsurface probing	17.02.2014
13*	Sergey Yunusov	Improvement of Models and Methods for Diagnostics of Gas Path of Gas Turbine Engine within the Aircraft Power Plant Monitoring System	08.05.2014
14	Joerg Kundler (Germany)	The methodology of maintenance and technical service model development for air traffic control service providers	26.06.2014
15*	Nadezda Spiridovskaya	Nontraditional regression models in transport planning and modeling	10.02.2015
16	Viktors Krebss	Research on localization methods of transportation networks objects using spatial databases	09.07.2015
17*	Dmitry Pavlyuk	Study of European airports' efficiency on the basis of spatial stochastic frontier analysis	13.07.2015
18*	Irina Pticina	Integral estimation of urban public transport system service quality from the end-users point of view	13.07.2015

* - TTI staff in 2015

Annex 7. Most important collaboration (till the project implementation)

Name and Organisation	Type of collaboration	Country
UNIVERSITIES		
Vilnius Gediminas Technical University	Common research projects „Safer Heavy Goods Traffic”, „The Impact of the market Structure on Safety and Security in BSR”; scientist exchanges	Lithuania
Kaunas University of Technology	Common projects	Lithuania
Hamburg University of Technology (Institute of Business Logistics and General Management)	Common research Project in the area of simulation application in logistics sphere (common workshops, publications, project proposal)	Germany
Magdeburg University	Common workshops	Germany
Centre for Maritime Studies, University of Turku	Common workshops, common project	Finland
Universidad Politécnica de Madrid	Scientist exchanges in the frame of common research activities on subject modelling public transport passenger flows in the era of intelligent transport systems	Spain
University of Murcia	Common project	Spain
Universidad Autònoma de Barcelona	Common project	Spain
University of Liege	Common research in area 3D urban models (chapter in the book, project proposals)	Belgium
Ben Gurion University	Common research, papers, seminars for master and PhD students and papers in Data Mining field.	Israel
Universidad Autònoma de Barcelona	Common project	Spain
Universita degli Studi di Trieste	Common project	Italy
Immanuel Kant Baltic Federal University (IKBFU)	Academic and scientific cooperation	Russian Federation
RESEARCH INSTITUTES		
Fraunhofer Institute for Factory Operation and Automation	Common researches in the area of application of mesoscopic approach to the simulation of logistics systems, 2008-2010 Knowledge exchange in the area of 3D virtual reality technologies application for the training, education and research	Germany
Institute of Logistics and Warehousing	Common FP7 project „B2BLOCO”	Poland
INRETS Laboratoire Ingénierie Circulation Transport	Common Projects: COST Actions TU0804, TU0903	France
ENTERPRISES		
LAGRANGE SARL	Common project	France
INRETS Laboratoire Ingénierie Circulation Transport	Common Projects: COST Actions TU0804, TU0903	France
KEMA Nederland BV	Common project	Netherlands
„Rīgas Satiksme”, State Ltd	Common projects	Latvia
State JSC „Latvijas Gaisa Satiksme”	Common projects	Latvia

Annex 8. Source of funding expressed in thousands EUR

Source of Funding (Expressed in thous.EUR)	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
										2006-2014
State budget funding										
Core (maintenance) funding										0
State budget funding for research development in HEE										0
Grants of the Latvian Council of Science	28.12	64.04	33.09	20.73	33.09	33.09	33.07			245.21
State Research Programs									2.63	2.63
Other funding										
Contract research		13.21	43.74	83.07	4.54	20.45	2.56	0.52	7.43	175.51
ESF, ERAF funding		51.69	104.23	173.81	344.78	221.24	835.46	1198.62		2929.82
Framework Program projects		5.7	6.0	10.7	10.7	2.8	14.1	209.33	69.24	328.41
Other international project funding	30.96	0.28	5.40	5.68	7.81	21.44	5.54	11.57	33.27	121.95
Private funding					36.35	45.44				81.79
Other	45.87	10.22	11.64		2.27					70.00
Total	104.94	145.12	204.05	293.94	439.49	344.49	890.68	1420.04	112.57	3955.33

Annex 9. Target calls in Horizon2020 (Mobility for Growth)

