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ASSESSING KNOWLEDGE LEVEL OF STAKEHOLDERS ON TRANSPORT INTERCHANGE DESIGN AND OPERATION

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Abstract. The paper advances the results of the on-going work conducted within the frame of the European Twinning project ALLIANCE. In the effort to assess educational needs of different stakeholder groups involved in the domain, this paper's main interest is to study knowledge and importance of governance issues and smart solutions, which enable smooth and seamless interconnectivity of alternative transportation modes, and techniques for facilitating decision-making and evaluation of these solutions. Data were collected through a questionnaire web-based survey addressed to different stakeholder groups in Latvia: policy makers, industry, academia/research and students. From the statistical analysis conducted it was concluded that there are differences in the average rating of different thematic areas (i.e. governance, smart solutions, decision-making) by the respondents. Especially stakeholders belonging to policy makers, industry and students valuated their knowledge on Governance and Smart Solutions below average and at the same time these areas as important for carrier development. Recommendations on the adaptation of an education/training program for Latvia were drawn from the above analysis.

Keywords: transport interchange, education, training, governance, smart solutions, decision-making, knowledge, stakeholder, questionnaire survey, statistical analysis.

Introduction

Digital society, combined with strategies that promote sustainability, enhance the promotion of soft modes of transport, public transportation and green logistics. Stakeholders need to identify new strategies to improve quality of life of citizens, so that to set up their planning according to economic competitiveness and business needs, but also to emerging travelling and consuming trends (Nathanail *et al.* 2016a).

The paper advances the results of the on-going work conducted within the frame of the European Twinning project ALLIANCE. The key concept of the project is to reveal and enable excellence on innovative solutions for intermodal transport interchanges in Latvia, through knowledge transfer and good practice exchanges between the TTI (Latvian research and educational institute) and two leading research and educational institutes with high expertise and know-how in the domain, UTH (Greece) and Fraunhofer IFF (Germany).

According to the Statistical Bureau of Latvia (CSB 2017), transportation and warehousing area is one of key drivers of national economics (12% in 2015). The main goal of the Latvian Transport Policy Guidelines 2014–2020 (OECD 2017) is to develop the competitive, sustainable co-modal transport system that provides high quality mobility, at the same time effectively using resources. Latvia is an attractive transit country and geographical location remains central to strategically relevant transportation flows connecting major world economies like the United States, European Union, Russia, the Commonwealth of Independent States and the Far East. The transit sector is one of the strongest industrial sectors in Latvia: nearly 90% of turnover in Latvian ports, more than 80% of rail cargo, and the major proportion of oil and oil products transported via trunk pipeline systems is transit. More than 8% of Latvia's employees are engaged in the transportation and servicing of transit cargo. The importance of the transport, transit and storage sector in terms of GDP contribution is substantial at around 9.5% in 2015 as stated by Investment and Development Agency of Latvia (LIAA 2017).

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In order to ensure a sustained response to the continuous growing mobility demand, the Latvian transport sector needs to be developed in a dynamic way and incorporated into the European transport system. The main goal for the sustainable development of Latvia's transport system is to fully integrate Latvia's transport infrastructure with the Trans-European multi-modal transport system. In the National Development Plan 2014–2020 (CCSC 2012) there are noted the following objectives for public transport: improvement of accessibility of public transport services and organizing of a single bus and rail route network to provide possibilities for inhabitants of rural areas to access regional significance centres and national significance centres and the capital.

All these priorities form the core strategies in moving Latvia towards meeting the needs of human resource development, and create a pool of highly competent knowledgeable specialists. According to the article 82 of the National Development Plan 2014–2020 (CCSC 2012), the main required significant aspects in order to improve the competitiveness of Latvian products and services are "a close cooperation with the scientific sector on a commercial basis, encouraging the interest of the private sector to invest in research and innovation" and "an outstanding business environment: predictable, reasonable and supportive to every entrepreneur". Moreover, one of the strategic objectives is to provide advanced research and innovation and higher education, which can be achieved by attracting human resources, developing innovative ideas, improving the research infrastructure, facilitating cooperation between higher education, science and the private sector, as well as by transferring research and innovation to business.