Topic	Dates	Potential partners
Addressing aviation safety challenges	Single stage- 26-01-2016	
Protection of all road users in crashes	2 stages: 1st 26-01-2017- 2nd: 19-10-2017	DEUSTO, ITS
Behavioural aspects for safer transport	2 stages: 1st 20-01-2016- 2nd 29-09-2016	AIT, ITS
Increasing the take up and scale-up of innovative solutions to achieve sustainable mobility in urban areas	2 stages: 1st 26-01-2017- 2nd: 19-10-2017	AIT, BME, DEUSTO, DLR, IFSTTAR, ITS
Supporting 'smart electric mobility' in cities	2 stages: 1st 26-01-2017- 2nd: 19-10-2017	AIT, BME, DLR, IFSTTAR, ITS, VTT
Innovative ICT solutions for future logistics operations	2 stages: 1st 26-01-2017- 2nd: 19-10-2017	AIT, BME, DEUSTO, VTT
Promoting the deployment of green transport, towards Eco-labels for logistics	Single stage- 26-01-2016	AIT, DLR, FHG /LBF, ITS, VTT
Innovative concepts, systems and services towards 'mobility as a service'	2 stages: 1st 20-01-2016- 2nd 29-09-2016	AIT, DEUSTO, FHG LBF, ITS
Roadmap, new business models, awareness raising, support and incentives for the roll-out of ITS	Single stage- 26-01-2016	AIT, DEUSTO, ITS
Optimisation of transport infrastructure multi-modal corridors and terminals	2 stages: 1st 26-01-2017- 2nd: 19-10-2017	AIT, DEUSTO, DLR, IFSTTAR, ITS, VTT
Big data in Transport: Research opportunities, challenges and limitations	Single Stage- 02-02-2017	AIT, DEUSTO, FHG /LBF, ITS
Maintaining industrial leadership in aeronautics	2 stages: 1st 26-01-2017- 2nd: 19-10-2017	
Innovative approaches for integrating urban nodes in the TEN-T core network corridors	Single Stage- 02-02-2017	AIT, DLR, IFSTTAR, VTT
Facilitating public procurement of innovative sustainable transport and mobility solutions in urban areas	Single stage- 26-01-2016	
New ways of supporting development and implementation of neighbourhood-level and urban-district-level transport innovations	2 stages: 1st 20-01-2016- 2nd 29-09-2016	AIT, DEUSTO, DLR, IFSTTAR, ITS
Networked and efficient logistics clusters	2 stages: 1st 20-01-2016- 2nd 29-09-2016	AIT, DEUSTO, FHG /LBF, IFSTTAR, VTT
Potential of the Physical Internet	Single Stage- 02-02-2017 (CSA part) + 2 stages: 1st 26-01-2017- 2nd: 19-10-2017 (RIA part)	AIT, BME, DLR, VTT
Large-scale demonstration(s) of cooperative ITS	2 stages: 1st 20-01-2016- 2nd 29-09-2016	AIT, DEUSTO, DLR, ITS,
Resilience to extreme (natural and man-made) events	2 stages: 1st 26-01-2017- 2nd: 19-10-2017	AIT, DLR, FHG /LBF, VTT
The Port of the future	Single Stage- 02-02-2017 (CSA part) + 2 stages: 1st 26-01-2017- 2nd: 19-10-2017 (RIA part)	AIT, DEUSTO
Assessing future requirements for skills and jobs across transport modes and systems	Single stage- 26-01-2016	IFSTTAR, ITS
Improving accessibility, inclusive mobility and equity: new tools and business models for public transport in prioritised areas	Single Stage- 02-02-2017	AIT, DEUSTO, ITS
Shifting paradigms: Exploring the dynamics of individual preferences, behaviours and lifestyles influencing travel and mobility choices.	Single Stage- 02-02-2017	AIT, DEUSTO, ITS

Annex 10. List of recommended journals for publication in sphere “Transport”

Scientific journal	Scientific journal
Archives of Transport	Transport and Telecommunication Journal
European Journal of Transport and Infrastructure	Transport Policy
European Transport Research Review	Transportation
International Journal for Traffic and Transport Engineering	Transport Problems: an International Scientific Journal
International Journal of Transport and Logistics	Transactions on Transport Sciences
Journal of Transport and Land Use	Transportation Research Procedia
Journal of Transportation Technologies	International Journal of Advance Innovations, Thoughts and Ideas
Journal of Air Transport Management	JBR Journal of Young Scientist
Transport	Transportation Research Part A: Policy and Practice
Transportation Research Part B: Methodological	Transportation Research Part C: Emerging Technologies
Transportation Research Part D: Transport and Environment	Transportation Research Part E: Logistics and Transportation Review
Transportation Research Part F: Traffic Psychology and Behaviour	

Annex 11. List of recommended international conferences

Conference	Location	Date
5 th International Conference on Dynamics in Logistics (LCID2016) jointly hold with 7 th IFAC Conference on Management and Control of Production and Logistics (MCPL2016)	Bremen, Germany	February 20-26, 2016
18 th , 19 th and 20 th Annual International Conference on Education	Athens, Greece (2016) N/A (2017) N/A (2018)	May 16-19, 2016 2017 2018
6 th and 7 th European Transport Research Arena Conferences	Warsaw, Poland (2016) N/A (2018)	April 18-21, 2016 April, 2018
International Education Conference	Venice, Italy	June 5-9, 2016
14 th World Conference on Transport Research	Shanghai, China	July 10-15, 2016
16 th International Conference Transport Systems Telematics	Ustroń, Poland	October, 2016
23 rd ITS World Congress	Melbourne, Australia	October 10-14, 2016
Fall Global Conference on Education	California, USA	November 18-19, 2016
10 th and 11 th International Conference on City Logistics	N/A	2017, 2018
ICE 2017: 19 th International Conference on Education ICE 2018: 20 th International Conference on Education	Barcelona, Spain Prague, Czech Republic	February 26-27, 2017 March 23-24, 2018
CIEC: Conference for industry and education collaboration'16 CIEC: Conference for industry and education collaboration'17	Austin, Texas Jacksonville, Florida	2016 2017
Transportation Research Board Annual Meeting	Washington, D.C., USA	January 2017, 2018
4 th International Conference on Sustainable Urban Mobility	Volos, Greece	May, 2017
ICSCLE 2017 : XV International Conference on Supply Chain and Logistics Engineering	Paris, France	May 18-19, 2017
ICKMI 2017 : XV International Conference on Knowledge Management and Innovation	New York, USA	June 4-5, 2017
12 th ITS European Congress	Strasbourg, France	June, 2017
ICHLSCM 2017 : XV International Conference on Humanitarian Logistics and Supply Chain Management	Athens, Greece	July 20-21, 2017
ICKM 2017 : XV International Conference on Knowledge Management	Singapore, Asia	September 10-11, 2017

Annex 12. Activity plan for SI#1: Improving the positions in research in the number of areas of the 6th technological order