The enhancement of the competitiveness of a region can be expected from third generation universities, as this is where not only education and research are significant but the utilization of knowledge is also crucial as mentioned in Lukovics and Zuti (2013). As a result, the connection between industry and universities deepens, so there is an opportunity of the local utilization of knowledge created in universities, which enhances the competitiveness of the region through the enhancement of the competitiveness of enterprises.

In recent years Latvia has made remarkable progress in its tertiary education attainment rate but issues remain to be addressed to improve the quality of vocational education and training and higher education (EC 2015). And one of the important tasks considers in Latvia: European Inventory on NQF 2016 (CEDEFOP 2017) – strengthening the link between the labour market and education. For instance, adult participation in lifelong learning in Latvia was 5.5% in 2014, below the European Union average of 10.7% (EC 2015).

One of the aims of the ALLIANCE project is to develop educational and training transport program addressing intermodal interconnections. By analysing good practices on interchanges for passenger mobility and freight transportation and an in-depth investigation of the current situation and trends that exist in EU and the Latvia and Baltic Sea region, about the planning and operation of intermodal terminals, project identified existing gaps between the transport industry and practice, and the research, education and training programs in Latvia, which could be fund in Mitropoulos *et al*. (2017).

In an effort to assess educational needs of different stakeholder groups involved in the domain, this paper's main aim is to study differences in their knowledge attained on present and emerging governance issues and smart solutions, which enable smooth and seamless interconnectivity of transportation modes, and techniques for facilitating decision-making and evaluation of these solutions. Data were collected through a questionnaire survey (web-based) addressed to four stakeholder groups in Latvia: policy makers, industry, academia/research and students. Statistical analysis was done to compare existing knowledge among these groups, to explain where any differences or similarities exist and as a consequence identify specific requirements for educating and training graduate students and professionals. Recommendations on the adaptation of the education/training programs were drawn from the above analysis.

1. State of the art

Transport decarbonisation and demographic trends generate new challenges for communities that are called to make an efficient and sustainable management of services and resources. Both economic efficiency as well as sustainability need to be balanced and addressed in a "smart" framework as stated by Hollands (2008). The sustainable transportation infrastructure development is not feasible without the application of advanced technologies in transportation, covering both passenger mobility and freight transportation.

Implementation of advanced technologies into transport over the 21st century transformed methods and applications that are commonly used to design, operate and maintain transport systems. *Transportation Research Circular E-C208* (TRB 2016) defined key transformational technologies in transport as connected and automated vehicles (including shared use services); unmanned aerial systems (drones); internet of things (including smart cities); and cybersecurity and technologies that have the potential to be transformational technologies such as Next-Gen, 3-D printing and big data. However, a gap exists between the availability of technology and what stakeholders in transport and logistics are using it for. Implementation of new concepts and technologies relies on different factors and one of the most significant is readiness of the end users to accept new solutions, etc.

White Paper (EC 2011) considered three pillars of priorities: (1) people, (2) integration, and (3) technology. The relationship between industry and higher education is changing and deepening and as mentioned by Ernst &

Young (EY 2012) industry plays multiple roles: as customer and partner of higher education institutions and, increasingly, as a competitor.

In the context of the European strategy *Europe 2020* one of the objectives for Latvian education system is to increase the openness and significance of education systems, by elaborating national qualifications systems and ensuring better compliance of the study achievements with the labour market needs (EC 2010). Developed to meet all needs, tertiary and vocational education should cover the desires of transport related professionals, through a transport program that corresponds to forthcoming challenges, include the hot topics and best practices. It should also cover the need of those who study both at masters and doctoral level in transport and logistics programs or needed short-term training during their carrier. Gartner analysts (Lowendahl *et al*. 2016) consider that employers are questioning if students are getting the right skills or, at least, if its assignment of traditional credits correlates with students skills and proficiency.

The research by Mateo-Babiano (2017) devotes the education of transport planning professionals in Australia, examines to what extent students are being prepared to enhance their skills that would make them more competitive in the workplace. Transport planning professionals are expected to be well-equipped with the knowledge and skills to address new and emerging urban transport challenges as well as to support the changing mobility and accessibility needs of addressing new and emerging urban transport challenges as well as to support the changing mobility and accessibility needs of communities. Because of this, the higher education sector experiences stronger pressure from industry, government and the public to demonstrate its ability to educate more work-ready graduates, including planning for transport.

In a research by Čižiūnienė *et al*. (2016) on competencies of human resources in Lithuanian transport sector the respondents indicated, that employers do not offer any training to achieve better activity results but at the same time more than 65% of the respondents indicated, that they have higher university education. This means that in the times of contemporary and competitive market, the competencies of the specialists in transport sector should upgrade on constant base and especially in sector-specific knowledge and skills.

Given the projected infrastructural developments for Latvia and Baltic countries, port interconnections, rail upgrade and connections with international transport corridors and networks there is a necessity to increase the competence of its educational system in the area of intermodal transport by creating an educational program that adopts its content based to regional needs and European best practices.

In accordance with the results of ALLIANCE project analysis existing research, educational and training programs in transport in Latvia and the Baltic Sea region present an adequate coverage of traditional transport principles and the generic methods that are used in transport for planning and design. However, the first result of deep analysis showed that these courses are not specialized on intermodality (Mitropoulos *et al*. 2017). It is possible to claim, that the transport education in Baltic countries is national oriented from the point of view of content, language and training material, and therefore integration of the Baltic transport networks with the European transport network should be especially included in transport programmes. Additionally, project ALLIANCE (Nathanail *et al*. 2016b) identified that standardization of approaches in terms of content and methodology of transport education are absent at national level and joint or intercollegiate programmes (and moreover with international cooperation) among educational institutes in transport area are limited.

2. Formulation of the educational and training topics

With the aim of enhancing competence of current and future professionals who work in the domain of transport, in the region of Latvia and other Baltic countries, a competitive educational and training program for University graduate students (MSc and PhD) was designed for Latvia and the region, under the title of Sustainable Transport Interchange Program (STIP). STIP was developed within the frame of the ALLIANCE project (Nathanail *et al*. 2016b) and has been implemented and approbated during the 1st ALLIANCE Summer School in Riga (Latvia) in July 2017. The program's development followed a thorough analysis of the needs analysis, which revealed the required skills and knowledge for professionals in the domain of transport interchanges by Mitropoulos *et al*. (2017). The analysis included identification of the requirements for sustainable passenger and freight interchanges, assessment of relevant educational programs and specific topics covered in European Universities, categorization of them into educational areas, and finally composition of twelve course modules comprising the core curriculum of STIP. These modules, grouped in three thematic areas, are the following:

- *Governance*:
  C1. The European policy on intermodal transport;
  C2. Building business models for intermodal transport interchanges;
  C3. Sustainable development and transportation planning;
  C4. Operation and management of intermodal transport systems;
  C5. Optimization of intermodal transport systems;
- *Smart solutions*:
  C6. Smart solutions for passenger transport interchanges;
  C7. Smart solutions for freight transport interchanges;
  C8. Design of passenger transport interchanges;
  C9. Design of freight transport interchanges;
  C10. Smart equipment for freight transhipment;

– *Decision-making*:
  C11. Decision-making methodologies;
  C12. Data collection methods.

In parallel, the rapid introduction of new emerging trends (TRB 2016) in the transport domain reveals more topics, which need to be covered in an educational and training program. These topics were also grouped in the three thematic areas. Specifically, under *Governance* are accumulated all topics, which require certain adaptation of existing governance and operational models, to be applied in transport interchanges. In this area also technological solutions are considered, which have already been developed and implemented in other fields of transport practices. Technological solutions and soft measures, which are being developed specifically for facilitating efficient operation of intermodal interchanges, are grouped under the *Smart solutions* thematic area. Finally, *Decision-making* includes topics, which enable a clear assessment of the interchanges' performance. All considered emerging topics are:

– *Governance* (Utilization of big data for policy-making; Public procurement of innovative sustainable transportation and mobility solutions in urban areas; Innovative organizational and governance concepts for mobility solutions at neighbourhood and district level; Optimization methods improving resilience of interchanges (i.e. under unexpected events); Incorporation of Vehicle-to-Infrastructure (V2I) and Infrastructure-to-Vehicle (I2V) systems and information-sharing in efficient operation and management of interchanges; Shared-use services and solutions promotion interchange sustainability; Unmanned aerial systems in logistics; Benefits of connected-automated vehicles in the operation and management of interchanges);
– *Smart solutions* (Innovative design methods and green buildings at interchanges; Promoting accessibility, inclusive mobility and equity in interchange design; Information Communication Technologies and cooperative Intelligent Transportation Systems for smart, safe, accurate and reliable interchange operations; Incorporation of alternative fuel vehicles in smart transhipment; 3D printing in supply chain);
– *Decision-making* (Collection, storage, processing and visualization of big data to support decision-making in transportation).

3. Methodology

The methodology implemented for studying the knowledge on the above topics assumed the definition of the target group of a program that accommodates first level learning needs (i.e. university students) but also long-life-educational requirements. So, those who are currently being educated, as well as those who practice the profession in the transport industry, were considered. Thus, the target group was discriminated in four stakeholder categories: (1) Academia/Research (AR), (2) Policy Makers (PM), (2) Industry (In), and (4) Students (St). The first consists of persons involved in education and research, the second of those involved in decision-making in the public domain, the third includes mainly professionals of the private sector and the last students, currently obtaining their knowledge on the subject.

An on-line questionnaire survey was conducted and all questions were addressed to the above groups. The questionnaire was composed of two parts. Part A aimed to assess the relevance of the 12 topics, related to the educational requirements of STIP, to the skills required on job.

Part A questioned:
– how important is to have knowledge on the topics;
– how familiar the respondents are with relevant methods/techniques;
– during their university studies, at what level the respondents developed skills;
– how important would it be for their career development to gain skills.

Part B aimed to assess the 15 emerging trends in the domain of intermodal transport mentioned above, and particularly:
– the level that each of them has been introduced in the profession;
– the level of importance in the career development.

The respondents selected from a symmetric Likert scale (1–5): from 1 (not important at all) to 5 (absolutely essential).

The questionnaire also included questions, about which stakeholder category the respondents belong to, age, gender, level of completed studies, identification of on-going studies (if any) and source other than regular university studies that led to knowledge on transportation interchange design and operation.

Analysis included assessment of the following two research questions:
– *Research question Q*1: Are there any significant differences in the average rating of respondents between different thematic areas (i.e. *Governanc*e, *Smart solutions*, and *Decision-making*)?
– *Research question Q*2: Does the stakeholder category affect the rating on the different thematic areas?

The answers for the six questionnaire questions for the 12 STIP and the 15 emerging topics were analysed, based on Wilcoxon test. Average values of the responses were obtained for each of the three thematic areas, thus 18 questions were finally structured and examined.

Also, inter-relationships among the answers on the six questions were examined, through bivariate correlations were conducted and in parallel to associating them with the stakeholder categories.

4. Analysis and results

4.1. The sample

A total of 45 stakeholders participated in the questionnaire survey, 32 of them are male (71%) and 13 female (29%). The majority of the respondents (46.7%) are

between 26…40 years old, 33.3% of them between 41…65, 15.5% between 18…25, and the rest 4.5% >65 years old. A proportion of 37.8% of stakeholders are coming from industry, 24.4% of stakeholders are academia and research, students are represented by 22.2% and 15.6% of the sample are policy makers. Regarding the educational level of the respondents, it is indicated that the majority of them (48.9%) holds a master degree diploma, 26.7% a BSc degree diploma, 15.6% a PhD diploma or have advanced graduate work experience, and 8.8% are high school graduates.