Stages		Tasks/Activities/Outputs	Funding		
2015	2016-2020		EU	National	TTI
<p>1. Preparing the conditions for improving the quality and the quantity of research characteristics, including publication activity, citations, patents, etc.</p> <p>2. Distribution of best practices of research activities, including allocation of funds for research and participation in significant scientific conferences; in all structural units of the output beyond the research staff research and teaching staff who are unable to comply with these standards</p>	<p>1. Creation of the conditions for improving the quality and the quantity of research characteristics, including publication activity, citations, patents, etc.</p> <p>2. The consolidation with those Research Institutes of a similar research profile into larger network units, such as research institutes and centres with shared usage and the improvement of scientific infrastructure, attraction of new talent and diversification of research with the emphasis on the multi-disciplinary approach.</p> <p>3. At the final stage, the research infrastructure including laboratories, centres with multiple users and research institutes, will be integrated into ICT&Transport&Logistics - Research and Tech Transfer Center in line with the global trends of scientific and technical development of sixth economic cycle based on TTI's core competences</p>	<p>Task 1. Organization of the "International Research Virtual Labs" activity with the participation of leading foreign academics Inviting EU specialists to join the 'International Research Virtual Labs' is aimed at ensuring that TTI is included in the international network of leading higher education institutions and increasing visibility and reputation in the international scientific and education community.</p> <p>The outputs of this task: increasing of the number of papers per researcher referred in the WoS and Scopus; increasing the average citation ratio per researcher; increasing the number of invited professors and researchers; increasing the percentage of income from R&D in the overall TTI income.</p> <p>Task 2. Increasing in the number of publications and improving the research quality in the TTI. This task requires multi-pronged approach</p> <p>1. Inviting scientists with high citation indexes to co-lead Laboratories will help kick-start the publication activity of the TTI as well as boost its average citation index.</p> <p>2. A system of financial incentives will be developed to encourage individual publication activity – the "TTI Visibility" program. It is currently in the works to have the TTI's own journal be included into WoS.</p> <p>3. An open digital database accessible a digital library of research papers by TTI staff will be set up.</p> <p>4. TTI will continue to regularly hold international conference, which is officially recognized by the international research community.</p> <p>5. A system for the patenting of TTI's intellectual property will be developed.</p> <p>Task 3. Recruiting researchers with a high publication record and presence in the citation index to work at TTI</p> <p>TTI recruits highly qualified specialists through the special recruiting program for Visiting Professor positions. or Visiting Professor positions.</p>	<p>Horizon 2020 (TWINNIG program)</p> <p>COST</p> <p>ERASMUS+</p>	<p>National Research Program</p> <p>PostDoc support programme</p>	<p>Development Budget</p>

Annex 13. Activity plan for SI#2: Integration of TTI into the global research and educational system through leading research, information and learning technologies

Stages		Tasks/Activities/Outputs	Funding		
2015	2016-2020		EU	National	TTI
Selection of research directions and creation the teams	<p>The development and launch of international Master's and PhD programs together with EU's universities, including double-degree programs.</p> <p>The programs will be built on open modules through the use of e-learning technologies in a multi-lingual environment.</p>	<p>Task 1. Creating Special Graduate Student Recruitment System TTI organizes and hosts conferences, academic competitions, scholarship competitions for grants to enter Master's and PhD degrees, developing a high-school graduate portfolio system, informing prospective students about the opportunities at TTI.</p> <p>Task 2. Creating and launching joint courses with foreign and Latvian universities and research organization This task is aimed at launching new programs, including double degree programs, at TTI together with the EU and Latvian universities and research organizations. It also includes the formation of an internship system for research internships during the dissertation preparation period.</p> <p>Task 3. Creating an environment for education at an international level This task is aimed at providing foreign students, researchers and invited lecturers, professors coming to TTI with all the necessary services.</p> <p>Task 4. Development of innovative learning technologies This task focuses on the development and implementation of new courses in various disciplines (in modules), and educational programs in an electronic format, partly in cooperation with partners; the introduction of the methodology of the task-oriented learning approach and problem-based learning into implementation of education programs.</p> <p>Task 5. The Implementation of a Double/Joint graduate and doctoral degree program and the establishment of a system of placements for postgraduate/doctoral students</p>	<p>ERASMUS+</p> <p>Horizon 2020</p> <p>COST</p> <p>NordPlus</p>	ESF	Development Budget

Annex 14. Activity plan for SI#3: Creating a novel HR system and forming a highly professional research staff