4.2. Results

Firstly, correlation analysis between respondents' answers on survey questions was conducted. Table 1 presents the values of correlation and their significance. Results showed that there is positive relationship between two pairs of responses: (1) the importance of knowledge on STIP topics and the importance of these skills for career development, meaning that respondents consider that high knowledge on STIP topics can contribute to their career development (Figure 1); (2) the importance of knowledge on STIP topics and the importance of knowledge on emerging topics for career development, attributing similar importance of knowledge to both current educational topics and emerging trends.

Then, hypothesis testing was conducted for each of the research questions that were formulated. The results are presented in Table 2.

From the results of Table 2, differences arose among the thematic areas. For STIP topics, respondents highlighted that importance of knowledge on governance is significantly higher than on smart solutions and decision-making (p-value < 0.05). However, they stated that they are more familiar with decision-making than with the other two thematic areas. It was observed that they developed skills during their university studies in relation to STIP topics mainly on decision-making, as compared to governance (z = –2.56) and smart solutions (z = –3.57). Likewise, they stated that they find more important for their career development to have knowledge on these topics addressing decision-making than smart solutions (z = –2.49) and they attributed a higher rating to decision-making than to governance (not significant).

Table 1. Bivariate correlation between questionnaire questions

Questions	*Q*1	*Q*2	*Q*3	*Q*4	*Q*5
*Q*1: Importance of knowledge on STIP topics	–				
*Q*2: Knowledge on STIP topics	0.2516	–			
*Q*3: University skills development on STIP topics	0.1953	0.4327*	–		
*Q*4: Importance of knowledge on STIP topics for career development	0.6284*	0.2469	0.0725	–	
*Q*5: Exposure level on emerging topics	0.3837*	0.3039*	0.4030*	0.1967	–
*Q*6: Importance of knowledge on emerging topics for career development	0.5199*	0.1429	0.1306	0.6516*	0.3208*

Note: *marked correlations are significant at p-value <0.05.

Table 2. Average rating and comparisons among thematic areas

Questions	Topics						z-statistic		
	Governance (G)		Smart solutions (S)		Decision-making (DM)		G vs. S	G vs. DM	S vs. DM
	M	SD	M	SD	M	SD			
*Q*1: Importance of knowledge on STIP topics	4.08	0.55	3.89	0.56	3.96	0.89	2.03*	2.02*	–1.49
*Q*2: Knowledge on STIP topics	2.96	0.75	2.81	0.74	3.35	0.99	1.19	–2.03*	–2.88*
*Q*3: University skills development on STIP topics	2.68	0.98	2.51	0.89	3.26	1.01	0.85	–2.56*	–3.57*
*Q*4: Importance of knowledge on STIP topics for career development	3.87	0.76	3.67	0.79	4.10	0.96	1.25	–1.76	–2.49*
*Q*5: Exposure level on emerging topics	2.66	0.90	2.47	0.95	3.02	1.21	0.912	–1.40	–2.05*
*Q*6: Importance of knowledge on emerging topics for career development	3.39	0.73	3.32	0.79	4	0.92	0.28	–3.42*	–3.46*

Notes: M – average rating; SD – standard deviation; *statistically significant (p-value <0.05).

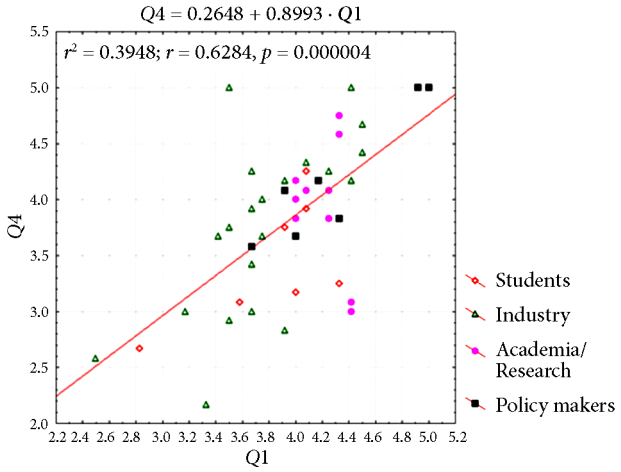

Figure 1. The importance of knowledge on STIP topics and its importance for the respondents' career development

For emerging topics, respondents also expressed that they are more exposed to decision-making than to smart solutions ($z = -2.05$) and governance (not significant) and therefore attributed higher importance to decision-making as compared to the other two thematic areas.

Of the most significant research questions, are those which refer to the differences in responses on all topics among stakeholders categories. The average rating of answers was calculated for the categories: AR – Academia/ Research, PM – Policy Makers, In – Industry, St – Students and per thematic area. The results of this analysis are presented in Table 3.

The analysis of the results for the first question shows that for all thematic areas received high ratings. In particular to knowledge, *Academia/research* and *Policy makers* indicated higher importance as compared to *Students* and *Industry*. This could be explained, by the fact, that probably the *Students* do not have any vision of how to apply received knowledge, meanwhile the Industry representatives have a lack of knowledge in these areas. On the other hand *Students* and *Industry* representatives gave highest rating to the importance of knowledge on *Governance*, as relevant topics are more familiar to them.

Based on the response on the second question, it is seen that all stakeholders believe that they are more familiar with topics on *Decision-making* as compared to topics of the other two thematic areas, with an average value of 3.33. The rest thematic areas were rated lower, thus it can be concluded that stakeholders have lack of knowledge in *Governance* and *Smart solutions*.

Most interesting findings are related to the responses on the third question. Specifically, policy makers pointed out that they gained low skills in *Governance* and *Smart solutions*, as compared to the rest, who indicated higher rating to skills and knowledge in all areas. However, it should be indicated, that rating on skills is below 3.5 for all stakeholder categories and thematic areas, with *Decision-making* receiving the highest rating by all stakeholders. The low rating of the skills in *Governance* and *Smart solutions* by the *Policy makers*, could be related with their older ages, so it means that their studies in the university did not focus on the field of transport intermodality and interchanges. To demonstrate better the differences in rating level of skills gained per stakeholder category and thematic area, a web diagram was constructed and is presented in Figure 2.

The answers on question *Q*4 regarding importance of knowledge of STIP topics in career development indicated that students consider it of lower importance as compared to the other stakeholder categories. This is understandable, as students are the least exposed to real applications in a business domain, where skills play a role in career development as compared to the other categories. On the contrary, the other three stakeholder categories believe that knowledge is important, and especially in *Decision-making* (Figure 3).

The interesting findings from the analysis of the response on question *Q*5 is that only *Policy makers* indicated

Table 3. Average rating and comparisons among stakeholder categories

Questions	Governance (G)				Smart solutions (S)				Decision-making (DM)			
	AR	PM	In	St	AR	PM	In	St	AR	PM	In	St
*Q*1: Importance of knowledge on STIP topics	4.26	4.37	3.92	3.97	4.10	4.11	3.66	3.71	4.35	4.50	3.64	3.79
*Q*2: Knowledge on STIP topics	3.30	2.74	2.93	2.74	3.06	2.69	2.78	2.69	3.55	3.29	3.36	3.14
*Q*3: University skills development on STIP topics	3.04	2.09	2.65	2.86	2.74	2.14	2.45	2.71	3.50	3.29	3.14	3.29
*Q*4: Importance of knowledge on STIP topics for career development	3.96	4.17	3.81	3.60	3.82	4.06	3.60	3.26	4.2	4.57	4.10	3.50
*Q*5: Exposure level on emerging topics	2.91	3.14	2.47	2.36	2.58	3.19	2.24	2.29	2.8	3.71	3.14	2.29
*Q*6: Importance of knowledge on emerging topics for career development	3.61	3.86	3.13	3.36	3.37	3.59	3.25	3.21	3.9	4.42	3.86	4.00