Stages		Tasks/Activities/Outputs	Funding		
2015	2016-2020		EU	National	TTI
<p>1. Creating the right environment for involving the stakeholders into the decision-making processes about boosting the TTI's competitiveness.</p> <p>2. Developing of regulatory documentation, regulating the KPIs for each staff group and each researcher</p> <p>3. A concrete plan outlining how to implement the observed developmental measures.</p>	<p>1. Large-scale expansion of recruitment of foreign and domestic students, academics and administrative employees.</p> <p>2. Creation of a Staff Continuing Education System (planning, organizing, monitoring of continuing education, etc.) staff development, programs of academic mobility, a strong alumni association.</p>	<p>Task 1. Reforming system of staff management through the transition from a system of personnel accounting to the HR management system</p> <p>a. Developing of regulatory documentation, regulating the KPIs for each staff group, as well as the content of 'efficient contracts' which will reflect the activity profile and competencies, in line with the level of the EU's leading research and education centres</p> <p>b. Conducting staff evaluations with an assessment of their competence level and performance outcomes, in line with the Program performance targets, leading to them signing 'efficient contracts'</p> <p>c. Reforming the structure of the HR by means of the creation of the following divisions:</p> <ul style="list-style-type: none"> • within the TTI administration: a service for the recruitment of research and education staff as well as administrative employees; • institutional structures: to set up HR commissions within the divisions for assessing the performance of research and administrative staff; <p>d. Development and implementation of programs for professional development to reflect performance targets (starting from 2016 each and every employee will have to upgrade their skills no less than 1 time in 3 years);</p> <p>e. Recruiting talented young people to TTI, there will be a development and implementation of the system for searching and inviting to work at TTI; the introduction of programs for supporting young people's professional advancement and career development (including internships, defence of PhD); the formation of a staff reserve-list for the positions of TTI heads at various levels</p> <p>f. Improving the system for financial incentives, as well as driving the moral motivation of TTI researchers to achieve the KPI;</p> <p>g. Improving of a mobility program for researchers and academics (e.g. between universities and research institutes), staff and students (e.g. with industrial enterprises and organizations in the public sector) in order to contribute to the formation of a network of partnerships and exchange of competence;</p> <p>h. Development and launch of a program for inviting leading guest specialists from government organizations, business, non-governmental sector, also from abroad, to fill part time consulting positions and accelerate the practical competencies and marketability TTI graduates.</p> <p>Task 2. Recruiting specialists to the TTI with successful employment experience, including for management positions. Improvement in the regulatory documents and business decisions which ensure a comfortable environment for inviting, receiving and accommodating foreign researchers at TTI for short-term and long-term visits;</p> <p>b. Holding competitions to fill vacancies</p>	<p>ERASMUS +</p> <p>Horizon 2020</p> <p>COST</p>	<p>National Research Program</p> <p>ESF</p> <p>PostDoc</p>	<p>Development Budget</p>

Annex 15. Activity plan for SI#4: Development of strategic communications and achieving high recognition of TTI nationally and globally

Stages		Tasks/Activities/Outputs	Funding		
2015	2016-2020		EU	National	TTI
Initial formation of a specialist team to manage communications at the TTI, upgrading of the TTI's portal and websites, broadening of the media channels, and recruiting students and faculty to create expert content for publication.	Active penetration of the global market for research, education and innovation. All forms of communication will be utilized, including advertising and PR-campaigns. Positive brand awareness is raised among the target audiences who are familiar with the TTI, brand awareness is increased at a global level.	<p>Task 1. Increase in TTI position in the international rankings Carrying out this task will have the greatest impact on raising the University's position in the QS and Times Higher Education league tables. As part of fulfilling this task:</p> <ul style="list-style-type: none"> • TTI participates in the largest international educational, trade and innovations events (Conference, Exhibitions, Forum etc) to increase its brand recognition, raise the awareness about the TTI activities among foreign experts, leading scientists, and prospective students • TTI launches PR and advertising campaigns in Latvia and in the foreign markets • The TT's annual report is prepared, distributed in English, disseminating the most up-to-date information about the TTI's activities, achievements and plans. <p>Task 2. Increasing recognition of TTI at the international level The following activities are part of this task:</p> <ul style="list-style-type: none"> • Systematic development of communication activities • Rebranding, including renaming (University). TTI brand promotion in Latvian and foreign scientific societies, associations, media Development of TTI's information resources, including the sites, and their promotion through social networks • Communications support of the alumni association • Building relationships with the embassies and missions of Latvia abroad, membership in international associations 	Horizon 2020 (TWINNIG program) COST ERASMUS+	National Research Program PostDoc	Development Budget

Annex 16. Activity plan for SI#5: Development of the innovation ecosystem to support the growth potential of TTI in knowledge and technology transfer

Stages		Tasks/Activities/Outputs	Funding		
2015	2016-2020		EU	National	TTI
The formation of a fully-fledged system of service support for knowledge and tech transfer products ensuring they are embedded in practical processes and protected by international patents by means of commercialization processes. The service will include the intensive development and up skilling of TTI staff with regard to commercialization and knowledge and technology transfer	Large-scale and widespread consolidation and implementation of new mechanisms for cooperating with other stakeholders within the innovation ecosystem as well as the establishment of an international innovation hub.	<p>Task 1. Developing technology transfer and commercialization at domestic and international levels</p> <p>It will be implemented through two interconnected approaches:</p> <ul style="list-style-type: none"> • Creating a system for utilizing TTI's research outputs in the national economy – a «technology-push» approach; • Creating within the TTI a «virtual» engineering research environment that provides solutions to business problems through applying of the TTI's own technologies and competences – a «market-driven» approach». <p>Measures in this area are focused on organizing systemic processes to manage knowledge and tech transfer. The substantial mechanisms for the implementation of this activity will be:</p> <ul style="list-style-type: none"> • Creating an investment policy for the TTI's portfolio of exploitable intellectual property, including mechanisms for valuations, marketing and local market research and technology foresight; • Developing and implementing a system of procedures for the creation, management small innovative enterprises, involving management and decision-making and so on. <p>Solving this task assumes that there is a network of partnerships with other stakeholders within the innovation ecosystem at the city, national, international levels, including clusters and associations.</p> <p>Task 2. Enhancement of the business culture and management competencies of the TTI</p> <ul style="list-style-type: none"> • Developing existing, and implementing, new technologies by organizing service support for students, staff and third parties with respect to implementation of their innovation projects (e.g., start-up acceleration); • Organizing and performing information and training events in the sphere of innovation and business activity. <p>Building entrepreneurial and leadership skills among the widest possible range of staff and students at TTI, as well as giving credibility to business activity will be achieved through:</p> <ul style="list-style-type: none"> • Involving leading Latvian and foreign experts and entrepreneurs as trainers and mentors in the work with start-up teams and in mainstream educational process; • Giving additional academic credits to students for participation in entrepreneurial activity and the inclusion of courses on entrepreneurship into formal programs of assessment; • Involving EU's specialists in the organization of our innovation activity; • Publicizing the «success stories» of TTI entrepreneurs in the mass media and elsewhere. <p>A key indicator for the success of the task will be the share of students and staff who get involved in business activities, as well as the number of third parties attracted by TTI through its activities in innovation and entrepreneurship.</p> <p>The above activities will focus on ensuring a high level of awareness about the chance to create innovation projects, including knowledge and technology commercialization and transfer through the use of TTI services</p>	ERASMUS + Horizon 2020 COST	ESF	Development Budget

Annex 17. Activity plan for SI#6: Transformation and development of the TTI management system based on the principles of a research and business-oriented University

Stages		Tasks/Activities/Outputs	Funding		
2015	2016-2020		EU	National	TTI
Aimed at reforming the management structure by means of performance reviews and creation of new administrative and service divisions necessary for the successful implementation of the Program	Aimed at deregulating the management system; reforming the organizational structure of research and education activities, including introducing the Integral Control System in strategic decision-making procedures on a large scale	Task 1. Improvement of the administration of the TTI's research organization <ul style="list-style-type: none"> • Improvement of the TTI Research Governance through introducing new administrative and maintenance services that support a comfortable environment of realization of the Program • Development of regulatory documentation and auditing all administrative, scientific and educational departments of the University • Development of guidelines to help improve departments deemed ineffective • Fulfilling this task will entail a reform of the organizational structure of research and education activities at TTI. Task 2. Ensuring the transparency and efficiency of administrative and business processes in the University <ul style="list-style-type: none"> • Analysis of the best practice, development of regulations, special events planning, including internships, and deregulation of the TTI management system at all decision-making levels; • Organization of Academic Councils (in research and education areas of TTI), whereby public meetings will be set up to discuss topical issues around research and education activities; • Development of the documentation and establishment of an endowment fund, fundraising activities; • Improvement of the system for acquisition, arrangement, storage and access to relevant, comprehensive information within the TTI, with regard to all Program performance targets, as well as the subsystem of strategic decision-making based on the collected data. 	ERASMUS+ H2020 COST	ERDF	Development Budget