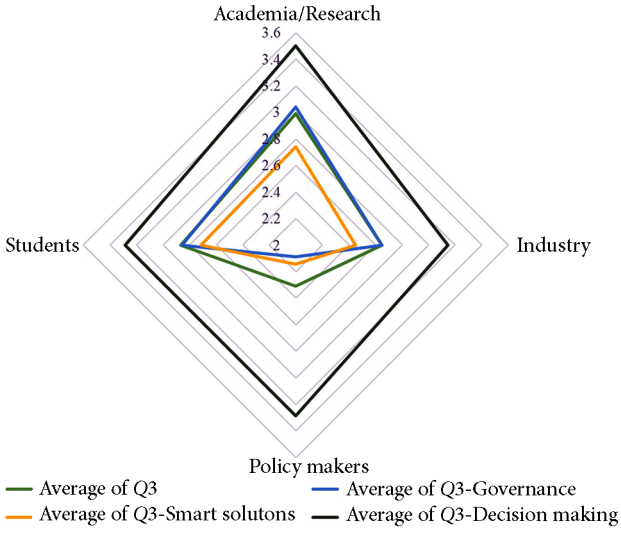

Figure 2. Rating of the level of developed skills

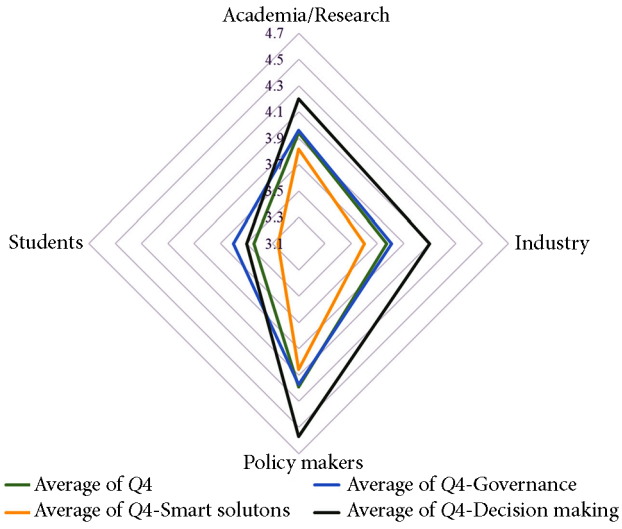

Figure 3. Rating of the importance of knowledge in career development

higher exposure level in decision-making in emerging topics as compared to other thematic areas and stakeholder categories. Exposure in *Smart solutions* received the highest rating in all categories, as this coincides with the low level of *Smart solutions* introduced in Latvia. At the same time the answers on question *Q6* indicated that the *Decision-making* is considered of highest importance for all stakeholder categories, followed by Governance and then by *Smart solutions,* except of the Industry, who indicated more interest to *Smart solutions* and lower level for *Governance*. The students indicated almost the same level for *Governance* and *Smart solutions*. The highest ratings here were provided by *Policy makers* in all thematic areas, indicating awareness of this sector on emerging needs in the domain.

Conclusions

The sustainable transportation infrastructure development is not feasible without the application of modern knowledge and skills in advanced technologies in transportation, covering both passenger and freight transport.

The research analysed the dependence of the existing knowledge, importance and requirements for skills and competence on job on different stakeholder categories: *Policy Makers*, *Industry*, *Academia/Research* and *Students*; and the differences in the average rating of stakeholders between different topics (i.e. *Governance*, *Smart solutions*, *Decision-making*). The gaps identified in research were used for focusing on current and future needs in knowledge of Latvian stakeholders and developing the new variant of STIP for long-life education to provide support to business and public authorities.

Development of (vocational) training programs to transform research results and findings into (good) practice should be delivered to students, post-doctoral fellows, professional practitioners and general staff from the domains of science, market and industry as well as to general public, to help them promote impact and prominence of research.

The offered for Academia STIP will deliver services addressed to research, development and innovation for enhancing transport for professionals who work or/and collaborate with stakeholders in the region of Latvia. It will also cover the needs of those who study both at undergraduate and post graduate level transport and ICT-related courses by providing opportunities for exchanges and short-term training with partner countries.

Knowledge, experience and best practice transfer from academia to industry through academic and long-life education and training will raise the R&I&D capacity of Latvia in the domain of the advanced technologies application in transportation field in order to make Latvia competitive in the global market and enable strength of economy development.

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